Novell NetWare Protocol Layering

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***Abstract*— the goal of this paper is to introduce the Netware layer protocols used primarily in Novell-based networks. The structures and the functionalities of this protocol, from its introduction in the early 1980 to its current form is discussed in this paper. Also comparison between OSI model and Netware protocols are discussed in this paper. Each Netware protocols play different roles in enabling a Netware router to perform its tasks. Today most of the network software and hardware supports Netware protocols.**

Keywords-IPX/SPX, Netware protocol

I. INTRODUCTION

Netware was created by Novell in the early 1980's. It was originally derived from an existing set of protocols created at Xerox's Palo Alto Research Center in the 1970's called XNS. By the early 1990's it was in use by over 60% of local area networks. Regardless of its popularity it did not support the TCP/IP protocol suite. In response to this need, Novell added TCP/IP support to their NetWare version 4. NetWare is a network operating system (NOS) that provides transparent remote file access and numerous other distributed network services, including printer sharing and support for various applications such as electronic mail transfer and database access. NetWare specifies the upper five layers of the OSI reference model and runs on any media-access protocol Layer 2. Furthermore, NetWare runs on virtually any kind of computer system, from PCs to mainframes. This paper summarizes the principal communications protocols that support NetWare. NetWare's client/server architecture supports remote access that is transparent to users through remote procedure calls. A remote procedure call begins when the local computer program running on the client sends a procedure call to the remote server. The server then executes the remote procedure call and returns the requested information to the local client. Figure 1 illustrates the NetWare protocol suite, the media-access protocols on which NetWare runs, and the relationship between the NetWare protocols and the OSI reference model. This paper addresses the elements and operations of these protocol components. Each NetWare protocol plays a different role in enabling a NetWare router to perform its tasks. NetWare media access control (MAC) protocols and IPX provide the addressing mechanism that delivers packets to their destination. The Routing Information Protocol (RIP), Service Advertising Protocol (SAP), and NetWare Link Services ProtocolTM (NLSPTM) protocols provide the means by which routers gather routing and service information and share it with other routers on an internetwork. Although the NetWare Core ProtocolTM (NCPTM) software does not play a direct role in routing, it does provide session control and packet-level error checking between NetWare workstations and routers. Similarly, the Sequenced Packet ExchangeTM (SPXTM) protocol neither routes packets nor advertises service information, but guarantees delivery of each packet to its destination. The higher-level protocols (NetBIOS, SAP, NCP, SPX, NLSP, and RIP) rely on the MAC protocols and IPX to handle lower-level communications, such as node addressing. With the exception of NetBIOS, NCP, and SPX, each of these protocols plays a role in the operation of IPX routing.

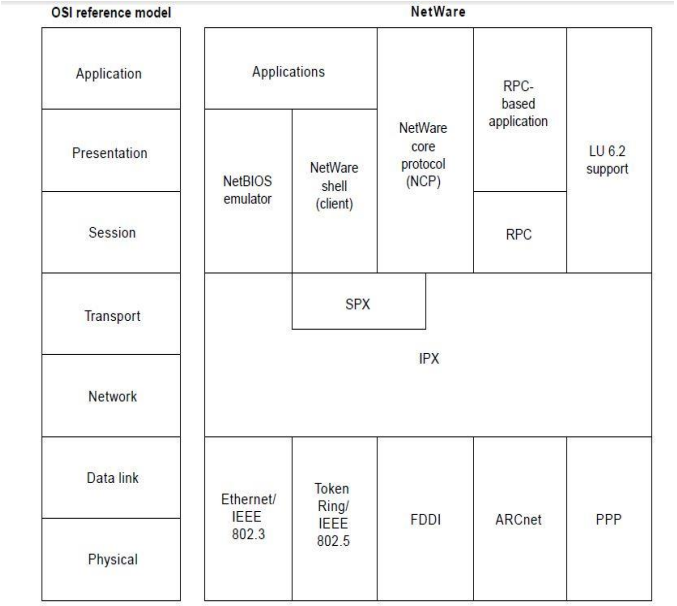

Figure-1. The NetWare protocol suites maps to all OSI layers

II. NETWARE MEDIUM ACCESS

Netware protocol suite supports several medium access layer-2 protocols as shown in figure 1. This includes Ethernet/IEEE 802.3, Token ring/IEEE 802.5, Fiber Distributed Data Interface (FDDI), Point-to-Point Protocol (PPP). FDDI is set of ISO and ANSI standard for data transmission through Fiber cables.

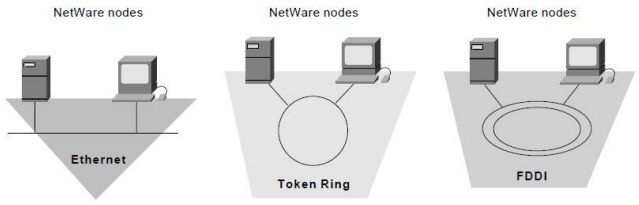

Figure 2. Netware supports most common medium access protocols

III. THE IPX PROTOCOL

The Internetwork Protocol Exchange (IPX) protocol is the most common NetWare network protocol at Layer 3 of the OSI model. Novell adapted IPX from the Xerox Network System (XNS) Internet Datagram Protocol (IDP). IPX is a connectionless- datagram protocol. Connectionless means that when a process running on a particular node uses IPX to communicate with a process on another node, no connection between the two nodes is established. Thus, IPX packets are addressed and sent to their destinations, but there is no guarantee or verification of successful delivery. Any packet acknowledgment or connection control is provided by protocols above IPX, such as SPX. Datagram means that each packet is treated as an individual entity, having no logical or sequential relation to any other packet. As shown in Figure 1, IPX operates at the OSI Network layer. As a Network layer protocol, IPX addresses and routes packets from one location to another on an IPX internetwork. IPX bases its routing decisions on the address fields in its header and on the information it receives from RIP or NLSP. IPX uses this information to forward packets to their destination node or to the next router providing a path to the destination node.

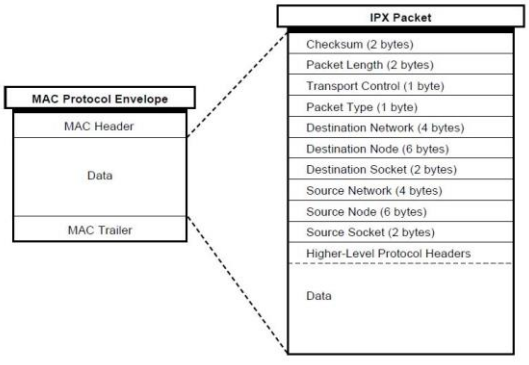

Figure 3. IPX Packet Structure

NOTE: Media constraints typically limit the actual maximum packet size allowed to something less than 65,535 bytes. Ethernet II packets, for example, are limited to a data size of 1,500 bytes, not including the MAC header.

IV. SERVICE ADVERTISEMENT PROTOCOL

The Service Advertisement Protocol (SAP) is an IPX protocol through which network resources such as file servers and print servers advertise their addresses and the services that they provide. Advertisements are sent via SAP every 60 seconds. Services are identified by a hexadecimal number, which is called a SAP identifier (for example, 4 = file server, and 7 = print server). A SAP operation begins when routers listen to SAPs and build a table of all known services along with their network address. Routers then send their SAP table every 60 seconds. Novell clients can send a query requesting a particular file, printer, or gateway service. The local router responds to the query with the network address of the requested service, and the client then can contact the service directly.

V. NETWARE TRANSPORT LAYER

The Sequenced Packet Exchange (SPX) protocol is the most common NetWare transport protocol at Layer 4 of the OSI model. SPX resides atop IPX in the NetWare Protocol Suite. SPX is a reliable, connection-oriented protocol that supplements the datagram service provided by the IPX, NetWare's network layer (Layer 3) protocol. SPX was derived from the Xerox Networking Systems (XNS) Sequenced Packet Protocol (SPP). Novell also offers Internet Protocol support in the form of the User Datagram Protocol (UDP). IPX datagrams are encapsulated inside UDP/IP headers for transport across an IP-based internetwork.

VI. NETWARE UPPER LAYER PROTOCOL AND SERVICES

NetWare supports a wide variety of upper-layer protocols, including NetWare Shell, NetWare Remote Procedure Call, NetWare Core Protocol, and Network Basic Input/output System. The NetWare shell runs clients (often called workstations in the NetWare community) and intercepts application input/output (I/O) calls to determine whether they require network access for completion. If the application request requires network access, the NetWare shell packages the request and sends it to lower-layer software for processing and network transmission. If the application request does not require network access, the request is passed to the local I/O resources. Client applications are unaware of any network access required for completion of application calls. NetWare Remote Procedure Call (NetWare RPC) is

another more general redirection mechanism similar in concept to the NetWare shell supported by Novell. NetWare Core Protocol (NCP) is a series of server routines designed to satisfy application requests coming from, for example, the NetWare shell. The services provided by NCP include file access, printer access, name management, accounting, security, and file synchronization. NetWare also supports the Network Basic input/output System (NetBIOS) session layer interface specification from IBM and Microsoft. NetWare's NetBIOS emulation software allows programs written to the industry-standard NetBIOS interface to run within the NetWare system.

VII. NETWARE APPLICATION LAYER

NetWare application layer services include NetWare message-handling service (NetWare MHS), Btrieve, NetWare loadable modules (NLMs), and IBM Logical Unit (LU) 6.2 network addressable units (NAUs). NetWare MHS is a message-delivery system that provides electronic mail transport. Btrieve is Novell's implementation of the binary tree (btree) database-access mechanism. NLMs are add on modules that attach into a NetWare system. NLMs currently available from Novell and third parties include alternate protocol stacks, communication services, and database services. In terms of IBM LU 6.2 NAU support, NetWare allows peer-to-peer connectivity and information exchange across IBM networks. NetWare packets are encapsulated within LU 6.2 packets for transit across an IBM network.

VIII. Summary

IPX is still installed in millions of computers in the NetWare networks. However, there has been a large change from IPX to IP within those environments, and this trend is likely to continue, with Novell supporting native IP within its networking environments.

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