CHAPTER 1

Cisco IOS for S/390 Architecture

This chapter describes the architecture of Cisco IOS for S/390. It includes the following sections:

- Overview

  An overview of the architecture of Cisco IOS for S/390.

- System Architecture

  Describes the architecture of the system, including interaction with other systems.

- TCP/IP Stack

  Describes the layers of the TCP/IP stack.

- Transport Providers

  Describes the access methods and transport providers supported by Cisco IOS for S/390.

- IFS Services

  Describes the IFS services in Cisco IOS for S/390, including dump & recovery, messages, SMF, latch, timing, tracing, and operator interface.

- Network Features

  Describes the network features of Cisco IOS for S/390.

- Protocol Features

  Describes the protocol features of Cisco IOS for S/390.

Overview

Responding to the need of IBM mainframes to communicate with client systems on various platforms, Interlink has developed Cisco IOS for S/390. Cisco IOS for S/390 is a comprehensive software package providing resources and capabilities of IBM MVS mainframes to non-IBM hosts and workstations using Transmission Control Protocol and Internet Protocol (TCP/IP).

Network Features provides functions such as file transfer between an MVS host and nodes on a TCP/IP network (FTP client and server), electronic mail exchange (SMTP), bidirectional terminal emulation for VT terminals (Telnet with TN3270), access to IBM printers (LPR server), domain name resolution, and network management (SNMP agent).

The Cisco IOS for S/390 application runs on IBM System/370 and System/390 mainframes running MVS/XA or MVS/ESA. Also required are OS PL/1 Transient Library version 1.5 (or later) or LE/370, ACF/VTAM version 3 (or later), and TSO/E.

System Architecture

Cisco IOS for S/390 runs as an MVS subsystem in its own address space under OS/390 with no operating system modifications. Interfaces to the external system security facility are implemented for sign-on, data set, and command access security using the MVS SAF router. interprocess and inter address space communication is accomplished using cross-memory services, ESA access registers, VTAM, and JES2/JES3. Cisco IOS for S/390 is installed and maintained using SMP/E.

Cisco IOS for S/390 runs within a run-time environment called the *Infrastructure* (IFS). IFS is a generic, multitasking, run-time environment for MVS system application address space that provides basic services such as cross-memory communications and storage management. A system using the infrastructure is an authorized, operator-started task or job that runs as a subsystem.

TCP/IP Stack

The TCP/IP stack is a layered set of routines which implement the various protocols to communicate on the Internet and Intranet. The layers within the TCP/IP stack are:

- Transport Layer—consists of the protocol routines that implement a particular IP protocol. This layer contains the TCP protocol modules, the UDP protocol modules and the RAW modules. Although ICMP is one of the IP protocols, for this discussion, it is considered part of the Internet Layer.
- Internet Layer—consists of the protocol routines to implement the IP and ICMP protocols. Some of the functions included at this layer include choosing routes, creating IP protocol headers in outbound packets, processing and removing IP protocol headers from inbound packets, and generating/processing of ICMP protocol messages.
- Link Layer—consists of the device drivers. The drivers are responsible for the sending and receiving of data to the physical network controllers. They additionally build / process the media layer headers within each packet and generate and respond to address resolution messages from other hosts. Currently the drivers support Ethernet, Token Ring, FDDI ring, CLAW, Hyperchannel and Loopback type controllers.

Transport Providers

Cisco IOS for S/390 supports three access methods via three transport providers. The transport providers support access via the Transport Layer Interface (TLI), OpenEdition (UNIX System Services) MVS sockets, and IUCV sockets. All three transport providers use a common interface to the transport layer called the Socket API.

- The Socket API is a set of routines that logically sits above the Transport Layer to implement native sockets. It consists of:
  - Function Processing Routines that are called directly from various transport providers such as the Open Edition PFS Transport Provider and implement native sockets logic. These routines generally run under the control of the application address space.
  - Transport Layer Exit Routines that are called as exits from the TCP/IP stack. These routines perform processing for events such as write completion, new data received, connection and confirmation indications.
- The Assembler API is a set of routines that logically sits above the Transport Layer to implement a variation of the AT&T Transport Layer Interface (TLI). It consists of:
  - Function Processing Routines that are called directly from various transport providers such as the Open Edition PFS Transport Provider and implement native sockets logic. These routines generally run under the control of the application address space.
  - Transport Layer Exit Routines that are called as exits from the TCP/IP stack. These routines perform processing for events such as write completion, new data received, connection and confirmation indications.
- Open Edition Transport Provider – is a set of routines that logically is located above the Socket API and provides cross memory access from Open Edition MVS sockets applications to Cisco IOS for S/390. It consists of:
  - Function Processing Routines that are called directly from various transport providers such as the Open Edition PFS Transport Provider and implement native sockets logic. These routines generally run under the control of the application address space.
  - Transport Layer Exit Routines that are called as exits from the TCP/IP stack. These routines perform processing for events such as write completion, new data received, connection and confirmation indications.
- IUCV Transport Provider is a set of routines that logically is located above the Socket API and provides cross memory access from sockets applications to Cisco IOS for S/390 via program calls that emulate the IUCV facility of VM. It consists of:
  - Function Processing Routines that are called directly from various transport providers such as the Open Edition PFS Transport Provider and implement native sockets logic. These routines generally run under the control of the application address space.
  - Transport Layer Exit Routines that are called as exits from the TCP/IP stack. These routines perform processing for events such as write completion, new data received, connection and confirmation indications.

IFS Services

The IFS Services are:

- Dump and Recovery Services include routines to capture dumps of Cisco IOS for S/390 and any other involved address spaces (such as an application address space or OpenEdition—UNIX System Services—MVS) and provide recovery.
- Message Services include routines that write to the operator console or sysout data sets. Messages can be filtered by component and severity, either through product configuration, or an operator command.
- SMF Services includes a standard interface to write records to the SMF data set. SMF data is captured for numerous events, including FTP data transfer, Telnet session end, transport provider events, and protocol layer events. SMF Services can also be configured to capture data at a desired interval. Link layer device driver statistics and virtual storage statistics can be captured at intervals.
- Latch Services are a set of IFS routines that provide resource serialization at a level more granular than an address space. This serialization mechanism is referred to as IFS Latches, or Ilatches.
- Timing Services include routines which measure time intervals for various processes.
- Tracing services include routines and macros that keep track of the events which have occurred within the Cisco IOS for S/390 address space. Tracing is done using the IFS internal trace table, the system trace table, through GTF and TCPEEP.
- Operator Interface is a set of various routines that allow significant operational control of the Cisco IOS for S/390 address space and the TCP/IP stack.

Network Features

The network features are:

- Software interfaces for Ethernet, Token Ring, FDDI, and Hyperchannel networks.
- Support for IBM Continuously Executing Transfer Interface (CETI) and Common Link Access to Workstation (CLAW) interface for high speed network I/O.
- Support for multi-homing with a virtually unlimited number of network segments.
- Support for a wide variety of IBM channel-to-LAN controllers.

Protocol Features

The protocol features are:

- Implementation of TCP and User Datagram Protocol (UDP) in accordance with MIL-STD 1778 and RFCs 768 and 793.
- Implementation of IP and Internet Control Message Protocol (ICMP) in accordance with MIL-STD 1777 and RFCs 791 and 792.
- Support of subnets in accordance with RFC 950.
- Implementation of Server and Client Telnet Network Virtual Terminal (NVT) protocol in accordance with MIL-STD 1782 and RFCs 854 and 855 plus selected Telnet negotiated options:
  - Access to VTAM applications, such as TSO, CICS, and IMS from remote Telnet clients.
  - Compatibility with UNIX, Macintosh, PC/DOS, Windows (95 and NT), OpenVMS, and OS/2 implementations of TN3270.
  - Support of LU2 and LU0 3270 SNA protocols.
  - Provision for Telnet server LU name support (LU security) that associates user ID and terminal access security to an individual Telnet user to useCisco IOS for S/390 in secure environments.