

Distributed Network Architectures

■ SCOPE

This Survey summarizes the features and functions of **11 Distributed Network Architectures** defined by computer mainframe vendors. The detailed entries cover the rules and regulations related to the vendor's software and hardware products to implement architectures. Some like IBM's SNA are grand in scope, while others like Tandem's EXPAND are elegant in simplicity.

Each entry in the Survey includes the vendor name and address; the architecture name, type, and announcement date; protocol layers; hardware and software support products; configuration ranges; network control, and distributed management features and functions; security features; user interfaces; foreign terminal support; and gateways to other networks. The following dot chart also provides a quick access to architectures that meet various criteria.

■ INTRODUCTION

Distributed Network Architectures are children of the 1970s. From the minicomputer side, they grew out of a need to separate a computer system with sensitive disk and magnetic tape devices from the harsh environment of the factory floor, laboratory, or industrial site. Minicomputer manufacturers such as Hewlett-Packard, developed master/slave configurations with stripped-down versions of their minicomputers located in the harsh environment while the larger systems with printers, disks, and magnetic tapes performed printing, storing, and reading functions for the smaller systems while residing in a clean, EDP-friendly atmosphere.

Mainframe users discovered that many EDP tasks could be done locally with little communication to a remote central-site system. Terminal and minicomputer vendors began to offer systems to perform these local tasks and

communicate with a central host (typically an IBM host) by emulating the function of an RJE batch or dumb terminal. Whether the mainframe vendors liked it or not, users were distributing processing.

Almost simultaneously, the proliferation of data communication equipment, growth of software products, and general entrepreneurship or confusion of software/hardware designers and users reached "Tower of Babel" proportions. IBM's "Tower of Babel" was bigger than anyone else's. Thus, IBM introduced its System Network Architecture (SNA) to bring order to its data communication offerings. Other mainframe vendors soon followed IBM's lead.

Pressure from minicomputer and terminal vendors, who offered systems challenging the mainframe's power and at much lower price, to distribute processing, inspired the mainframe vendors to do better. They used large-scale integration and some of the minicomputer philosophy of tailoring a system for its application to develop previously unheard of price/performance wonders. If users were going to distribute, the mainframe vendors intended to offer products that were competitive with those offered by minicomputer and terminal vendors. And so they did.

At the same time, mainframe host processors have become more powerful, allowing them to perform more and varied tasks. But, users appear insatiable. They have gobbled up MIPS located at central sites as well as distributed throughout networks.

Such distributed processing systems running parts of the data processing task had to communicate with each other in a consistent way. Rules were defined and adhered to, so all users on a network could develop and run applications in concert with each other and without conflict. Such network rules and procedures constitute the distributed network architectures outlined in the Survey. Entries present details on important characteristics of networks.

DISTRIBUTED NETWORK ARCHITECTURES OUTLINE

| COMPANY | NETWORK TYPE Host-Controlled Peer-to-Peer | DISTRIBUTED FUNCTIONS Database Network Control Processing | SECURITY Sign-On Password Program Containment Data Access Limited Encryption | GATEWAYS SNA X.25 Other |
|----------------------------|---|--|---|----------------------------------|
| Burroughs BNA | — ● | — ● ● | ● ● ● ● — | ● ● — |
| Data General XODIAC | — ● | — ● ● | ● ● ● ● — | ● ● — |
| Digital Equipment DNA | — ● | — ● ● | ● ● ● ● — | ● ● — |
| Hewlett-Packard AdvanceNet | — ● | — ● ● | ● ● ● ● — | ● ● — |

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|-------------------------|---|---|---|----------------------------------|
| Honeywell DSA | ● ● | — ● ● | ● ● ● ● — | ● ● ● |
| IBM SNA | ● ● | ● ● ● ● | ● ● ● ● ● | — ● ● |
| Modular Computer MAXNET | ● ● | ● ● ● | ● ● ● ● ● | ● ● — |
| NCR/COMTEN CNA | ● ● | — ● ● | ● ● ● ● — | ● ● — |
| Prime Computer PRIMENET | — ● | — ● ● | ● ● ● ● ● | ● ● ● |
| Sperry DCA | — ● | — ● ● | ● ● ● ● ● | ● ● — |
| Tandem Computers EXPAND | — ● | ● ● ● | ● ● ● ● ● | ● ● ● |

DISTRIBUTED NETWORK ARCHITECTURES FEATURES

Type • host-controlled or peer-to-peer; mainframes tend toward host control, minicomputers tend toward peer-to-peer • trend is toward distributed rather than host or central control; communication traffic is increased when a remote site must ask a central host's permission to start and cease transmitting • on the other hand, somebody must be in charge, making host control a still viable approach.

Announced • when first announced; usually the announcement has preceded delivery of products by several years.

Layers of Protocols • dating from the first definition of network architectures when the idea of layering the network logic was new • today, vendors tend to talk of the network architecture in terms of functional levels/layers • layers/levels presented in the Survey are related to the proposed Open System Interconnection (OSI) model that will someday become the international industry standard • all vendors perform all the functions required in the OSI model but boundaries differ somewhat, especially for IBM's SNA and DEC's DNA, which were initially developed before the OSI Model • most vendors today closely follow the OSI model.

Applications Layer serves the user, and provides the window into and out of the network, initiating the information transfer and interconnection within the network; the user specifies network parameters through this layer.

Presentation Layer interfaces user data to the network, translates and formats data, and selects the syntax to be used (translates specific file-store command into standard virtual file protocol).

Session Layer coordinates interaction between the Presentation Levels at each end of the network link; establishes or terminates the cooperative venture (session) between 2 functional units such as a terminal data entry program and a host file processing program.

Transport Layer selects the appropriate network services, and multiplexes transport connections into a single network connection; optimizes data unit size, maps addresses onto connections, and establishes facilities for recovery from abnormal network situations.

Network Layer provides routing, switching, and relaying (transparent forwarding) of data through the network.

Data Link Control Layer provides the functional and procedural facilities to activate, maintain, and deactivate data links between network entities or nodes; implemented using High-Level Data

Link Control (HDLC) procedures; corresponds to IBM Synchronous Data Link Control (SDLC), or ANSI's Advanced Data Communications Control Procedure (ADCCP).

Physical Layer interface to physical network; operates as umbrella over all physical connections • many standards have been developed for physical connections; they include EIA's RS-232C or newer RS-422/-423, X.21 for packet-switched networks, and others.

Network Hardware Products • vendor-provided hardware (hosts, satellite CPUs, communications processors) used to implement the architecture.

Network Software Products • vendor-provided software used to implement the architecture; relates software modules with one another, and with network components.

Configuration • network node, host, subsystem minimum and maximum criteria.

Network Operator Control • defines how an operator controls the network, and other functions the operator can perform (generate the network, reconfigure, monitor, test, add, delete).

Distributed Network Management • defines what management functions are distributed and where they are located; covers routing, network definition, limitation of power.

Distributed Function Management • defines where the user goes to get work done on the network and what facilities are offered (batch processing, interactive computing, and file management).

User Interface to Network • defines how the user gains access to the network.

Security • defines degree of assurance that data and programs are free from piracy and disaster; covers passwords, log-on, IDs, file lockup, and encryption.

Support for Foreign Terminals • cites what other vendor terminals are allowed or supported on the network.

Gateways to Other Networks • defines specific gateways • X.25 gateway can implement only the trunk line protocols because upper layers are undefined; present X.25 recommendation for packet-switched networks includes only the Physical, Data Link Control, and Network Level protocols • SNA gateways generally emulate one or more IBM BSC/SDLC terminals such as 3270, HASP, RJE, or MRJE.

DISTRIBUTED NETWORK ARCHITECTURES LISTINGS

■ **BURROUGHS CORPORATION**
Burroughs Place, Detroit, MI 48232; 313-972-7000 • Canadian

Distribution: Oceanic Information Systems; 1245 Sherbrooke Street West, Office 1900, Montreal, PQ H3G 2L5; 514-288-6422.

Distributed Network Architectures

□ Burroughs Network Architecture (BNA)

Type • peer-to-peer network with distributed network control and peer-to-peer relationship between hosts.

First Announced • 1976.

Layers of Protocols • Applications, Host Services, Port, Router, and Station • in comparison to OSI model, Applications relates to Applications; Host Services relates to Presentation; Port relates to Session and Network; Router relates to Transport and Station equals Data Link plus physical.

Network Hardware Products • heterogeneous mix of Burroughs computer systems from CP 9500 communication processors and B1000 through B7900, A Series and V Series small-to-large scale mainframe computers • Intersystem Control (ISC) I/O between CP9500, B2000/B3000/B4000/B5000/B6000/B7000, V Series and A Series systems • BDLC support on all systems • direct X.25 support for CP9500, B5000/B6000/B7000 and A Series system CP9500 provides X.25 for B2000/B3000/B4000 and V Series systems.

Network Software • BNA software provides host and network services; host services located in host processors, and network services located in nodes; nodes can be either CP 9500 communications processor systems or host processors • host services include file, job, task, operator display and communication terminal transfers, status changes, remote file access, virtual terminal, and interprogram communications • network services implement port, router, and station levels of network protocols • applications subsystems in host processors run the same as on local processing systems.

Configuration • minimum network includes at least 2 nodes and 1 host processor • maximum network virtually unlimited • small host processors such as B 90 Series use integrated communications channels with network services provided in host processor; larger B 5900 and above systems use Network Support Processors (NSP) which provide network services • up to 8 ISC-connected processors can distribute applications at one host site.

Network Operator Control • through one or more centralized network management consoles from which network commands can be entered • network management supervisor programs can be located at each node to receive reports from network services and pass them on to management console.

Distributed Network Management • network management is distributed among nodes on network • each node can run software to support its local resource, including Network Definition Language (NDL), Generalized Message Control System (GEMCOS), Command and Edit (CANDE), On-Line Data Entry System (ODESY), Direct On-Line Maintenance, and Inquiry (DOMAIN).

Distributed Function Management • provides transaction and batch processing with RJE on hosts which control their own resources, and can honor or refuse requests for service; requests can be addressed to any host which is selected by its unique hostname on network • local ISC-coupled computer can function as single host site with dedicated applications processors in local network • nodal processors are multiprocessor systems using 2 to 8 processors; each processor can be dedicated to specific function such as data communication, file management, or application processing • supports transaction processing, database management, order entry, word processing, shop floor management, hospital management, and general business applications.

User Interface to Network • through host services from operator console, program, or virtual terminal.

Security • Generalized Message Control System (GEMCOS) requires valid sign-on evaluation • Database Management System (DMS) II provides lock-out to unauthorized users to record level.

Support for Foreign Terminals • virtual terminal gateways provide access to BNA Host Services.

Gateways to Other Networks • through nodal processor to X.25 packet-switched networks and IBM's SNA; nodal processor looks

like Physical Unit (PU) Type 2 to SNA network; X.25 interface certified for DATAPAC (Canada), TELENET, and TYMNET • nodal processors can also connect to IBM hosts as 360/20 HASP RJE workstation, 2780/3780 Terminal, or 3271 Control Unit.

■ DATA GENERAL CORPORATION

Westboro, MA 01581; 617-366-8911 • Canadian Distribution: Data General Canada; 2155 Leanne Boulevard, Mississauga, ON L5K 2K8; 416-823-7830.

□ Data General XODIAC

Type • Eclipse host-oriented with control and functions distributed among hosts on network.

Announced • 1979.

Layers of Protocols • Applications, Function, Connection, Link Control, and Physical Link levels • in comparison to ISO model, Applications relates to Applications; Function relates to the combined functions of Presentation, Session, and Transport levels; Connection relates to Network; Link Control equals Data Link level, and Physical Link equals Physical level • Function level makes network access transparent to user, and is located in operating system.

Network Hardware Products • any ECLIPSE computer running on Advanced Operating System (AOS) on configuration with at least 512K-byte main memory, Synchronous Line Multiplexers (SLM) with Data Control Unit (DCU-200), Multiprocessor Communications Adapters (MCA), IEEE 802.3 LAN, and Dasher terminals • MCA can locally interconnect up to 32 Data General computers.

Network Software Products • AOS/VX XODIAC includes Resource Management Agent (RMA), Virtual Terminal Agent (VTA) and File Transfer Agent (FTA) residing in Advanced Operating System (AOS) in ECLIPSE host computer; AOS X.25 software interface to public packet-switched networks using CCITT Recommendation X.25; AOS X.29 Host/PAD for asynchronous terminals to access host through X.25 network; Network Operator Process (NETOP); and AOS Network Generation Program (AOS NETGEN); DG/SNA, RJE80, Remote Cluster RCX70, and HASP Workstation Emulation (HAMLET) for IBM emulation • SNA/RJE emulates IBM 3770 remote batch-processing devices; runs concurrently with XODIAC network management software and bisynchronous communication products; runs under AOS and AOS/Virtual Storage on ECLIPSE 16- and 32-bit systems • automated office software available for word processing, electronic mail, filing, and administrative support • XODIAC Network Bus System (NBS) local area networking capability.

Configuration • host-subsidiary arrangement where multiple ECLIPSE AOS systems interconnect directly by communication lines, indirectly by public data networks, or through LANs • ECLIPSE Data System (EDS) host running RCX70, RJE80, or HAMLET can communicate with IBM host • RJE80 allows EDS to emulate IBM 2780/3780 Remote Job Entry station and supports point-to-point (2 systems) or multidrop (host-tributaries) with a host (EDS or IBM) supporting mix of up to 9 subsidiary stations running RJE80; HAMLET (HASP II workstation emulation) provides interleaving and multileaving for up to 7 devices or disk files; RCX70 allows interaction between EDS and IBM 360/370 hosts which support IBM 3271 terminal cluster controller; RCX70 supports up to 16 EDS terminals • DG/SNA, RCX70, and RJE80 can all run on Eclipse AOS system connected to XODIAC network.

Network Operator Control • network manager uses Network Operator Process (NETOP) to control XODIAC processes; control/monitor AOX X.25; start/stop AOS X.25 process; enable/disable X.25 links; determine what local processes are using X.25; determine number/status of virtual circuits; and control and gather accounting and statistical information.

Distributed Network Management • each ECLIPSE host has network directory which contains 2 entries for every other host on network; one used for system intercommunication, and other used by XODIAC agents and AOS X.25 • AOS Network Operator Process (NETOP) creates and executes XODIAC processes in response to commands from network manager • AOS X.25

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implements connection level protocol in each Eclipse node.

Distributed Function Management • control through AOS on ECLIPSE computer system; supports timesharing, interactive, online, and batch applications; shared resources and data exchange capabilities • users communicate directly or indirectly through AOS with agents on local system (Using Agents) that pass user requests to remote system agents (Serving Agents); Resource Management Agent (RMA) and Virtual Terminals Agent (VTA) perform most management functions; RMA is single process on XODIAC host providing local and remote users access to remote files, devices, or processes with each RMA acting as both Using and Serving Agents; VTA device entry in local host allows remote users to logon as if they were local • other processes include access to Remote DG/DBMS databases using DG/DBMS DML commands; Remote INFO II (RIA) allows users to access remote INFO II files using INFO II commands and language interfaces; File Transfers Agent (FTA) allows rapid transfer of files across network.

User Interface to Network • through RMA process for remote resource access and Command Line Interpreter (CLI) command to perform file maintenance and execute utility and user programs; VTA on local system is logically connected to process in remote system.

Security • Network Manager controls user access to network through extensions of user and file access controls within AOS.

Support for Foreign Terminals • none.

Gateways to Other Networks • to X.25 packet-switched networks and SNA networks • DG/SNA provides gateway to SNA networks • can access IBM hosts through IBM 3274/3276 terminal cluster controller emulation; SNA/3270 (AOS RCX70) Information Display System emulation; and AOS RJE80 support for IBM 3780/2780 emulation to communicate with IBM 370-compatible host • SNA/RJE support for IBM 3770 remote batch-processing devices • X.25 interface certified by TELENET (USA), DATAPAC (Canada), and TRANSPAC (France).

■ DIGITAL EQUIPMENT CORPORATION

146 Main Street, Maynard, MA 01754; 617-897-5111 • Canadian Distribution: Digital Equipment of Canada; P.O. Box 13000, Kanata, ON K2K 2A6; 613-592-5111.

□ DEC Digital Network Architecture (DNA)

Type • distributed control with peer-to-peer relationship between nodes.

First Announced • 1975 DECnet; 1976 DECnet Phase I; 1978 DECnet Phase II; 1979 DECnet Phase III; 1982 DECnet Phase IV.

Layers of Protocols • User, Network Management, Network Application, Session Control, End-to-End Communications, Routing, Data Link, and Physical Link Layers • in comparison to OSI model, User and Network Management Layers (undefined in OSI) relate to Applications Layer of OSI, Network Application Layer to Presentation Layer, Session Control Layer to Session Layer, End-to-End Communications Layer to Transport Layer, Routing Layer to Network Layer, and Data Link and Physical Link Layers to same layers in OSI model.

Network Hardware Products • distributed processor nodes include PDP-11, VAX-11, DECsystem-10/20 computer systems, and Professional 300 • communication processors include DN20 front end to DECsystem-10/20 with RJE stations connected to DN20; DMF32, DMP11, DMV11 communication controllers for UNIBUS and VAX systems; KMS11 Communications Controller front end to VAX-11; KMS11-P communications interface linking VAX to X.25; KMV11 programmable communication interface for LSI-11; DZ11 asynchronous multiplexer for PDP-11/24 and VAX-11 models • interfaces supported are EIA synchronous and 20 mA asynchronous at up to 9.6K bps, EIA synchronous up to 19.2K bps, remote or local synchronous at up to 56K bps; DECnet Router nodes that interconnect remote Ethernets support EIA interfaces for up to 19.2K-bps rates and V.35 interface for up to 500K-bps data rates • terminals include Digital's DECwriter IV and LA DECwriter printing terminals, VT55 graphics and VT100/200 VIDEO terminals, cluster controllers, and direct-connect and dual-speed modems • data and physical links

include point-to-point or multipoint DDCMP communication lines, X.25 packet-switched network, and Ethernet local area network (LAN) • interfaces to Ethernet are through DEUNA (Unibus-based systems) or DEQNA (Q-bus-based systems) • DELNI multiplexer can connect multiple DEUNAs or DEQNAs to Ethernet transceiver.

Network Software Products • collection of networking software called DECnet includes DECnet Phase I, Phase II, Phase III, and Phase IV products • DECnet Phase I products limited primarily to real-time data acquisition and control applications running under RSX-11 (PDP-11) and TOPS-10 (DECsystem-10) • DECnet Phase II products provide for general interconnection of PDP-11, DECsystem-20, and VAX-11; also provides for connection to foreign networks • DECnet Phase III products add auto-answer, network management, network command terminal, multipoint line support, and adaptive routing; implemented for VAX-11 VMS; PDP-11 RT-11, IAS, RSTS/E; RSX-11/S, RSX-11/M, RSX-11/M-PLUS, and DECsystem-20 TOPS-20 • DECnet Phase IV incorporates Ethernet Local Area Network (LAN) into DNA, increases number of nodes to 1,000; compatible with Phase III nodes, Phase III and Phase IV nodes can reside on same network • Phase IV products include interfaces to Ethernet and servers on Ethernet • servers include DECnet Router, X.25 Gateway, and DECnet/SNA Ethernet Gateway.

Configuration • DECnet Phase IV allows up to 1,023 nodes per network, any number can be routing nodes; path end-to-end can include up to 63 hops (1 hop equals a node-to-node communication) • DECnet Phase III allows up to 255 nodes per network; 120 can be routing nodes, the remainder must be end nodes • Phase III allows up to 31 hops for communications between nodes • Phase II nodes can reside on Phase III network but must be located adjacent to Phase III node; Phase II nodes can route only to an adjacent node • Phase III nodes can be implemented with PDP-11 RSX-11M, RSX-11M-PLUS, RSTS/E, and IAS systems; VAX-11 VMS systems; and DECsystem-20 TOPS-20 systems • PDP-11, RSX-11S, and RT-11 systems can function only as end nodes • Phase I nodes cannot reside on Phase III network; however, DECsystem-10 can connect to up to 36 RSX-11M Phase II nodes, functioning as Phase III end nodes • Phase IV nodes implemented on all VAX/VMS, PDP-11, RSX-11 Unibus-based and Q-bus-based and P300 Professional systems; later, it will be added to DECsystem-20 TOPS-20 systems • DECnet Router Series interconnects Phase IV networks and Phase III with Phase IV networks; it can operate with or without one or more Ethernet LANs as elements being linked.

Network Operator Control • provided through the Network Information and Control Exchange (NICE) protocol used throughout network for operator interface; defines network parameters, controlling operational functions, monitoring performance, downline loading satellite nodes, online reconfiguration, and node and line diagnostic testing • OBSERVER Network Monitoring Software runs on VMS, RSX-11M and RSX-11M-PLUS nodes enables operator to monitor the performance of both Phase III and Phase IV networks.

Distributed Network Management • Network Management distributed node-to-node but user can define centrally controlled network • although resources at nodes vary, every node must provide task-to-task communications for establishing logical links with other systems for data and program exchanges, intersystem file transfer, (sequential ASCII), and network command terminal so local users can log onto remote systems.

Distributed Function Management • provided by resources available on processor at each node • DEC PDP-11, VAX-11, and PDP-20 processors offer timesharing, transaction processing, batch processing, and database management facilities • DNA provides File Transfer, Remote Resource Access, Down Line System Load, Remote Command File Submission, Virtual Terminal Services, Task-to-Task Communication, and Adaptive Routing as standard DECnet services.

User Interface to Network • through application program, or peripheral terminal, using DAP functions/commands such as OPEN, WRITE, CLOSE, and DELETE • many functions are implemented in operating system and transparent to user.

Security • depends on user-established policy and access

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control rules through password and memory management facilities for data and program accesses; primary products are optional access control in Session Control layer • DBMS provides security schema to control user's ability to execute data manipulation verbs, to modify data items, and access record installations; also protects Database Operator Utility (DBO) commands through Command Authorization List (CAL) • other security provided by operating system.

Support for Foreign Terminals • Bisync Teletype Dataspeed 4541, IBM 3270 terminals, Honeywell SPD315, Memorex 1371, Lee Data 310/320, Carterfone 6270/6274 using VAX BTS (BSC Terminal Support) software.

Gateways to Other Networks • PSI (Packet-Switching Network Interface) X.25 for VAX-11 and PDP-11 RSX-11 systems provide for interconnection to packet-switching networks in Canada and France for PDP-11, and in United Kingdom (PSS), France (Transpac), Germany (Datex-P), and U.S. (Telenet) for VAX-11 • Internet products provide interactive and batch communication with SNA through IBM hosts; IBM 2780/3780/HASP terminal emulators for RJE data exchanges; IBM 3271 interface for SNA and multidrop BSC communications • Sperry hosts through UN1004 Terminal emulator • CDC hosts through MUX 200 emulator • DECnet/SNA gateway available for VAX/VMS, micro/VAX, and RSX-11M/11M-PLUS permits communication between SNA and DECnet networks using 3270 terminal emulation, RJE, Distributed Host Command Facility (DHCF), a DISOSS facility, 3287 Printer emulation, and program-to-program communications • Ethernet local area network and public packet-switched networks; X.25 gateway allows X.25 to be the dominant protocol; DDCHP will be used for compatibility with older networks, Phase III.

■ HEWLETT-PACKARD CORPORATION

19447 Pruneridge Avenue, Cupertino, CA 95014; 408-725-8111
 • Canadian Distribution: Hewlett-Packard Canada Limited; 6877 Gorenay Drive, Mississauga, ON L4L M3B; 416-678-9430.

□ Hewlett-Packard AdvanceNet

Type • distributed network with control located throughout communications network; control resides in computer systems supporting terminals.

Announced • DSN 1977, HP AdvanceNet 1984.

Layers of Protocols • User Language Programs, Network Access Method, Network Manager, Message Control Protocol, Communication Line Protocol, and Communications Line Control Electrical Interface • in comparison with ISO model, User Language Programs relates to Application; Network Access Methods relates to Presentation; Network Manager relates to Session; Message Control relates to both Transport and Network; Communication Line Protocol relates to Data Link; Communication Electrical Interface relates to Physical Level.

Network Hardware Products • hosts geographically and functionally distributed • hosts include HP 3000 Series 37, 39, 42, 48, and 68 business-oriented systems; HP 1000E- and F-Series 16-bit minicomputers and A- and L-Series microcomputers real-time event-driven, multiprogramming computers; IBM or IBM-compatible mainframe systems for centralized computer facility; Intelligent Network Processor (INP) as front end for HP 3000 to off-load communications • hardware interfaces include Asynchronous Data Communications Controller (ADCC) on Models 39, 42, and 48; Intelligent Network Processors (INPs) on Models 37, 39, 42, 48, and 68; Advanced Terminal Processors (ATPs) on Models 39, 4X, and 6X; and ATP37 for Model 37 • distributed computers include HP Series 100 Personal Office Computers (HP Portable and HP 150 Touchscreen); HP Series 200 Personal Computers; HP 250 • Series Office Computers can operate as terminals to HP 3000 by LK 3000 Utility and DSN/DS 250 Distributed System; HP display, graphics and factory terminals; and HP 9000 Series Desktop Workstations for computer-aided engineering (Series 500/600/700 uni-, dual-, triple-processor models).

Network Software Products • network operates under Distributed Systems (DS) software that provides intercommunications and transaction processing to geographically dispersed HP systems • software modules allow sharing of programs, files,

and peripheral devices; modules include Network Terminal Access (NTA), Network File Access (NFA), Network Peripheral Access (NPA), Network Database Access (NDBA), Network Interprogram Database Access (NDBA), Network Interprogram Communications (NIPC), and Network File Transfers (NFT) • emulation of IBM 3270, 2780/3780 (RJE), HASP, and multileaving RJE terminals support communication with IBM host; IBM 3270 emulator includes Interactive Mainframe Facility (IMF) to IBM host.

Configuration • any number of HP 3000 Series Processors operate as nodes on AdvanceNet • AdvanceNet interfaces to DS 1000 local networks through HP 1000 which connects to HP 3000 through hardwired direct-connect cable or communications link • AdvanceNet access to IBM S/370-compatible host through either HP 1000 or HP 3000; both emulate IBM 2780/3780 RJE terminal, and HASP II workstation supports Network RJE (NRJE); HP 3000 also emulates Multileaving RJE (MRJE) HASP Workstation and IBM 3270 CRT terminals operating under SNA/SDLC and BSC protocols • Intelligent Network Processor (INP) models provide support for HP 3000, offloading communications tasks; up to 7 are supported by HP 3000 • HP 3000 supports up to 14 (Series 37), 28 (Series 37XE), 56 (Series 39), 92 (Series 42), 152 (Series 48), and 400 (Series 68) online point-to-point and multipoint terminals • HP 9000 Series desktop computers and HP Series 100 and 200 personal computers and HP 250 office computers operate as terminals to HP 3000 on HP AdvanceNet.

Network Operator Control • single system manager at central EDP-facility can control all satellite HP 3000 systems through remote command processing feature; each user assigned different capability on different computers such as program development on one computer and batch on another, with capability assignments enforced by operating system; can redefine or readjust with no reprogramming; through use of security code, user or manager can obtain exclusive access to any specified link in network.

Distributed Network Management • resides in Distributed System/3000 (DS/3000) software which runs on all Series 3000s in network control distributed throughout network • cross network facilities include Remote Command Execution (RCE), Remote File Access (RFA), Remote Peripheral Access (RPA), Remote Database Access (RDBA), and Program-to-Program Communication (PTOPC) • resides in DS/1000-IV software on HP 1000 for HP 1000 networks.

Distributed Functions Management • RJE/3000 and MRJE/3000 can be used with programs on IBM host to submit and receive jobs for execution; RJE/3000 can be used with CICS on IBM host for batch I/O to interactive applications, MRJE/3000 can be used with HASP II, JES2, JES3, or ASP job entry subsystems on IBM S/370-compatible host • Program-to-Program Communications (PTOPC) facility provides 9 intrinsics that allow users to write applications programs where master program on local computer controls execution of slave program on remote computer • Query facility for IMAGE database management system can be used with REMOTE command to access remote database as though it were local; Remote File Access (RFA) facility allows access to remote HP 3000 or HP 1000 files; Program-to-Program Communications (PTOP) allows indirect file transactions by initiating remote slave programs from a local master program • a Remote Query facility is available for HP 3000 to HP 3000 database accesses.

User Interface to Network • logical interfaces through software subsystems running under MPE operating system; user-friendly software provides English word commands, high-level programming facilities, and automatic low-level screen control character manipulation.

Security • network manager responsible for network security and for assigning security codes to obtain exclusive use of network links or resources • HP AdvanceNet provides full data security, password required to invoke Query Facility of IMAGE database management systems, data access protection at data set level down to each data item.

Support for Foreign Terminals • HP-1B (HP Interface Bus) implements IEEE Standard 488 so all terminals that conform to

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that standard can interface to HP 3000, HP 1000, and other HP systems • supports BSC protocol so terminals conforming to the discipline can connect to HP systems • supports IBM 3270 terminals with passthrough facility to IBM S/370-compatible host • supports most XON/XOFF or ENQ/ACK terminal protocols, ASCII, RS-232C, and RS-422 terminals over direct-connect, dial-up, leased, or X.25 communication facilities.

Gateways to Other Networks • to SNA through emulation of IBM 2780/3780, IBM HASP Workstation and IBM 3270 controllers • to public packet-switched network through support of CCITT X.25 Standard, LAP B protocols, and to X.21 circuit-switched networks • Hewlett-Packard AdvanceNet supports Open Systems Interconnection (OSI) model • Hewlett-Packard has announced support for IEEE committee 802 on local area networking standards, HP provides an Ethernet interface on its 9000 Series Desktop Workstation.

■ HONEYWELL INFORMATION SYSTEMS

200 Smith Street, Waltham, MA 02154; 617-895-3246 • Canadian Distribution: 1500 Gordon Baker Road, Willowdale, ON M2H 3N7 • 416-499-6111.

□ Honeywell Distributed Systems Architecture (DSA)

Type • host control with peer-to-peer relationship between hosts, with distributed control throughout communications network; control resides in hosts, front-end processors (FNPs), remote concentrators, and DPS 6 systems functioning as distributed processors and terminal concentrators • Distributed Systems Architecture (DSA) products implement Distributed Systems Environment (DSE); evolution includes DSE, DSA 100, and DSA 200 • DSE represents inception of DSE philosophy • DSA 100 interconnects L66 DPS, DPS 8, Level 64, DPS, DPS 7, Satellite, and Datanet 8 processors; available as RPQ only; withdrawn from active marketing • DSA 200 extends functions and replaces DSA 100; connects to public X.25 packet-switching/X.21 circuit-switching networks; supports host/Datanet 8 front end and Datanet 8 use as network switch/concentrator; transfers files between hosts, between DPS 6 distributed systems between DPS 6 and hosts; provides cross net load/dump and enhanced network administrative facilities; cooperative processing between hosts and host/DPS 6 in transaction processing/remote batch processing environments; provides SNA gateway; supports all Honeywell terminals on secondary network.

Announced • DSE 1977; DSA 100, 1981; DSA 200, 1982.

Layers of Protocols • 7 layers corresponding directly to OSI reference model—Applications, Presentation, Transport, Network, Data Link, and Physical • all 7 layers in DPS 6 systems • Datanet 8 front end shares implementation of layers with host processors; application and message management implemented by hosts; communications layer implemented by front end • Datanet 8 implements all 7 layers with Node Operator Interface (NOI), Terminal Manager, and Gateway Modules.

Network Hardware Products • host processors: DPS 8/88/90 large systems; DPS 7 and 64 DPS medium scale systems • front end: Datanet 8 Network Processor running Distributed Network Supervisor (DNS) provides front-end control/node administration for hosts; Gateway emulation software allows older 66 DPS and 64 DPS processors to appear as DSA hosts and DSA network to appear like GRTS-II or NPS network • Datanet 8 also operates as terminal controller or network switcher • DPS 6 minicomputer running GCOS 6 MOD 400 Executive provides distributed processor functions • Cluster Control Subsystems include VIP 7700R Display, VTS 7710, and VTS 7740 Video Terminals, and VIP 7760 and VIP 7800 Display terminals • terminals include VIP 7100/7200/7205/7300/7800 Displays and asynchronous/synchronous Printer Terminals • network consoles (workstations) provide network control.

Network Software Products • networks operate under control of Distributed Network Supervisor (DNS) software residing in DATANET 8 hosted by GCOS 64 (DPS 7) or GCOS 8 (DPS 8/88/90) operating system; provides interface between remote facilities and host; supports public data networks (PDNs), value added networks (VAN), private networks, and X.25 networks • DSA provides communications management functions through front-end processor, with access to primary networks or hosts for

terminals; computers on secondary networks; switching or routing services in primary networks • Distributed Systems (DS) software runs under GCOS 6 MOD 400; supports all levels of DSA • Remote Terminal Supervisor (GRTS-II) emulator in front-end processor not as comprehensive as DNS, but serves as low-cost alternative; supports all functions of Time Sharing Systems (TSSs) • IBM terminal emulations include IBM 2780/3780, HASP, and 3270 • Gateway modules running under DNS support non-DSA terminals on secondary networks • emulation package allows MS-DOS PCs to emulate VIP 7800 Series Terminal, thus connect to DSA network.

Configuration • host processors (DPS 8/88/90 large systems or DPS 7 medium systems from CII-HB) using Datanet 8 Network Processors as front ends running Distributed Network Supervisor (DNS) executive software; Datanet 8 supports up to 4 large-system host connections; DPS 8 systems can interface to network through 8 Datanet 8s, DPS 88/90 systems can interface to up to 16 Datanet 8s, DPS 7 systems can interface to network through 2 Datanet 8s • Datanet 8 also functions as terminal concentrator or network switch • DPS 6 processor can operate as Distributed System to control secondary terminal network functions in addition to distributed processing system functions • hosts with Datanet 8 front-end, Datanet 8 operating as concentrator, and DPS 6 processors can all function as nodes on primary networks; secondary networks include terminals operating under control of 1 processor • 66 DPS and 64 DPS can also function as hosts through emulation program in Datanet 8 that makes them appear as DSA hosts • DSA devices can also interface to Ethernet or IEEE 802.3 LAN through CS/1 or CS/100 Communications Servers, and can interconnect 2 or more LANs through X.25 networks or through microwave or fiber optic links • interfaces MS-DOS PCs to DSA networks through software package that allows PC to emulate VIP 7800 Series terminals.

Network Operator Control • through workstation(s) at network control center(s) • operator access of system through one or more Network Operator Interfaces (NOIs), which establish logical connections with device mailbox of operator's terminal (single NOI can support multiple operators); a Node Administrator (NAD) allows operator to interrogate or modify object description tables, control neighbor nodes at start-up and after failures, monitor operations and report errors, accumulate statistics from all layers and forward to Network Administration Storage Facility (NASF) • NASF contains data about network, including statistics and error information used to diagnose problems, network and node configuration information, and access control information • Network Control Facility (NCF), an option for DPS allows it to function as control center of entire network.

Distributed Network Management • through various Message Management services; session control connection services provide logical connection between 2 processes in same system or determines transport services needed to provide logical connection between processes in different systems; terminates/restarts logical connections or requests reestablishment of logical connection; fragments data units • routing facility maps transport connections onto dedicated line or switched network or over virtual circuit through X.25 packet-switching network; virtual circuit service provides end-to-end flow control • data transfer between 2 adjacent nodes linked physically by X.25 LAP-B HDLC • Network Processing Supervisor (NPS) interfaces remote facilities to DPS 7/8/88/90 or 64/66 DPS host • DNS supports remote job entry and file transfer facilities for hosts/satellites; provides interactive terminal connections to timesharing and transaction processing on the host; supports DPS 6-DSA facility running under GCOS 6 MOD 400; supports public/private/value-added network; operates with Terminal Manager and Gateway modules.

Distributed Function Management • processing facilities provided in host and DPS 6 remote processors; supports real-time processing, remote batch jobs, transaction processing, remote job entry, and automated office facilities • Data Manager IV (DM-IV) in DPS 8/88/90 and IDS-II DPS 7 Series provide database management facilities • DPS 6 uses Data Entry Facility II (DEFII) for data entry applications and Distributed Processing Facility (DPF) for cooperative processing with DPS 8/88/90 and DPS 7 on DSA network.

Distributed Network Architectures

User Interface to Network • through application programs, peripheral devices or terminal/workstations • logical connection initiated to workstation mailboxes, which are address point(s) assigned by mailbox name (Endpoint); once logical connection is initiated, its defining parameters are established by negotiation • Personal Data Query (PDQ) family of user-friendly software facilities for database functions.

Security • user establishes security policy and access control rules; user implements security with Honeywell products • security is responsibility of 2 correspondents over a network; primary Honeywell security method is through password identification for access to network management directories, files, and services and to data files and programs • both DNS on Datanet 8 and DPS 6-DSA on DPS 6 can create permanent connection so terminals can access only 1 host; DPS 6-DSA can screen network access requests and refuse access.

Support of Foreign Terminals • TTY 33, IBM 2780, IBM 3270.

Gateways to Other Networks • X.25 packet- and X.21 circuit-switching networks currently available throughout world • SNA networks through SNA Interactive Facility, SNA RJE Facility, and SNA Transport Facility • to secondary networks with non-DSA Honeywell terminals/hosts.

■ IBM CORPORATION

Information Systems Group, National Accounts Division (NAD); 1133 Westchester Avenue, White Plains, NY 10604; 914-696-1900 • National Marketing Division; 4111 Northside Parkway, Atlanta, GA 30327; 404-238-2000 • Canadian Distribution: IBM Canada Limited; 3500 Steeles Avenue East, Markham, ON L3R 2Z1; 416-474-2111.

□ IBM System Network Architecture (SNA)

Type • host-controlled domain with peer-to-peer relationship between domains • evolution includes versions delivered as SNA 1 (1974), SNA 2 (1975), SNA 3 (1976), SNA 4.1 (1979), and SNA 4.2 (1981); SNA 1, SNA 2, SNA 3/4.1/4.2 represent 3 groups that cannot coexist on same network.

First Announced • 1973 (SNA 1); 1975 (SNA 2); 1976 (SNA 3); 1979 (SNA 4.1 and 4.2); 1983 extensions; 1984 extensions.

Layers of Protocols • from functional point of view, SNA consists of 2 layers: Network Addressable Unit (NAU) services and Path Control Network (PCN) services • NAU services are further subdivided into NAU Services Manager, Function Management Data (FMD) services, Data Flow Control, and Transmission Control layers • PCN services are subdivided into Path Control (PC) Data Link Control (DLC), and Physical Control layers • in comparison to OSI model, NAU Services and FMD Services layers perform some functions as the Applications and Presentation Layers of OSI model; Data Flow control and Transmission Control Layers perform same functions as the Session Layer of OSI model and some Path Control functions of Transport Layer; Path Control corresponds to Network Layer of OSI and performs some functions of Transport Layer; Data Link Control and Physical Control layers corresponds to same layers in OSI model.

Network Hardware Products • host computers 3090 include IBM S/370-138 and up, 3030 Series, 3081, 3083, 3084, 4300 Series, or S/370-compatible systems running under OS/VS1, OS/MVS, OS/MVS-XA, DOS/VS, or DOS/VSE • distributed computers include IBM 4361, 8100, Series/1, S/23, S/34, S/37, S/38, PCs, 5280, and 5520 • local network processors include IBM Series/1 and 8100 • cluster controllers include SDLC, BSC, and Start-Stop (synchronous) units such as IBM 3270 Series, 3104, 3600, 3630, 3650, 3660 Series, 3730, 3790, 4700, 5250, 6670, and 8100 • terminals include IBM 3640 Series, 3101, 3104, 3270 display-printer family, 3640, 3767, 3770-batch printer family, 6580, 8775, 8815, and IBM PCs; many terminals emulate 3270 or 3770 data streams and 5250 Information Display • integral and detached modems • communication processors include the 3705 and 3725; 3710 is network processor.

Network Software Products • messages managed by ACF/NCP/VS in 3705/3725 front end • distributed systems and network resources are managed by SSCP (System Services Control Point) in the host TCAM or VTAM, which provides bind

information for sessions; NCP supports multiple hosts; MSNF in ACF/VTAM or ACF/TCAM supports communication across domain boundaries • ACF/VTAM V.2 R.2 provides gateway to interconnect independent SNA networks • network managed by ACF/NCP/VS and SSCP as defined to TCAM or VTAM by user • up to 8 hosts (SSCPs) can share an ACF/NCP/VS program but only 6 concurrently; only 4 of hosts can be channel-attached • CICS in host is terminal manager; JES 2, JES 2 with NJE, and JES 3 support job/batch processing • Information Management System/Virtual System (IMS/VS), DL/1, Database II (DBII) or SQL/1 running on host for database management; distributed databases supported • Network Communication Control Facility (NCCF) running under VTAM or TCAM provides network control; Network Problem Determination Application (NPDA) provides NCCF with information for diagnostics and control • network analysis programs include Network Performance Analyzer (NPA) running under OS/VS1 or MVS with VTAM and/or TCAM and at least one modified NCP program; Network Performing Analysis Reporting System (NETPARS); and Generalized Performance Analysis Reporting (GPAR) • network problem and configuration management is provided by Information/Management Feature of Information/System program product; and Account Network Management Program (ANMP), a field-developed program • ACF/TCAM 3.0 is a subsystem of ACF/VTAM 2.0 or 3.0 and can no longer serve as an access method; functions as message handler and queuing interface to applications • ACF/VTAM cannot run under VM directly; support level is about the same as ACF/VTAM 2.1 under MVS.

Configuration • minimum network includes single domain with one S/370-compatible host, its front-end 3705/3725 Communications Processor, locally and remotely attached cluster controllers and/or terminals • maximum network unlimited; can include interconnected multiple domains and multiple interconnected independent SNA networks; each NCP running in 37X5 can be shared by up to 8 host processors—4 local and 4 remote only 6 concurrently; any number of 3705/3725s can be interconnected locally and remotely with local and remote cluster controllers and terminals; 3710 Network Controller operates as remote concentrator to 37X5 controller • distributed processors such as S/38, 8100, and 5280 can operate as independent data processing or control systems communicating over SNA network to hosts for summary or exception reporting, for transaction processing with central database, or for remote job entry (RJE) application • some 4300 systems and 8100 can operate as Local Area Network (LAN) processors for connecting to specific equipment • S/36 or S/38 can function in peer-to-peer relationship with host system as a SNA Physical Unit (PU) 2.1 and SNA Logical Unit (LU) 6.2.

Network Operator Control • through network control operators at network control terminals using facilities of Network Communications Control Facility (NCCF) for networks running under OS/VS1 or MVS, or using facilities of VSE/Operator Communications Control Facility (VSE/OCCF) for networks running under DOS/VSE; NCCF 2.0 can run under ACF/VTAM 3.0 under VM/SP • provide facilities for defining network resources, monitoring its operation, and diagnosing problems • Network Problem Determination Application (NPDA) works with NCCF to determine a problem exists, to provide statistical data, and to aid in troubleshooting • Communications Management Configuration (CMC) consolidates controls in single host for multiple hosts (S370-compatible) at single site.

Distributed Network Management • network includes host, intermediate (subarea) and peripheral nodes; host nodes define, allocate, and control network resources; intermediate nodes handle path and line control functions to route information through network; and peripheral nodes perform local routing only and require boundary assistance from subarea node for global network orientation • distributed processors generally operate as peripheral nodes although many (Series/1, System/38, 8100, and 4300) can handle network of workstations and peripherals • supports multiple routes between nodes; provides multiple services depending on transmission speed, priority, and response times required; paces transmissions so that sending stations don't overrun capacity of receiving stations and network does not become congested.

Distributed Function Management • primarily through

Distributed Network Architectures

CICS/VS which acts as terminal-oriented transaction monitor with file processing facilities or through IMS/VS and Database II with ACF/VTAM/VS • handles sessions, batch and transaction processing using IBM system software program products • session or interactive processing supported by timesharing, personal computer, conversational monitor, and other interactive facilities running on host processor • batch jobs can be transmitted to hosts by single RJE facilities on terminals and distributed processors as well as through RJE networks • transaction processing requests interface to programs in host through terminal monitor and database management resources; other facilities in distributed processors also handle local transactions.

User Interface to Network • through logical unit (LU), which is implemented by physical unit (PU), such as terminal or application program; binding of LU to PU is done in software tables, thus PU can be changed without affecting application program • IBM provides many easy-to-use programs for 8100, 4300, Series/1, and S/38 so it is an easy-to-use system.

Security • depends on management establishing policy and access control rules and assigning responsibilities • IBM products depend on authorized access to programs and data, and to encryption for security across communications links • primary products for system security are Resource Access Control Facility (RACF) and Virtual Storage Extended/Interactive Computing and Control Facility (VSE/ICCF); data security includes Encrypt/Decrypt Feature ACF/VTAM and ACF/TCAM V.2 or later, 3845/3846 Data Encryption Devices; Terminal Encrypt/Decrypt Feature.

Support for Foreign Terminals • AT&T 83B3 Line Control Type, Western Union 115A Line Control Type, TWX Line Control Type, IBM World Trade Teletypewriter Terminals; others supported if they emulate SNA devices such as IBM 3270 or ASCII terminals like 3101.

Gateways to Other Networks • X.25 interface to foreign and domestic packet-switching data networks • Direct Multinetwork Link (DMNL) under CICS/OS/VS, CICS/DOS/VS, and IMS/VS and Direct S.W.I.F.T. Network Link IBM host to the Society for Worldwide Interbank Financial Telecommunication, S.C. (S.W.I.F.T.) network.

■ MODULAR COMPUTER SYSTEMS, INC

P.O. Box 6099, 1650 West McNab Rd, Ft. Lauderdale, FL 33310; 305-974-1380 • Canadian Distribution: ModComp Canada Limited; 400 Matheson Boulevard East, Unit 24, Mississauga, ON L4Z 1N8; 716-845-5684.

□ MODCOMP MAXNET

Type • host-oriented with distributed network control; peer-to-peer; designed to interconnect MODCOMP computers in host/satellite configurations.

Announced • 1974.

Layers of Protocol • MAXNET essentially supports transmission system, while MAX IV operating system provides functional levels.

Network Hardware Products • host processors include CLASSIC II Series 75/45/25/15 or CLASSIC 32/85 running under MAX IV operating systems with MAXNET extensions; disk and console device; communication link interfaces; operator terminals; card readers; CRTs; magnetic tape; line printers; peripheral I/O devices and MODACS III or MODACS V physical data acquisition equipment; IBM emulation on 2780/3780/3271; CDC 6000/7000 series • devices designated as MAXNET devices can be shared by all processors on network.

Network Software Products • MAXNET is an extension of MAX IV operating system; generally, software available for execution under MAX IV available under MAXNET • INFINITY database management system (DBMS) with Transaction Processor Extension (TSX) available under MAX IV.

Configuration • minimum network includes Classic II Series Model 25 or above host and communications link to adjacent node; Classic II Series Model 15/25/45/55/75: CLASSIC

32/85 • current maximum network is 6-tier 100-computer system; no network-imposed limit on size • nonhierarchical timing considerations system, however, will limit levels allowed for 1 transaction; supports redundant configurations.

Network Operator Control • through operator's console or through remote terminal • Operator Communications module provides operator with online control; can assign devices to logical files, generates logical files, assign tasks to priority levels, control execution of tasks, establish disk/resident tasks, and add control commands that can be entered on dedicated terminal's device or through basic Operator Communications File.

Distributed Network Management • MAXNET is resident at each host or satellite node; routing table in each node passes off service requests node-to-node until message reaches the node providing the service.

Distributed Function Management • provides remote program load/activate/hold, program development, batch processing, file access, downline loading and program-to-remote program message transmission • distributed database functions across network for the infinity database • typical MAXNET configurations include host processor with multiple satellite processors performing real-time tasks in laboratory, industrial, or scientific environment; host supports the satellites with disk storage, EDP peripherals and the operator terminal.

User Interface to Network • through local MAX IV operating system; logical connection through procedural job control language for program compiling, assembly, cataloging, link-editing, and execution; Basic I/O System (BIOS) controls I/O operation requests; Operator Communications module provides online control; Terminal Monitor Program provides local terminal task control.

Security • network designed for nonhostile environment • memory protection under MAX IV; scheme provides privileged task execution in protected state and unprivileged task execution in unprotected state • terminal monitor program implements password security for user log-on • password protection for Operator Communications functions • INFINITY database provides file protections.

Support for Foreign Terminals • none.

Gateways to Other Networks • IBM 2780/3780 RJE terminal emulation; IBM 3271-compatible device emulation and 3271 transmission control driver for IBM 3271 host processor emulation; CDC UT200 remote user terminal emulation to CDC 6000/7000 series computers • X.25 Network Interface (NX) supports remote I/O processing across X.25 packet-switching networks.

■ NCR COMTEN INC

2700 Snelling Avenue North, St. Paul, MN 55113; 612-638-7777 • Canadian Distribution: NCR Canada Limited; 6865 Century Avenue, Mississauga, ON L5N 2E2; 416-826-9000.

□ NCR Communication Network Architecture (CNA)

Type • CNA integrates 2 types of networks: SNA and OSI—SNA is a host-oriented architecture and OSI is a distributed architecture • SNA-compatible network supports IBM-compatible hosts and IBM SDLC, BSC, and S/S terminals; CNA will operate as universal network supporting NCR, CDC, Cray, and IBM hosts and Industry Standard terminals, pre-SNA (BSC and S/S) and SNA (SDLC) networks, X.25 networks, X.21 circuit-switching networks, packet switching on public data networks (PDNs), COMTEN Communications Networking System (CNS), local area networks, and future technologies such as digital PBX's, Integrated Services Digital Network (ISDN), and other OSI networks.

First Announced • SNA-compatible network in 1974; CNA in 1975.

Layers of Protocols • SNA-compatible networks use the SNA-7 layers: Application, Presentation, Data Flow Control, Transmission Control, Path Control, Data Link Control (SDLC), and Physical • CNA network layers are identical to the OSI layers: Application, Presentation, Session, Transport, Network, Link Level, and Physical/Electrical.

Distributed Network Architectures

Network Hardware Products • NCR V-8500/8600 hosts; NCR terminals; NCR 621 (hardwired) and NCR 721 (programmable) communications processors; NCR Comten 3600 and 5620 Series of front-end and remote communications processors; Comten 7160 Commander Series of diagnostic modems; Comten 2200 Matrix Switch; Comten Disk; and Comten Integrated Protocol Converter.

Network Software Products • NCR host software runs under VRX operating system on V-8500/8600 processors; includes host communication access methods (VRX-TAM), NCR Advanced Communications System (NCR/ACS), COMTEN Communications Access Method (CAM), Message Control System (MCS), and Low-Level Interface (LLI), Transaction Processing (TRAN-PRO), TOTAL database management system with inquiry facilities, and RJE support for NCR 8200 systems • COMTEN software for its communications processors includes COMTEN Communications Network System (CNS), Network Control Program (NCP), Emulation Processing (EP), Advanced Communication Function (ACF)/Network Control Program (NCP), Comten Network Gateway (CNG), Partitioned Emulation Processing (PEP), Communications Access Method (CAM), 3270 Multiple Access Facility (MAF), MAF/Remote Host Option (MAF/RHO), Subarea Routing Manager (SRM), Network Terminal Option (NTO), and X.25 Interface to Packet Switched Networks.

Configuration • SNA-compatible network is same as for IBM's SNA except COMTEN front-end processors can support 8 local hosts versus 6 on the IBM 3725 communications processors • CNA network can range from NCR host with Comten 721, 5620, and 3600 front-end communications processors allowing users to connect to SNA, NCR, and pre-SNA IBM hosts supporting NCR, SNA, BSC, and S/S terminals communicating over SNA, X.25, or CNA/OSI networks.

Network Operator Control • in SNA-compatible networks, the operator controls network through NCCF • in CNA networks, the COMTEN console on 3600 or 5620 communications processor operates as command console.

Distributed Network Management • in SNA-compatible networks, network management rests in IBM SNA network • in CNA networks running CAM software, control is distributed among the COMTEN communications processors; network management functions that reside in host under SNA, such as SSCP, reside in the 3600.

Distributed Function Management • in SNA-compatible networks, functions are distributed in SNA network • in CNA networks, functions will be distributed depending on applications and network users orientation (NCR users to NCR hosts, BSC and S/S users to IBM hosts operating in emulation mode, and SNA users to SNA hosts).

User Interface to Network • through application programs, operator console, or terminal; network and transmission control facilities transparent to user.

Security • for SNA-compatible networks, security provided in SNA network • for CNA networks, running under Comten Automatic Message Switching and Comten Communications Access Method, CAM/AMS provides security through password-access, logical access groups, and span-of-control operators.

Support for Foreign Terminals • none unless they emulate IBM or NCR-supported terminals.

Gateways to Other Networks • to SNA through COMTEN 3600 Communications Processor; to X.25-compatible networks through X.25 interface or X.21 circuit-switching networks • CNG switches between SNA hosts and networks, MAF/RHO switches terminals to non-SNA and non-IBM hosts, SRM switches terminals between SNA and non-SNA hosts.

■ PRIME COMPUTER

Prime Park, Natick, MA 01760; 617-655-8000 • Canadian Distribution: Prime Computer; 5945 Airport Road, Mississauga, ON L4Z 1N8; 416-678-7331.

□ Prime Computer PRIMENET

Type • peer-to-peer global network with distributed control among single or local networks of PRIME 50 Series systems; conforms to CCITT X.25 recommendation, thus X.25-compatible terminals or computers are compatible with PRIMENET at the link level.

First Announced • 1978.

Layers of Protocols • Physical (X.21); Link Control (CCITT X.25 HDLC); Virtual Circuit Control (CCITT X.25); User Services and Applications • in comparison to OSI model, Physical relates to Physical; Link Control relates to Data Link; Virtual Circuit relates to Network; User Services and Applications Layer relates to Transport, Session, and Presentation Levels; Applications lie outside the specifications.

Network Hardware Products • Prime Series 50 processors, with Prime Node Controller (PNC) that allows up to 128 processors to interconnect through local twin-axial 10-MHz baseband Ringnet token-passing network • Multiple Data Link Controller (MDLC) for Synchronous Communication over 2 to 4 RS-232C or V.35 lines per board, up to 56K bps • Intelligent Communications subsystem, Model 1 (ICS1), for synchronous data communications over 1 RS-232C line, up to 9600 bps, additional 8 synchronous lines on ICS1 • Intelligent Controller subsystem, Model 2 (ICS2), provides RS-232C and V.35 synchronous communication lines for PRIME/SNA up to 64K bps.

Network Software Products • runs under PRIMOS operating system on Series 50 processors • Inter-Process Communications Facility (IPCF) allows user programs to set up virtual circuits to programs in another Prime system or another vendor's system • Interactive Terminal Support (ITS) allows terminals on packet-switched network or another Prime System to log onto a Prime system as if directly attached; ITS complies with CCITT X.3 and X.29 procedures • Remote File Access (RFA) allows programs running under PRIMOS to access files on another Prime system on the network • File Transfer Service (FTS) provides queued file transfer between Prime systems using Primenet • Remote Job Entry emulators provide for IBM 2780/3780, IBM HASP, Control Data 200 UT, Sperry 1004, Honeywell G-115, ICL 7020, and XBM support • Host mode or compatibility in IBM HASP, IBM 2780/3780, and Honeywell GRTS-115 for remote job entry stations—binary synchronous terminal support for 3271/3277 display systems—SNA/SDLC interactive terminal support for 3274/3278 display systems • 3270 printer emulation support for 3284/3286/3287 printers for binary synchronous networks and 3287/3289 printer support for SNA networks • SNA/SDLC RJE support will be available in late 1985.

Configuration • requires one or more Prime Series 50 Processors running under PRIMOS operating system • IPCF, ITS, and FAM are integral to PRIMENET and not add-on modules; all 3 packages must be implemented in PRIMENET node; processors on Ringnet, however, can be dedicated to one or more functions • any number of Prime 50 Series processors in single configuration or in Ringnets with up to 128 processors can interface to packet-switched networks and communicate with virtually any number of other Prime local networks and single Prime Series 50 systems • ITS supports terminals that interface directly to packet-switched networks; terminal emulation packages allow systems on a PRIMENET network to interface to other networks.

Network Operator Control • through system administrator and interactive program (CONFIGNET) which allows administrator to define the global network; NETRAC logs errors and makes them available to administration; MONITORNET allows monitoring of the network with the ability to archive statistical data; STATNET allows administrator to check which nodes in network are active • ITS facility provides operator access to all remote systems, PRIMENET allows dynamic reconfiguration of network.

Distributed Network Management • among hosts on network including PRIME 50 Series processors that can reside on Ringnet; all nodes on PRIMENET include same network management facilities.

Distributed Function Management • functions performed at each node determined by parameters set when system

Distributed Network Architectures

configured • all nodes must support ITS (Interactive Terminal Support), RFA (Remote File Access), and IPCF (Inter-Process Communication Facility) • location of files, organization (centralized or distributed) of files, and functions performed at each node are application dependent.

User Interface to Network • through application program, peripheral, or terminal • user from terminal logs on network through Interactive Terminal Support (ITS) facility.

Security • through same access control mechanisms as for local file access; each User File Directory (UFD) has associated Access Control List (ACL) specifying read/write/execute/truncate/delete; system administrator can confine access to disk storage regions or to local users and can refuse access to remote programs.

Support for Foreign Terminals • any TTY-compatible terminal, IBM 3270 terminals, and other block-mode terminals.

Gateways to Other Networks • compatible with other CCITT X.25 networks; TELENET and TYMNET (US), DATAPAC (Canada), TRANSPAC (France), PSS (United Kingdom), DATES-P (West Germany), and EURONET (Europe) • ITAPAC (Italy), and AUSTPAC (Australia) • gateway to IBM SNA networks using PRIME/SNA product for 3270 terminal and printer emulation (PRIME/SNA interactive and PRIME/SNA server) • gateway to IBM Binary Synchronous networks through 3271/3277 terminal emulation (DPTX) and HASP, 2780/3780 remote job emulators • non-IBM RJE emulators provide access to other vendors: Honeywell G-115, Univac 1004, CDC 200 UT, and ICL 7020, and XBM.

■ SPERRY CORPORATION

P.O. Box 500, Blue Bell, PA 19422; 215-542-4011 • Canadian Distribution: Sperry Information Systems; 3 Hamilton Avenue, P.O. Box 390, Ottawa, ON; 613-728-4681.

□ Sperry Distributed Communications Architecture (DCA)

Type • host-controlled hierarchical network or distributed processing network with front-end and nodal processors providing control function.

Announced • 1976.

Layers of Protocols • 2 major logical concepts: the Application Environment (AE) and the Communication System (CS); a part of each terminal/host is dedicated to CS and is called Termination System (TS) and the rest of terminal/host resources can be used for user AE; the rest of CS is devoted to Transport Network (TN); the TS provides bridge between termination environment and communication system • in comparison to OSI model, Applications relates to Applications; TS relates to Presentation; TN relates to Session, Transport, Network, and Data Link layers of OSI; and Transmission Facilities equals Physical Level.

Network Hardware Products • hosts include Sperry 90 and 1100 Series; front-end and remote nodal processors include Communication Processor DCP/10, DCP/20 and DCP/40; Sperry UDS 2000, UTS 4000 Series cluster controllers; gateways to SNA; and both DCA terminals and some non-DCA terminals; SPERRYLINK Office Systems; cluster controller subsystems and Sperry terminals (Uniscope, DCTs, and UTS series) Sperry Terminal Multiplexer and Modems.

Network Software Products • network operates under TELCON software control; resides in DCP-Series communications processors and hosts; terminals include some software modules such as Applications Management Services (AMS) and Termination System (TS) • TELCON implements AMS and TS modules that interface to TS and AMS in hosts and terminals, provides Network Management Services (NMS), and interfaces to Transmission System (UDLC over trunk lines) and public networks • TELCON software in DCPs can include ADAPT, logical interface for non-DCA terminals, to connect foreign terminals to DCA networks.

Configuration • DCA network can include DCA hosts, DCA terminals, network processors, (front ends, nodal processors, and remote concentrators) transmission facilities, and foreign attachments; must include at least 2 Termination Systems and 2 Termination System Transport Network interfaces, such as

contained in DCA host and DCA terminal • host can be Sperry 1100 or 90 Series (90/60, /70, /80 under VS9) System; UTS 4000 Series terminals can function as termination systems • DCP/10, DCP/20, and DCP/40 are the network processors • functioning as front-end processors, DCP/10, DCP/20, and DCP/40 support direct channel interfaces to 1 or more host systems; DCP/10 limited to connection to 1 host; DCP/20 is limited to 3 directly connected hosts; DCP/40 is not limited except each connection reduces number of communications line modules by 1; number of communications lines supported is 20 (DCP/10), 192 (DCP/20), or 1,000 (DCP/40).

Network Operator Control • through designated network consoles, physically assigned at system generation time • operator can start/stop network, monitor network status, activate/deactivate network facilities, change line scheduling specifications, start dump/trace programs, start and control online testing, start and control network simulators, and redefine network configuration.

Distributed Network Management • through different levels of Network Management Services (NMS), which provide session, physical resource, maintenance, security, and network administrator services.

Distributed Functions Management • provides transaction processing, time sharing, and job/batch transaction processing with database management facilities to local and remote terminals by host software includes Total Information Management Systems (TIMs) in 1100 Series and Information Management System (IMS)/90 on Series 90 • AMS software in host and terminal provide interface between the application software and network interface in DCP.

User Interface to Network • through End-User (EU) application program in host or terminal; EU is resources sink of information, and can be program, device, and/or operator under control of Communications System Users (CSU) software which accesses network through logical port.

Security • user establishes security and access control rules using Sperry products • primary security through password sign-on when session is established and through database facilities for file access protector.

Support for Foreign Terminals • Teletype 33/35, IBM 3270, and IBM 2780/3780 BSC terminals • ADAPTS software maps non-DCA devices into DCA environments; treats device as Communications System User (CSU), performs function of terminal handler/line protocol handler, and transforms received units into units required by DCA units.

Gateways to Other Networks • to public and private X.21 circuit- and X.25 packet-switched networks, such as Transpac and Datapac; considered subarchitectural network by DCA system • DCP also emulates IBM 3270 and 2780/3780 BSC protocols as well as 3270 SNA protocols for access to IBM hosts • electronic mail feature of Sperry Link interfaces to Western Union's Electronic Mail Services.

■ TANDEM COMPUTERS

19333 Vallico Parkway, Cupertino, CA 95014; 408-725-6000 • Canadian Distribution: Tandem Computer Canada Limited; 7270 Woodbine Avenue, 3rd Floor, Markham, ON L3R 4B9; 416-475-8222.

□ Tandem EXPAND NonStop Network System

Type • distributed network system consisting of up to 255 nodes with 2 to 16 processors per node.

First Announced • 1976.

Layers of Protocols • Guardian Message System, Network Control Process, End-to-End, Network Routing Table, Network Line Handlers, and Physical • in comparison to OSI model, Application relates to Application (both outside specification); Guardian Message System relates to Presentation Layer in OSI; Network Control System relates to Session; End-to-End relates to Transport; Network Routing Table relates to Network; Network Line Handler relates to Data Link; and Physical equals Physical • Tandem views the EXPAND Network as an extension of the Guardian Message System.

Distributed Network Architectures

Network Hardware Products • Tandem NonStop, NonStop II, and TXP multicomputer systems running under GUARDIAN/EXPAND operating system; variety of terminals including Tandem 6530 Multi-Page Display, and IBM 3270 supported by PATHWAY in ENCOMPASS software • physical links supported include asynchronous, synchronous point-to-point, multipoint X.25 and SDLC procedures • system-to-system fiber optic link (FOX) is available to connect up to 14 systems up to 1 kilometer apart operating full-duplex transmissions at 1M bytes per second over each of 2 pairs of strands; 4 fiber optic strands for fault-tolerance operations at 4M-byte-per-second aggregate rate • controllers, modems, and computer/satellite communications interface modules for INFOSAT satellite transmissions (nonstop) over dual 56K-bps lines (American Satellite Company supplies earth stations).

Network Software Products • network operates under GUARDIAN/EXPAND Operating System which runs on each Tandem processor in the network; ENCOMPASS Distributed Data Base Management System includes database management, terminal management, and transaction definition and application control; ENFORM, an ENCOMPASS subsystem, is query/report writer facility • all processes on Tandem systems are considered files, thus all processing reduces itself to file processing; all processing occurs between process-pairs • TRANSFER information delivery system designed to allow organizations to deploy information throughout a single system or a network of distributed systems; includes TRANSFER/MAIL electronic mail system and TRANSFER/FAX for interface to U.S. I and II groups of facsimile devices.

Configuration • network can support up to 255 nodes with 2 to 16 processors per node for maximum of 4080 processors per network; normal mode of operation is for each processor to be checkpointed by another processor; if error occurs, the back-up processor automatically assumes load of the processor that has gone down • up to 255 I/O devices per processor • Network Control Process, located in each node, and all Line Handlers run as NonStop process pairs • in nonstop mode, all components are duplicated.

Network Operator Control • ENCOMPASS Distributed Management System provides Application Monitor, the initial program that enables the applications operator to begin transaction processing and control application execution online • control designated from operator terminal where parameters for monitor are defined; centralized control point is movable to any node in network • controls include stop/alter application module, report errors and system status, and monitor through network control monitor (NETMON); utilities program traces events within specific Line Handler (NETTRACE); accumulates, displays, and reports statistics for line handler (NETSTATS); provides entire network status (NETMAPS) from any remote system; and provides current path to any remote system or any node (NETPROBE).

Distributed Network Management • network control process resides in each node; builds and maintains own Network Routing Table, which local Guardian message system uses to direct messages to other systems • network control process, in each

node online, informs its neighbor (directly connected) nodes of line failure; nodes establish new route around the failed node, and update routing tables.

Distributed Function Management • through ENCOMPASS provides Terminal Management, Data Base Management, Transaction Definition and Application control, and Transaction Monitoring Facility (TMF) • Terminal Management supports different applications such as screen formatting, data validation, screen sequencing/data mapping, and sequencing for single and multiple terminals • relational database management provides data definition for uniform access to database via DATA Dictionary and allows single database to be spread over multiple sites in network; provides multikey database access, 3 types of file organization, record and file locking, currency control, security control, and cache buffer for high transaction rates; ENFORM subsystem provides querying or report writing on Tandem relational database through LINK statement that relates database files • Transaction Definition and Applications control provides centralized monitoring and control of all applications online: create/delete process, add/delete transaction type, and report errors and system status • Transaction Monitoring Facility allows transactions to be controlled concurrently and provides audit trails, transaction backout, online dumps, and roll-forward recovery.

User Interface to Network • interactive access to system provided by Guarding Operating systems command interpreter COMINT accessed from terminal or from any type file; COMINT is seen by operating system as another application process; if command is not recognized, process will stop and error message is printed • processes created by COMINT or by application process called NEWPROCESS using process-pair concept.

Security • at file level by function, user class, network node, application program, and specified terminal • NonStop redundancy philosophy extends to network level with dual transmission facilities for backup.

Gateways to Other Networks • AXCESS X.25 Access Method allows Tandem systems to communicate directly over public packet-switching networks using standard protocols such as X.25 and X.29; certified for use with TELENET, TYMNET, and UNINET • Tandem systems can connect to FED Wire, BankWire, TWN TELEX, and S.W.I.F.T. (Society for Worldwide Interbank Financial Telecommunications), international electronic funds transfer network • Tandem Hyper Link (THL) provides hardware/software link to the Network Systems Corporation HYPER Channel; Tandem implements only the trunk protocol, user must write end-to-end protocol • SNAX (System Network Architecture Communications Services) provides communication between Expand and SNA networks: allows Tandem NonStop computers access to IBM hosts, application programs, controllers, terminals, and printers; supports all SNA devices connected to SNA physical unit Type 1 terminal node and Type 2 cluster controller • INFOSAT provides satellite transmissions.

• END

