FACULTAD DE INGENIERIA U.N.A.M.
DIVISION DE EDUCACION CONTINUA

TALLER DE REDES (LAN) DE MICROCOMPUTADORAS

PARTE IV

MATERIAL DIDACTICO

JUNIO, 1992.

Palacio de Minería Calle de Tacuba 5 Primer piso Deleg. Cuauhtémoc 06000 México, D.F. Tel.: 521-40-20 Apdo. Postal M-2285

P R E S E N T A C I O N

Dando respuesta a la gran demanda de los asistentes a los cursos: INTRODUCCION A REDES (LAN) DE MICROS PARTE I, PARTE II, E INSTALACION Y MENEJO DE REDES CON NETWARE DE NOVELL, esta División preocupada por mantener en alto la excelencia en el cumplimiento de su mision, considero que despues de haber impartido progresivamente desde 1987 y con muy buena aceptación dichos temas, era imperativo que se diseñara este curso donde los participantes podran llevar a la práctica el manejo y solución a los problemas que en un momento dado presenta la instalación de una Red.

El tema contiene siete topicos principales con el mínimo indispensable de teoria, ya que se pretende generar un verdadero y ameno TALLER, principiando por orientar la Plataforma del mismo (de acuerdo al perfil medio de conocimientos de quienes han pasado por los modulos I, II y III antes citados), siguiendo con la tarea de dominar desde la instalación física y lógica de la Red incluyendo el Sist. Op. de la misma y el software de aplicaciones, y la actualización en cuanto a Ruteadores, Concentradores y Tarjetas de 32 bits, ect., hasta lograr que el grupo haga una Aplicación Real empleando herramientas modernas e implementando una base de datos verdaderamente distribuida.Poteriormente se abundara sobre los S.O. para Red bajo DOS, y sin que el tema este orientado hacia Netware, se ponderaran las versiones 2.15, 2.2, y 3.11 ya que Novell sigue marcando el estandar.

En Conectividad, se instalaran puentes internos y externos, teniendo contemplado hacer enlaces remotos hacia el interior del País. Se instalaran varios servidores en una misma Red centralizando uno hacia varias Redes donde se abundara sobre caracteríticas y requerimientos de los mismos (ISA, EISA, M.C. etc.), se reforzara sobre tecnologías de discos duros y su instalación, se contempla conectar Laptop's y Notebook's, etc. Finalmente, se analizara un Proyecto Real donde se implementa un enlace de 110 microcomputadoras empleando fibra óptica con la integración de Unix - Netware con opción a enlaces remotos. En fin, los objetivos son ambiciosos y solo para quien requiera estar actualizado en este apasionado campo de las Redes.

O B J E T I V O S

Que los participantes se actualicen y dominen los puntos clave, y Tip's que les permita evaluar los Sistemas Operativos para Red,los equipos y perifericos, cuyas tecnologias (ISA, EISA, MCA, RISC, SPARC, etc.), y la elección del software y hardware adecuados, cumplan con los requerimientos de sus aplicaciones.

Que puedan explotar todas las prácticas y experiencias tenidas en los modulos anteriores-ademas de las adquiridas en el Proyecto Real contemplado en este Taller-.Que puedan minimizar la problematica que representa el manejo e instalación de Redes (LAN), a fin de que se coloquen en la corona de la piramide que han formado todos los asistentes a los modulos del tema, en bien de su propia productividad y de sus respectivos organismos.

A QUIEN VA DIRIGIDO:

A los participantes que ya hayan pasado por dos de los modulos anteriores de este tema, así como a ejecutivos, profesionales, técnicos y/o usuarios que hayan instalado su red y necesiten optimizarla.

R E Q U I S I T O S:

Tener conocimentos de/o equivalentes a los modulos I y II como mínimo, con amplio manejo de MS-DOS y dominio en microcomputación.

TALLER DE REDES (LAN) DE

MICROCOMPUTADORAS

***.-I N T R O D U C C I O N.**

- Plataforma Básica para el Taller.

***.- H A R D W A R E**

-Instalación, configuración y características ARCNET, ETHERNET Y TOKEN RING.

-Ruteadores y Concentradores, distancias máximas.

-Tarjetas de 32 bits.

***. - SOFTWARE Y SISTEMAS OPERATIVOS**

-Instalación de Netwarwe V 2.12, 2.15, y 2.2.

-Instalación de Netware V 3.11.

-Sistemas Operativos de Red con Plataforma DOS.

-Instalación de Paquetes para Red.

***. - S E R V I D O R E S**

-Requrimientos en: Velocidad, Memoria, Disco Duro, y Tecnologias.

-Instalación de Discos Duplicados y Discos en Espejo.

-Instalación de UPS Inteligentes.

-Comandos de consola.

-Super Servidores.

***. - E L S U P E R V I S O R**

-La Administración de la Red.

-Tips, Trucos y Trampas /Netware 2.1x. 2.2 y 3.11.

-Utilerias de apoyo.

-Instalación de Estaciones de Trabajo sin diskets.

-Los problemas con el cableado.

-Deteccion de fallas en la Red.

-Instalación de Windows 3.0 bajo Netware.

***.- A P L I C A C I O N E S.**

-Aplicación Real con una base de datos distribuida.

-Correo Electrónico.

*** . - C O N E C T I V I D A D**

-Puentes Locales (Internos y Externos).

-Puentes Remotos.

-Enlaces con Fibra Optica.

-Laptop's y Notesbook's en las Redes.

-Integración Unix-Netware.

P R O F E S O R E S

ING. JUAN F. MAGAÑA CARRILLO.

ING. SAUL S. MAGAÑA CISNEROS.

ING. JUAN CARLOS MAGAÑA C.

LIC. ALEJANDRO NUÑEZ CASTRO.

S O P O R T E   T E C N I C O

ADRIAN F. MAGAÑA C.

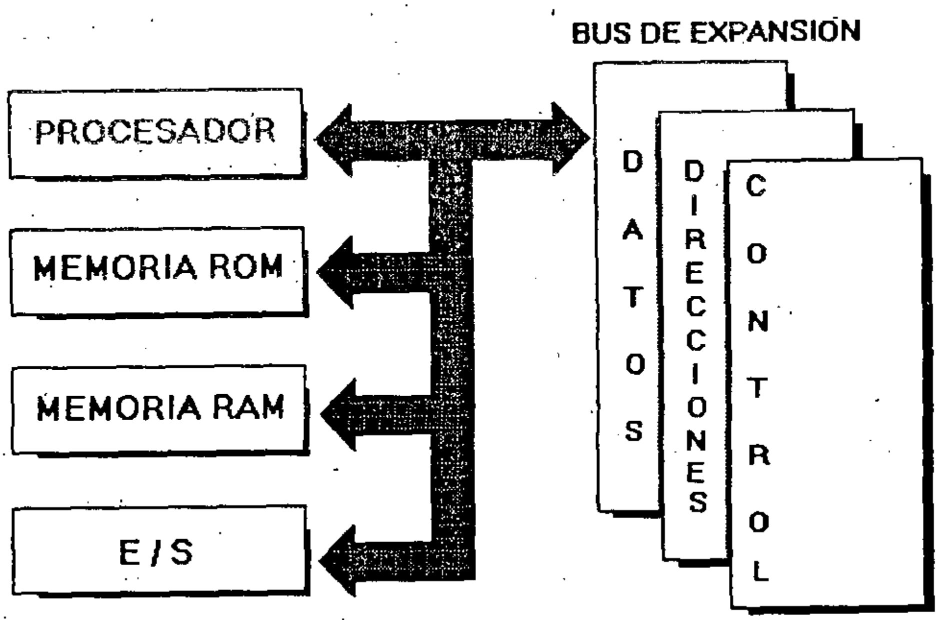
PEDRO HUERTA A.

OSCAR HERNANDEZ D.

FRANCISCO G. MAGAÑA D.

INTRODUCCION

Arquitectura General de la PC



apuntes

Características de un Microprocesador

Un microprocesador es un circuito combinacional y secuencial que interactua con otros circuitos para formar en conjunto un sistema digital de cómputo.

Funciones Principales:

*Provee las señales de tiempo y control para todos los elementos del sistema.
*Busca instrucciones y datos desde la memoria.
*Transfiere datos desde y hacia Dispositivos de Entrada/Salida.
*Decodifica instrucciones.
*Realiza operaciones lógicas y aritméticas solicitadas através de instrucciones.
*Responde las señales de control de E/S, tales como RESET e INTERRUPT.

apuntes

NIVELES DE INTERRUPCION XT

N°	CAUSA
NMI	Error de Paridad
0	Contador
1	Teclado
2	Reservado
3	Comunicación / Puerto Serie (COM2), SDLC o BSC (Secundaria)
4	Comunicación / Puerto Paralelo (COM1), SDLC o BSC (Primaria)
5	Disco Duro
6	Puerto Paralelo

apuntes

NIVELES DE INTERRUPCION AT

N°	FUNCION
0	Timer del Sistema de salida 0
1	Salida del Teclado buffer lleno
2	Interrupción del controlador 2 (niveles 8-15)
3	Puerto Serial 2
4	Puerto Serial 1
5	Puerto Paralelo 2
6	Controlador de Discos
7	Puerto Paralelo 1
8	Reloj de Tiempo Real
9	Redireccionado vía Software a INT 0AH
10	Reservado
11	Reservado
12	Reservado
13	80287
14	Disco Duro
15	Reservado

apuntes

Memoria ROM (Read Only Memory)

Funciones Principales:

*Inicialización del Sistema.
*Diagnóstico de Encendido y Revisión del Sistema.
*Determinación de la Configuración del Sistema.
*Manejo de Dispositivos de E/S.- ***BIOS***
*Cargado del Sistema Operativo.
*Patrones de bits para los 1ros. 128 caracteres ASCII.

apuntes

Mapa de memoria XT (ROM)

C0000	
C8000	DISCO DURO
CC000	192K PARA EXPANSION DE ROM
F6000	ESPACIO DEL USUARIO
FE000	AREA DEL BIOS
FFFFF	

apuntes

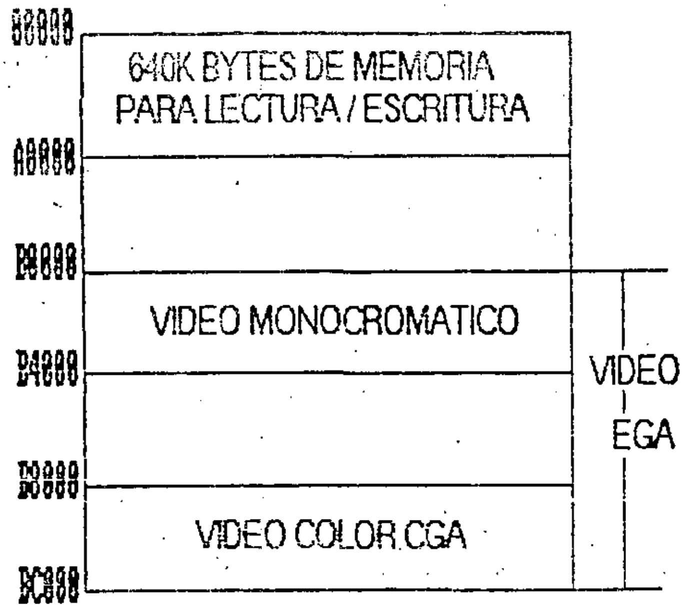
Memoria RAM (Random Access Memory)

Características Principales:

*Lectura / Escritura.
*Acceso Aleatorio.
*Espacio Disponible al Usuario y sus aplicaciones.
*Tamaño Limitado por el número de bits de direcciones del Microprocesador.
*Se direcciona através de un mapa de memoria predefinido.
*Tiempo de acceso de 150 a 80 nanosegundos.

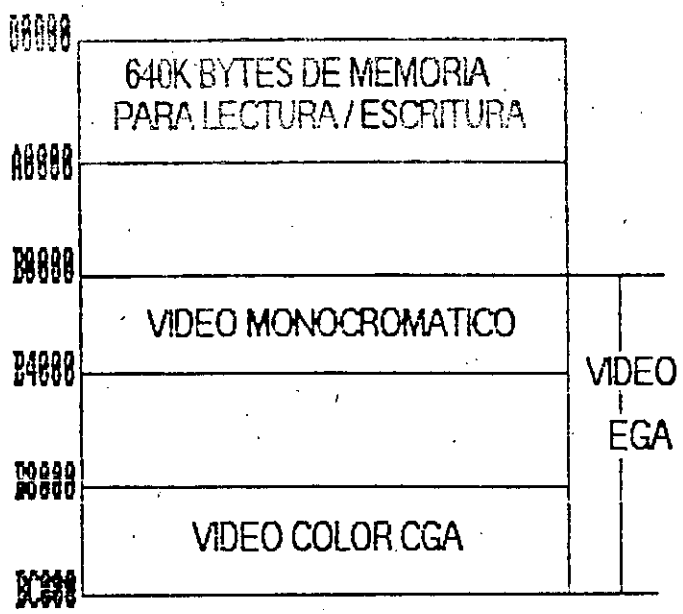
apuntes

Mapa de memoria XT (RAM)



apuntes

Mapa de memoria XT (RAM)



apuntes

Arquitectura de una computadora

D.1 I/O Address Map

Hex Range	Devices	Usage
000-01F	DMA Controller 1	System
020-03F	Interrupt controller 1	System
040-05F	Timer	System
060-06F	8042 (keyboard)	System
070-07F	Real time clock, NMI mask	System
080-09F	DMA page register	System
0A0-0BF	Interrupt controller 2	System
0C0-0DF	DMA controller 2	System
0F0	Clear math Coprocessor busy	System
0F1	Reset math coprocessor	System
0F8-0FF	Math coprocessor	System
1F0-1F8	Fixed disk	I/O
200-207	Game I/O	I/O
278-27F	Parallel printer port 2	I/O
2F8-2FF	Serial port 2	I/O
300-31F	Prototype card	I/O
360-36F	Reserved	I/O
378-37F	Parallel printer port 1	I/O
380-38F	SDLC, bisynchronous 2	I/O
3A0-3AF	Bisynchronous 1	I/O
3B0-3BF	Monochrome display and printer adapter	I/O
3C0-3CF	Reserved	I/O
3D0-3DF	Color/graphics monitor adapter	I/O
3F0-3F7	Diskette controller	I/O
3F8-3FF	Serial port 1	I/O

apuntes

Bus de Expansión

Funciones Principales:

*Conecta los componentes funcionales al Microprocesador.
*Está formado por: Bus de Datos
Bus de Direcciones
Bus de Control
*Además da las señales de:
Tiempo
IRQs
DMA

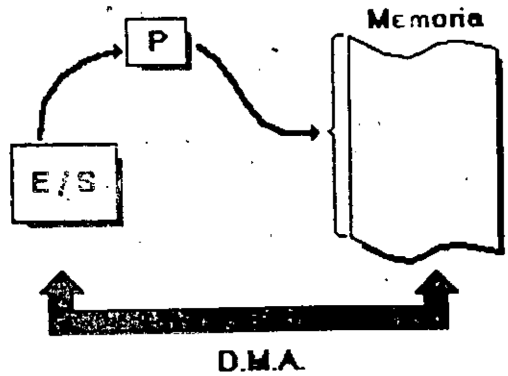
apuntes

Dispositivos Inteligentes

DMA (Direct Memory Access)

Ventajas:

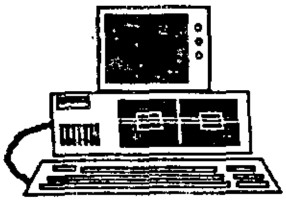
*Velocidad en el Dispositivo.
*No "distrae" al Microprocesador.
*Transferencia de información rápida.



apuntes

Arquitectura de las Microcomputadoras

Especificaciones IBM Personal Computer

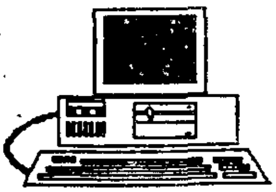


* Fuente de Poder de 63.5 Watts
* Microprocesador 8088 de 4.77 Mhz
* 5 Slots de Expansión (Con socket de 62 pins.)
* Memoria RAM base de 16K - 64K
* Bocina
* Unidad de Disco Flexible de 320K o 360K de 5¼
* Teclado de 83 teclas.

apuntes

Arquitectura de las Microcomputadoras

Especificaciones IBM Personal Computer XT



* Fuente de Poder de 130 Watts
* Microprocesador 8088 de 4.77 Mhz.
* 8 Slots de expansión (Con socket de 62 pins.)
* Memoria RAM base de 256K
* Disco Duro (En algunos modelos)
* Adaptador de Comunicaciones Asíncronas (En algunos modelos)
* Teclado de 83 teclas

apuntes

Microprocesador Intel 8088

*Velocidad de Reloj en MHz. 4.77 - 12
*Tamaño del Bus de Datos 16 / 8
*Tamaño del Bus
de Direcciones 20 ---> Memoria = 1MB
*Modos de Operación: Real

{ 640 KBytes Usuario
384 KBytes Sistema }

apuntes

Microprocesador Intel 8086

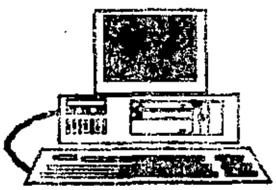
*Velocidad de Reloj en MHz. 4.77 - 12
*Tamaño del Bus de Datos 16 / 16
*Tamaño del Bus
de Direcciones 20 ---> Memoria = 1MB
*Modos de Operación: Real

640 KBytes Usuario

384 KBytes Sistema

apuntes

Especificaciones IBM Personal Computer AT



* Fuente de poder de 192 Watts switchable para 115 o 230 Vac
* Microprocesador 80286 de 6 Mhz.
* 8 Solts de expansión
  6 con 1 socket de 36 pins y 1 de 62 pins
  2 con 1 socket de 36 pins unicamente
* Memoria RAM base de 256K
* Memoria RAM de tipo Semiconductor Complementario de Oxidos Metálicos (CMOS) para mantener la configuración del setup del sistema.
* Batería para manteneer activa la memoria CMOS cuando el equipo este apagado.
* Bocina
* Disco Duro
* Unidad de Disco Flexible de 5¼" de 1.2MB
* Seguro que inhibe cualquier entrada por eel teclado
* Teclado de 84 teclas.

apuntes

Microprocesador 80286

Modos de Operación 80286

Modo REAL

Se comporta como un: 

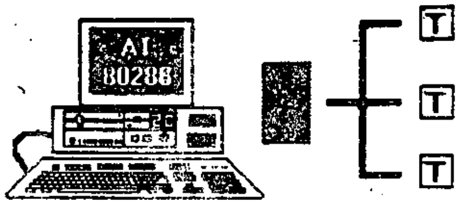
Modo PROTEGIDO

* 16 MB Memoria RAM
* Multitareas
* Multiprocesamiento
* Memoria Virtual

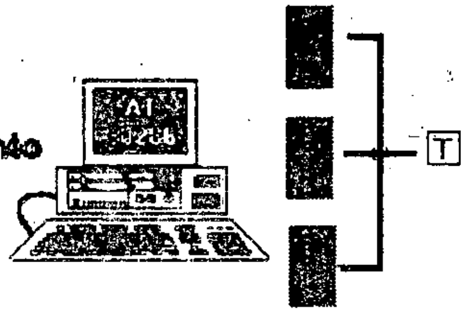
apuntes

Modo Protegido de Operación 80686

Multitareas



Multiprocesamiento



apuntes

Microprocesador Intel 80286

*Velocidad de Reloj en MHz. 6 - 20
*Tamaño del Bus de Datos 16 / 16
*Tamaño del Bus
de Direcciones 24 ---> Memoria = 16MB { 15 MBytes Usuario / 1 MByte Sistema }
*Modos de Operación: Real
Protegido

apuntes

Microprocesador Intel 80386

*Velocidad de Reloj en MHz. 16 - 33
*Tamaño del Bus de Datos 32 / 32
*Tamaño del Bus
de Direcciones 32 ---> Memoria = 4GB
*Modos de Operación: Real
Protegido
Virtual

Limitante Tecnológica
(128 MBytes) Usuario

1 MByte
Sistema

apuntes

Microprocesador Intel 80386/sx

*Velocidad de Reloj en MHz. 16 - 20
*Tamaño del Bus de Datos 32 / 16
*Tamaño del Bus
de Direcciones 32 ---> Memoria = 4GB
*Modos de Operación: Real
Protegido
Virtual

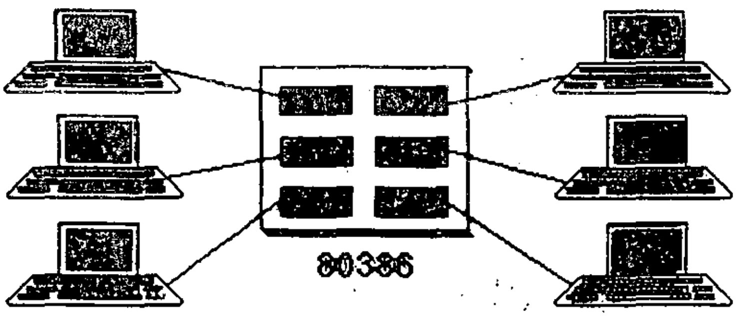
Limitante Tecnológica
(128 MBytes)Usuario

1 MByte
Sistema

apuntes

Modos de Operación 80386

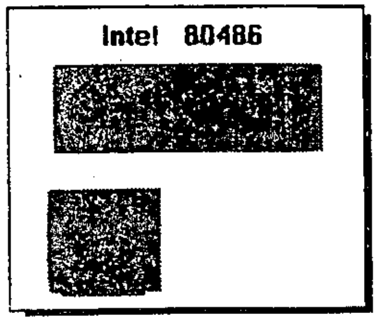
Modo Virtual 8086



apuntes

Microprocesador Intel 80486/sx

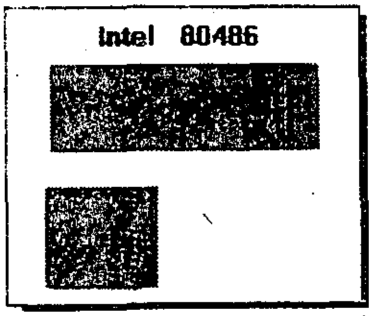
*Características Similares al 80386/sx
*Incluye Memoria Caché



apuntes

Microprocesador Intel 80486/sx

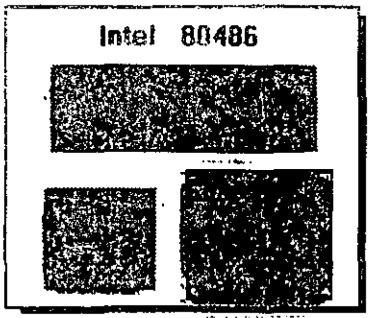
*Características Similares al 80386/sx
*Incluye Memoria Caché



apuntes

Microprocesador Intel 80486

*Características Similares al 80386
* Incluye Coprocesador Matemático
*Incluye Memoria Caché

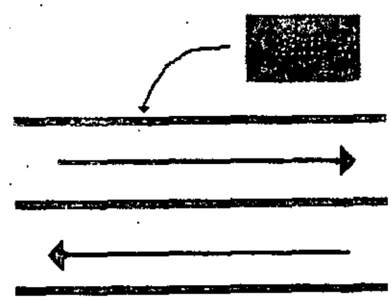


apuntes

Arquitectura 80386

Flex Compaq:

- *Alta Velocidad.
- *Compatibilidad.
- *Canal Dual con Procesador Adicional 82385.
- * No Comparte Canal Ni Memoria.



apuntes

Arquitectura 80386

Smartslot AST Research:

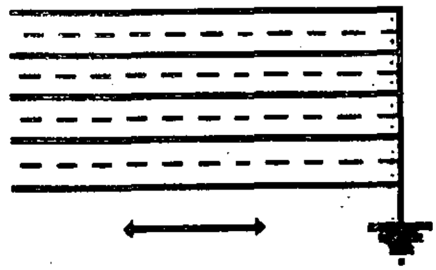
*Enfoque Arquitectónico Intermedio.
*Bus Arbitrado.
*Procesador Múltiple.
*Buena Velocidad.
*No 100% Compatible.
*Necesita Adeptos.

apuntes

Arquitectura 80386

Micro Channel IBM:

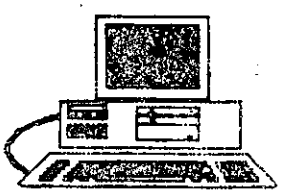
* "Nuevo Estándar....?"
*Canal Compartido.
*Alta Confiabilidad.
*Orientado a Multitareas y Multiprocesos.
*Utiliza e Implementa el POS.
* <u>No Compatible.</u>



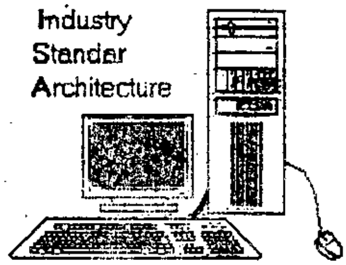
apuntes

Tecnología de las Microcomputadoras

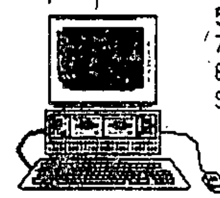
Industry
Standar
Architecture



Extended
Industry
Standar
Architecture



Micro
Channel
Adapter



Modelos:

50
50Z
50/386
70
80
90

apuntes

Caracteristicas Principales de las diversas Arquitecturas

CARACTERISTICA	MCA	EISA	ISA
Amplitud mínima de Datos	32 bits	32 bits	16 bits
Permite el uso de Periféricos inteligentes y bus master de 32 bits	SI	SI	NO
Promedio máximo de Datos: DMA CPU	 20MB/seg 14MB/seg	 33MB/seg 16MB/seg	 2MB/seg 8MB/seg
Soporte para memoria direccionable	16MB	4GB	16MB
Compatibilidad	Ninguna	ISA	Ninguna

apuntes

ARQUITECTURA " R I S C "

¿ EN QUE CONSISTE LA ARQUITECTURA RISC ?

Introducción.
Sun Microsystems ha diseñado la arquitectura RISC, llamada SPARC (Scalable Processor ARChitecture) o Arquitectura de Procesador Escalable, en que se enfatiza una amplia gama de aplicaciones tanto para máquinas pequeñas o grandes. El estandar SPARC es un sistema de arquitectura abierta, es decir, el diseño y sus especificaciones han sido publicados, permitiendo hoy en día diversos diseños de procesadores y muchas computadoras basadas en el diseño SPARC.
El término escalable se refiere al tamaño de las lineas del chip del procesador, debido a que el set de instrucciones del procesador es bajo (alrededor de un 10% de un procesador normal de tecnología CISC por ejemplo el Intel 8087), se facilita la construcción del procesador y como la tecnología es abierta existen muchos fabricantes para este tipo de procesadores. Cada tres a seis meses se esta liberando al mercado un procesador RISC más veloz, siempre basado sobre el mismo conjunto de instrucciones.

¿QUE ES RISC ?
Es una abreviatura de Conjunto Reducido de Instrucciones de Computador (Reduced Instruction Set Computer), es un tipo de arquitectura que enfatiza en la simplicidad y la eficiencia en el uso de la información.

En el diseño de los primeros computadores se noto que el 80% de los cálculos computacionales requerían sólo el 20% del conjunto de instrucciones en el procesador. Esto motivó el diseño de un nuevo procesador muy veloz, fácil de hacer y por lo tanto muy fácil de ir construyendo uno nuevo a medida que la tecnología avanza. Por otro lado la tecnología CISC abreviatura de Conjunto de Instrucciones Complejas de Computador (Complex Instruction Set Computer) ha crecido dando pasos muy lentos, por el grado de complejidad de sus operaciones, por ejemplo para pasar del Intel 8087 al Intel 80286, pasarón más de 5 años; además otra limitante es que la tecnología CISC tiene pocos fabricantes (Intel Corp. , Motorola Corp.)

Como conclusión tenemos que en la tecnología RISC la carga de procesos es muy baja, la velocidad muy alta y es extremadamente simple de fabricar el procesador.

Bajo la tecnología RISC se hace eficiente el uso del procesador, debido al diseño en el que se ejecutan las instrucciones más frecuentes en uso del software, por ejemplo un compilador de lenguaje C usa sólo el 30% del conjunto de instrucciones disponibles en un procesador CISC Motorola 68030.

Por la simplicidad del procesador, la arquitectura RISC es más portable que las tradicionales, debido a que es más facil de implementar, permitiendo una rápida integración a las nuevas tecnologías a medida que se desarrollan.

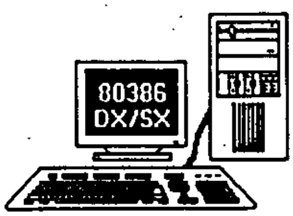
E I S A

Miembros del consorcio *EISA*:

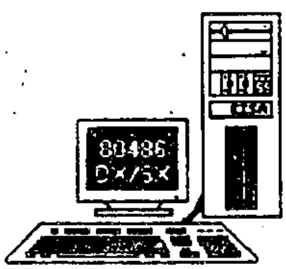
*AST Research
*Compaq
*Hewllett Packard
*NEC
*Zenith Data Systems
*Epson
*Olivetti
*Tandy
*Wyse Technology

apuntes

Características de las Computadoras



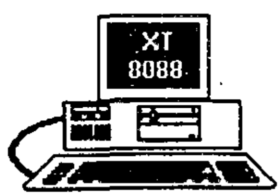
- Liberación México:1989
- Direccionamento:4GB
- Memoria Usuario:
  Limitante Tecnológica (64M
- Almacenamiento: en TB
- Velocidad: de 16 a 33 Mhz.



- Liberación México:1990
- Características:
  Similares al 80386
- Incluye Memoria Caché y
  Coprocesador Matemático
- Tecnología:RISC
- Velocidad:de 25 a 55 Mhz.

apuntes

Características de las Computadoras

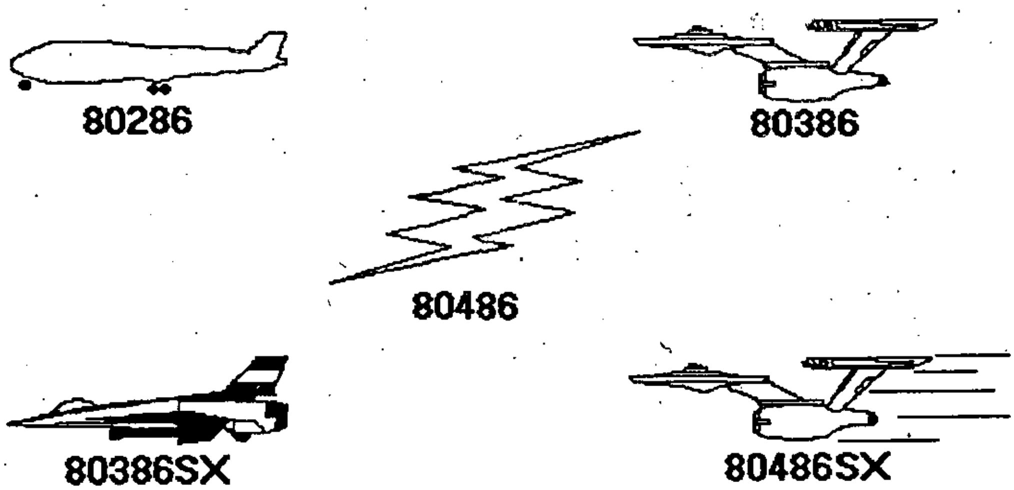


* Liberación México:1982
* Direccionamiento:1MB
* Memoria Usuario:640KB
* Almacenamiento:
  32MB (MS-DOS 2.xx)
  70MB (MS-DOS 3.xx)
  Tan grande como el disco duro (MS-DOS 4.xx y 5.xx)
* Velocidad:de 4.77 a 12 Mhz.
* Modo de operación:Real

* Liberación México:1986
* Direccionamiento:16MB
* Memoria Usuario:15MB
* Almacenamiento:2GB
* Velocidad:de 8 a 20 Mhz.
* Modos de operación:Real y Protegido

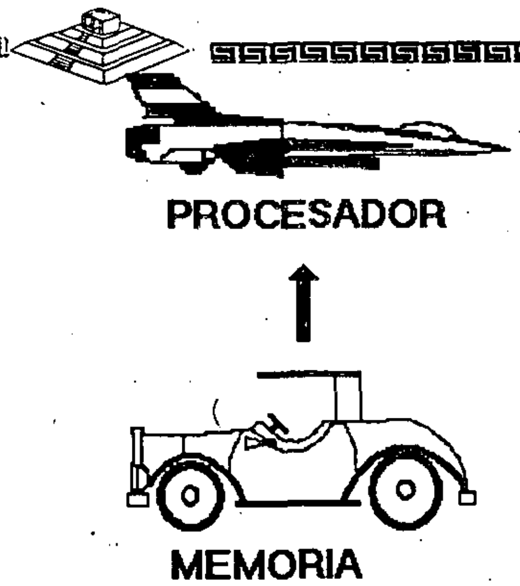
apuntes

EL MICROPROCESADOR



apuntes

LA MEMORIA

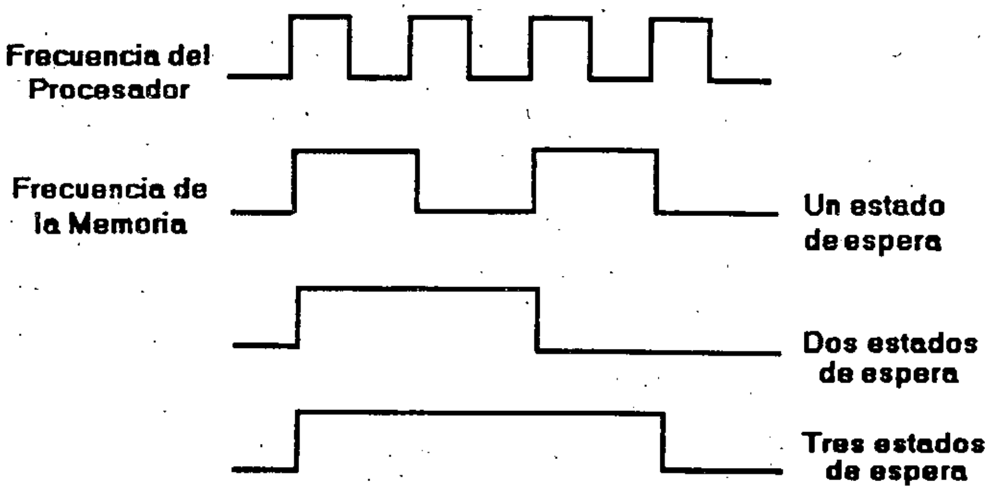


ESTRATEGIAS

- Simple DRAMS
- Simple SRAMS
- Interleaved RAM
- Page Mode
- Caching

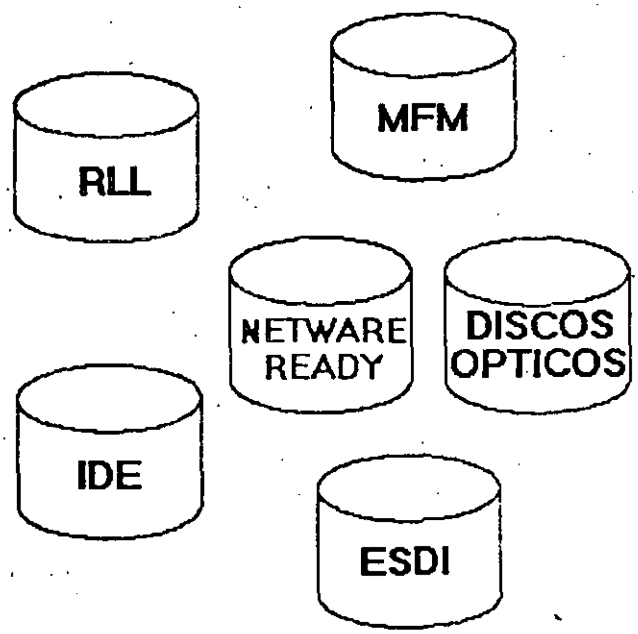
apuntes

Estados de Espera "Wait States"



apuntes

TIPOS DE CONTROLADORES



apuntes

Parámetros Para La Selección De Equipo

- Tecnología, arquitectura.
- Procesador y velocidad.
- Tipo de bios.
- Estados de espera.
- Tipo de disco duro.
- Capacidad de despliegue gráfico.
- Tipo de dispositivos.
- Penetración en el Mercado.
- Costo.

apuntes

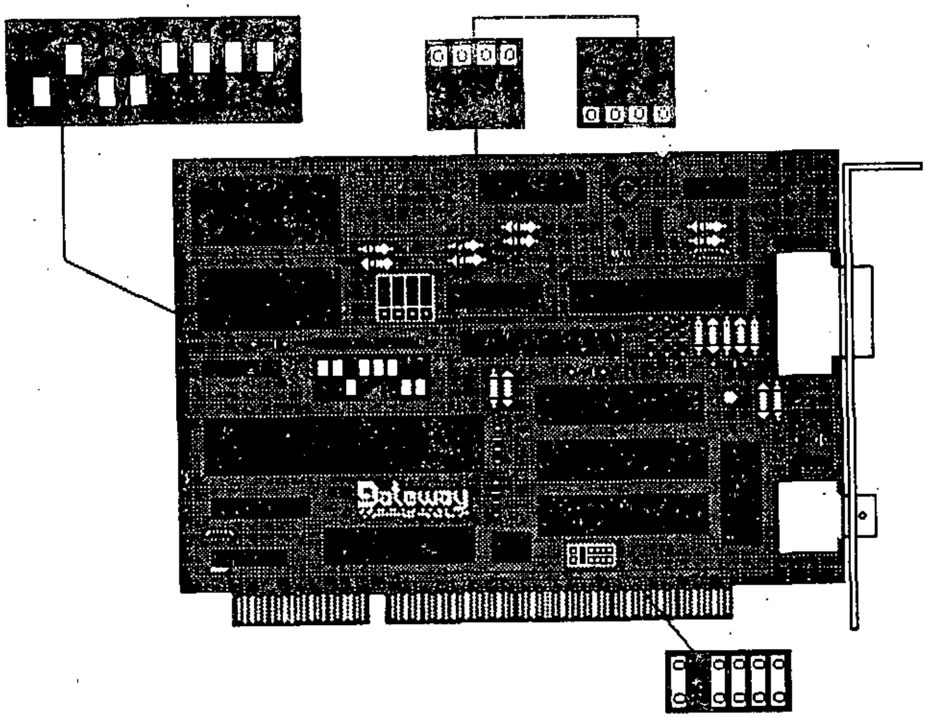
Parámetros Para La Selección De Hardware

- Tecnología ISA, EISA, MCA.
- Tamaño, palabra, 8, 16, 32 bits.
- Tamaño buffer memoria.
- Posibilidades de configuración.
  - IRQ.
  - I/O Address.
  - Memory Address.
  - D.M.A. (Inteligentes).
- Driver's y diagnósticos.

apuntes

HARDWARE

Estructura General ETHERNET



apuntes

Estructura General ETHERNET

CARACTERISTICAS

* Creada por Xerox (1970)
* Estándar más estable
* Muchos Ambientes
* "Difícil" de Instalar

apuntes

ESPECIFICACIONES TECNICAS

<table>
<tr><td>Velocided</td><td>10MBits/seg</td><td>Cableado</td></tr>
<tr><td>Protocolo</td><td>CSMA/CD</td><td rowspan="2">THICK (RG-11) 1500m
THIN (RG-58) 300m
Fibra Optica
Twisted Pair</td></tr>
<tr><td>Nodos</td><td>1 a 1023</td></tr>
</table>

apuntes

FABRICANTES MAS IMPORTANTES

3COM		MICRON
	GATEWAY	
EXCELAN		NOVELL

apuntes

VARIANTES EN TARJETAS PARA PC

* Tamaño del Buffer
* 8,16,32 ó MCA
* Uso de DMA
* Procesador

apuntes

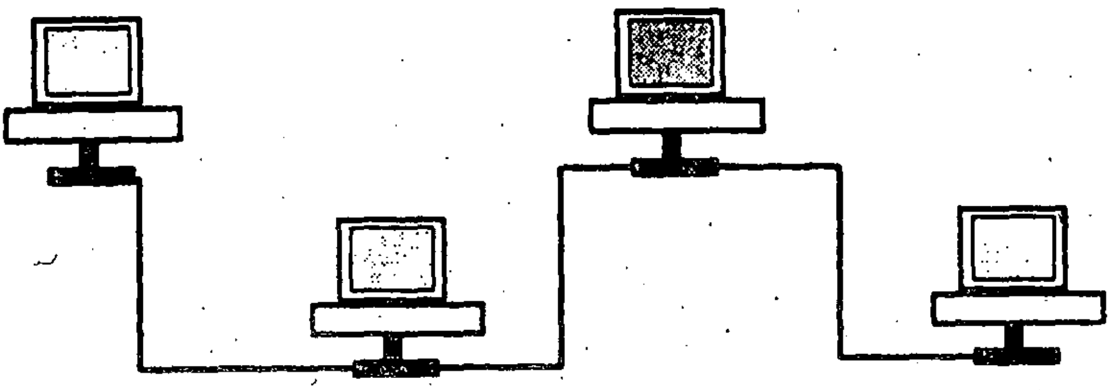
Estructura General ETHERNET

FORMATO DEL FRAME

Dirección Destino	Dirección Fuente	Tipo	Datos	CRC

apuntes

CONFIGURACION TIPO EN THINLAN

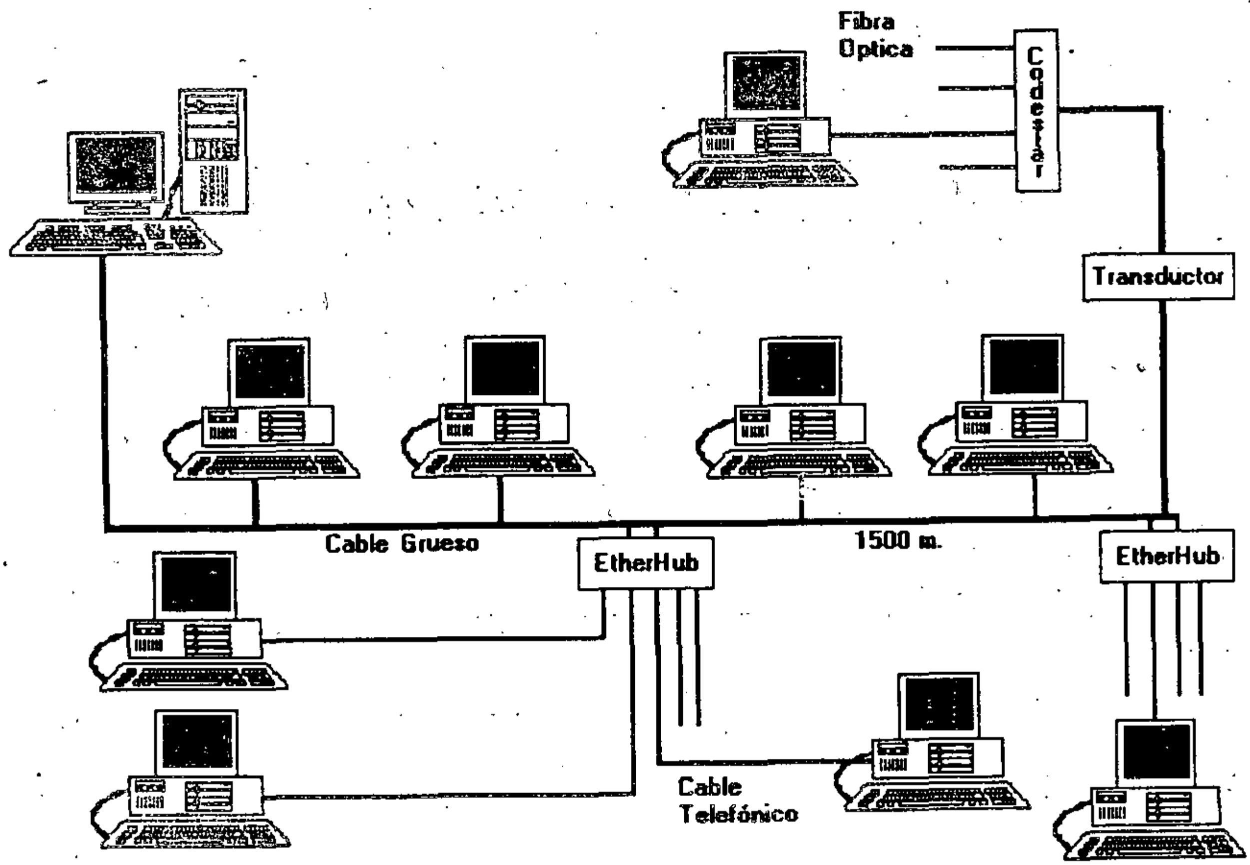


apuntes

ETHERNET

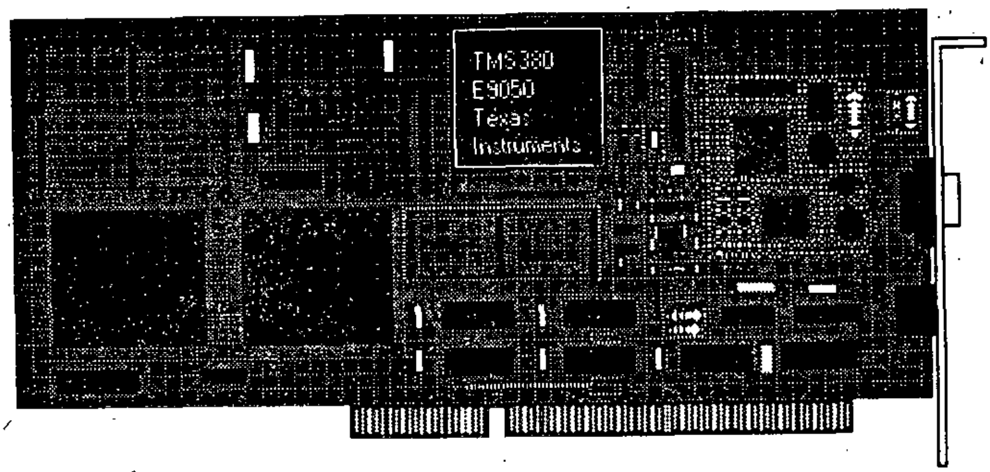
- 10 MBits/segundo
- Estándar mas utilizado mundialmente
- Rendimiento más alto (High Performance)
- Múltiples opciones de cableado
  - coaxial delgado (RG-58)
  - par telefónico (Twisted Pair)
  - fibra óptica
  - coaxial grueso (RG-11)
- Cableado sencillo y económico
- Conectividad hacia otros sistemas bajo Ethernet

Configuración Tipo ETHERNET



apuntes

TOKEN RING



apuntes

CARACTERISTICAS

* Creada por IBM
* Alta Conectividad en IBM
* Cableado Complejo
* Buen Rendimiento
* Opción de 4/16 MBits.

apuntes

Estructura General TOKEN RING

ESPECIFICACIONES TECNICAS

Velocidad	4/16 Mbits/s.
Protocolo	Token Passing
Nodos	1023
Instalación	MAUs

Cableado
STP/IBM tipo 2 UTP Fibra Optica

apuntes

FABRICANTES MAS IMPORTANTES

3COM	MICRON
IBM	
PROTEON	UNGERMAN-BASS

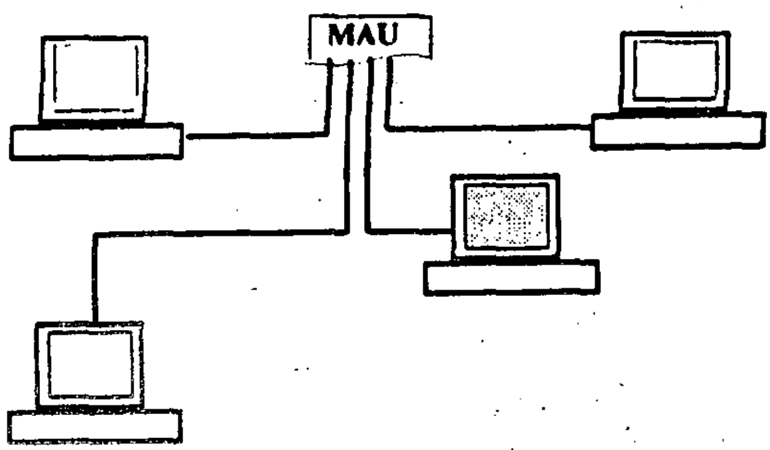
apuntes

FABRICACION

El conjunto de Chips para Token Ring se desarrolló conjuntamente entre IBM y Texas Instruments. Casi todas las tarjetas Token Ring se basan en el Chipset de T.I. (TMS380)

apuntes

CONFIGURACION TIPO EN TOKEN-RING

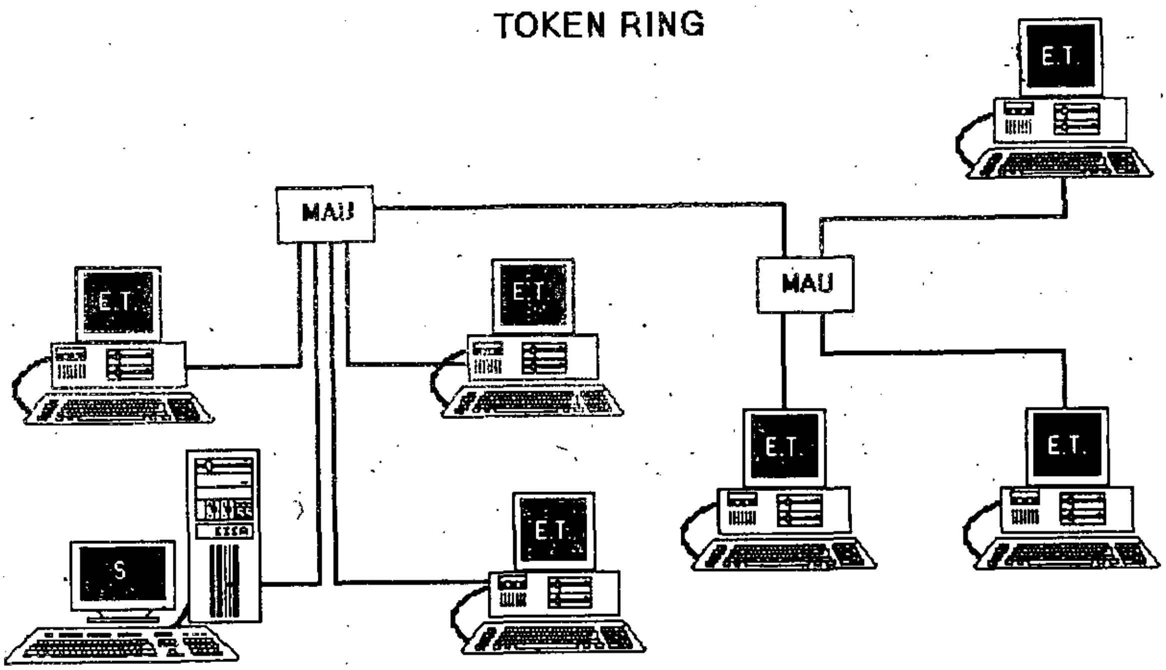


apuntes

TOKEN-RING

- 4 MBits/segundo
- Topología de estrella distribuída
- Protocolo Token Passing
- Cable IBM tipo 2
- Conectividad hacia ambientes IBM 3270 bajo Token Ring

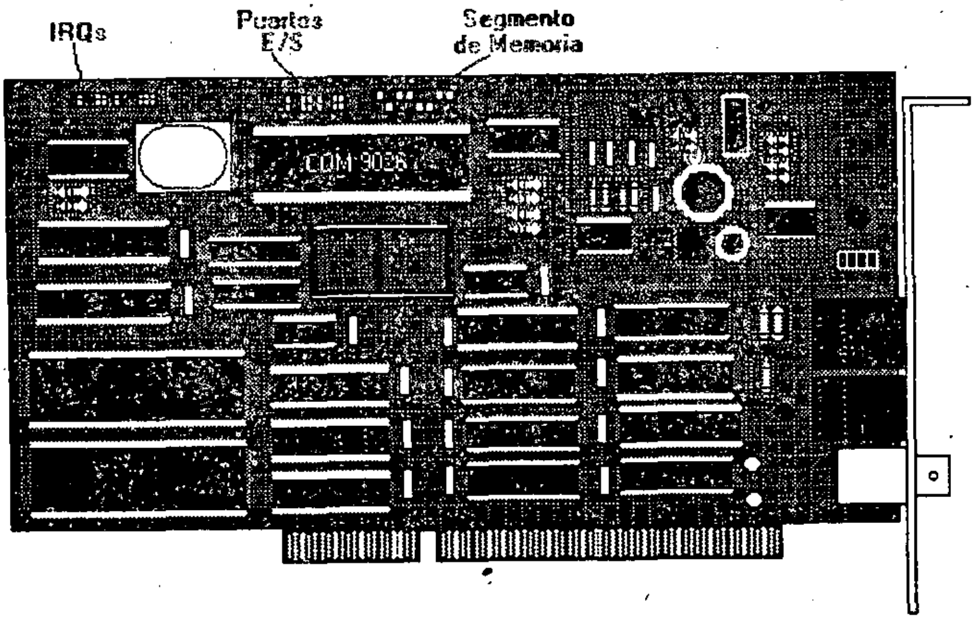
Estructura General TOKEN RING



apuntes

Estructura General ARCNET

SWITCHES



apuntes

Estructura General ARCNET

CARACTERISTICAS

* Creada por Datapoint
* Mejor Precio/Rendimiento
* Cableado muy versátil
* "Facil" de instalar

apuntes

Estructura General ARCNET

ESPECIFICACIONES TECNICAS

Velocidad	2.5 Mbits/s.
Protocolo	Token Passing
Nodos	1 a 255
Instalación	Repetidores A/P

Cableado
RG-62 / Bus-Star
Twisted Pair
Fibra Optica

apuntes

FABRICANTES MAS IMPORTANTES

DATAPOINT	STANDAR MICROSYSTEMS	MICRON
PURE DATA	THOMAS CONRAD	NOVELL

apuntes

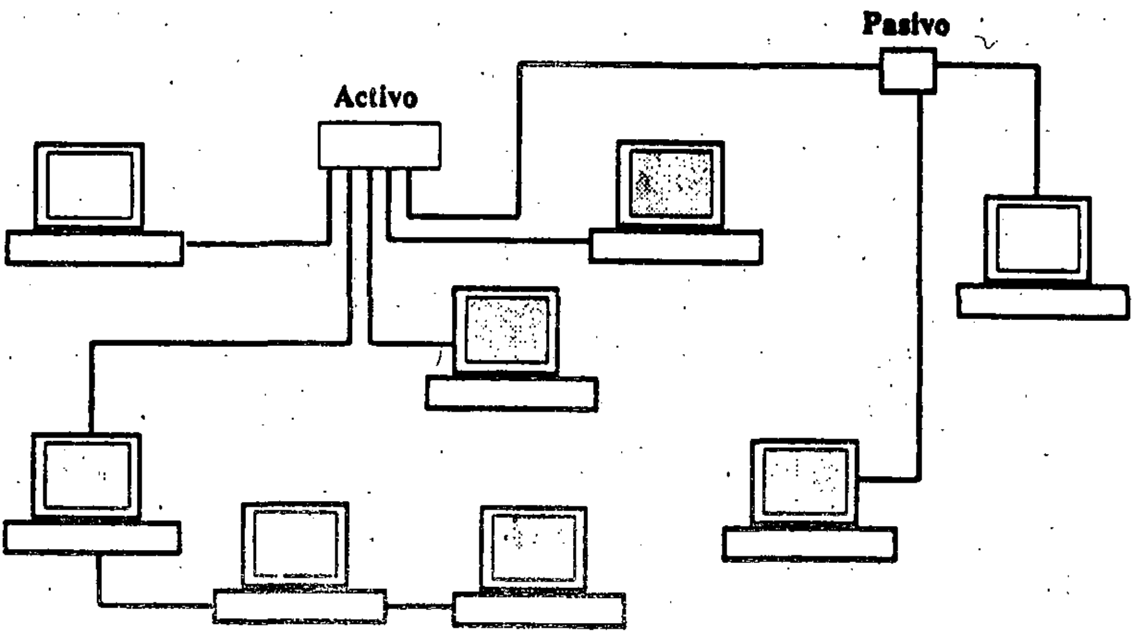
Estructura General ARCNET

FORMATO DEL FRAME

ALERT	SOH	SID	DID	DID	COUNT	DATOS	CRC	CRC

apuntes

CONFIGURACION TIPO EN ARCNET

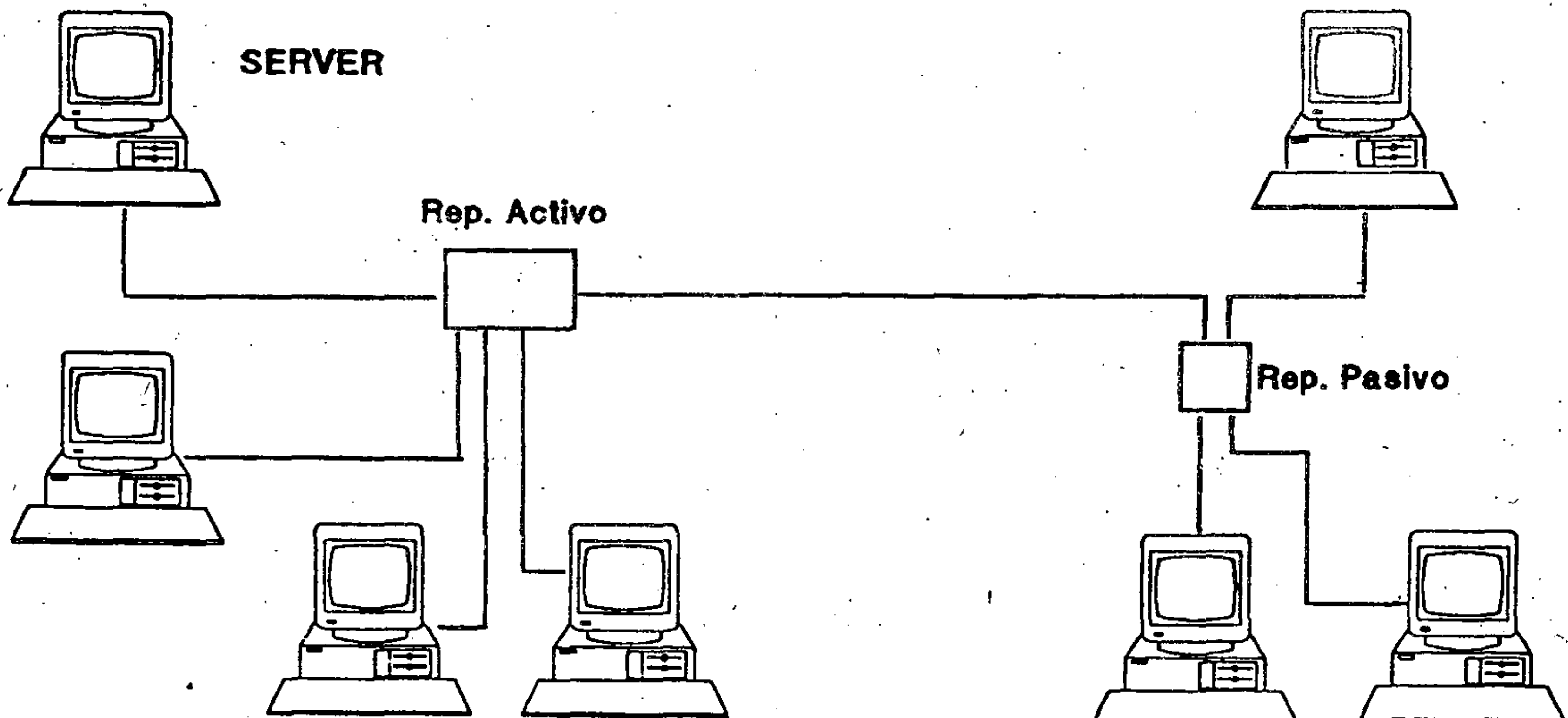


apuntes

ARCNET

- 2.5 MBits/segundo
- Topología de estrella distribuída
- Protocolo Token-passing
- Cable coaxial delgado (RG-62)
- Bajo costo
- Permite distancias grandes (hasta 6km)

ARCNET



GATEWAY

COMMUNICATIONS

Installation Guide

G/Ethernet™ 8-bit PC Adapter

G/Ethernet™ 8-bit WS Adapter

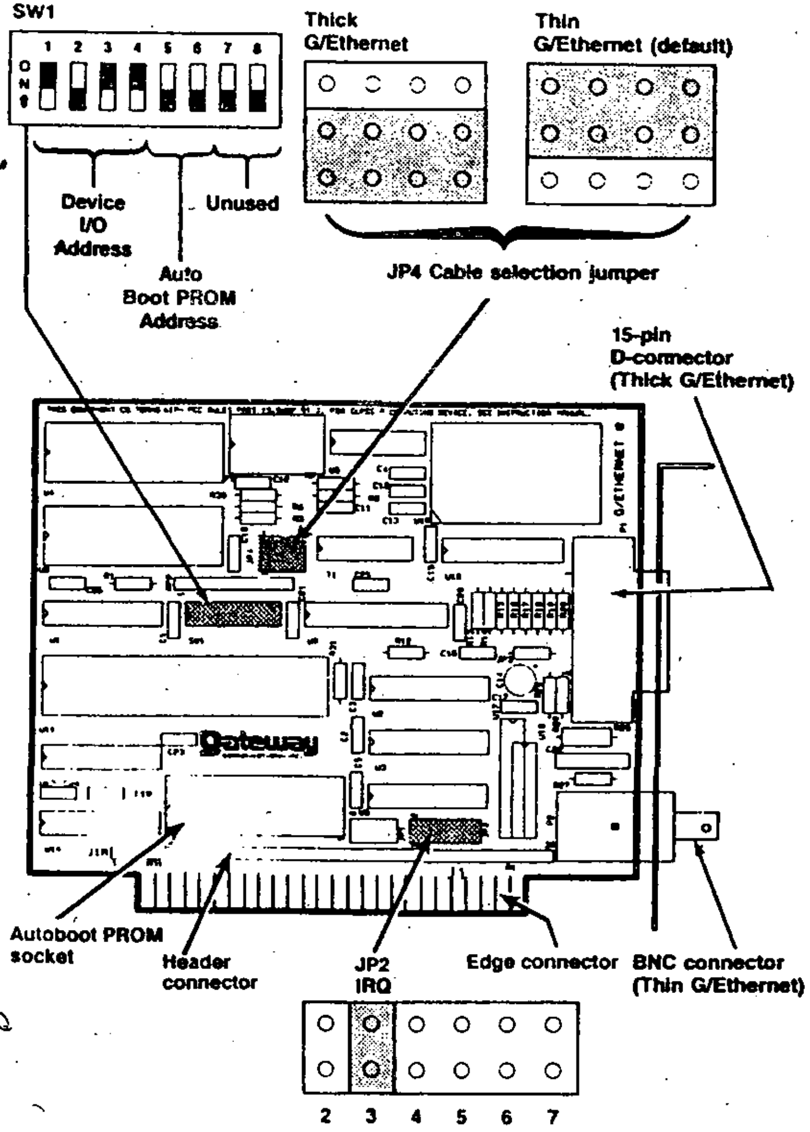


Figure 2-1. G/Ethernet 16-bit Component Locations.

SELECTING THE DEVICE I/O ADDRESS

The device I/O address allows the PC to locate and differentiate between installed devices. Switches 1, 2, 3, and 4 of switch block SW1 set the device I/O address. The default is 002A0-002BF (hexadecimal). Table 2-1 lists the available device I/O address ranges and their correct switch positions.

If you have installed an Autoboot PROM, select device I/O address 2A0h.

Table 2-1. Device I/O Address Selections.

Address Range	SW1-1	SW1-2	SW1-3	SW1-4
00280-0029F	ON	ON	ON	ON
002A0-002BF (1)	ON	OFF	ON	ON
002C0-002DF (2)	ON	ON	OFF	ON
002E0-002FF	ON	OFF	OFF	ON
00300-0031F (3)	ON	ON	ON	OFF
00320-0033F	ON	OFF	ON	OFF
00360-0037F (4)	ON	OFF	OFF	OFF

NOTES:

(1) Default

(2) Both IRQ2 and IRQ3 are available with this address

(3) Possible conflict with some tape devices

(4) IBM LAN default

Table 2-3 lists the IRQ and device I/O address combinations that are selectable through the NetWare software installation process. Be sure that the device I/O and IRQ setting you have selected matches one of those combinations. Refer to Selecting the Software Configuration in this section for more details.

SETTING THE AUTOBOOT PROM ADDRESS

The Autoboot PROM address allows the PC to locate the Autoboot PROM. If you cannot use the default, CC000h-CFFFFh, select a new address by setting switches 5 and 6 of switch block SW1 (Figure 2-1) according to the Table 2-2.

The Autoboot PROM requires IRQ 3 and device I/O address 2A0h.

Table 2-2. Autoboot PROM Address Ranges.

Address Range	SW1-5	SW1-6
C0000-C3FFF (1)	ON	ON
C4000-C7FFF (2)	OFF	ON
C8000-CBFFF (2)	ON	OFF
CC000-CFFFF* (2)	OFF	OFF

NOTES:

* Default address

(1) Possible conflict with hard disk controller or VGA and EGA adapters

(2) Possible conflict with EMS memory or LAN adapters

SELECTING COMPATIBILITY

The G/Ethernet 16-bit adapter is compatible with most PC motherboards. If you experience intermittent failures when booting the PC, the PC locks up, or you receive continous network error messages, and you cannot attribute these problems to incorrect software installation, poor cable connection, or faulty hardware, then you may need to change the compatibily jumper, JP5.

JP5 has one column of three pins with one jumper installed. Select position A (default) by strapping the top and middle pins (Figure 2-1). Select position B by strapping the middle and bottom pins.

If the problem still occurs refer to the Diagnostic and the Troubleshooting sections of this manual.

SELECTING THE SOFTWARE CONFIGURATION

During the NetWare installation process, you will need to select the IRQ and device I/O settings to match the adapter. Table 2-3 lists the combinations that will display for the NetWare Configure Drivers/Resource option. Verify that one of these combinations matches the adapter's hardware settings.

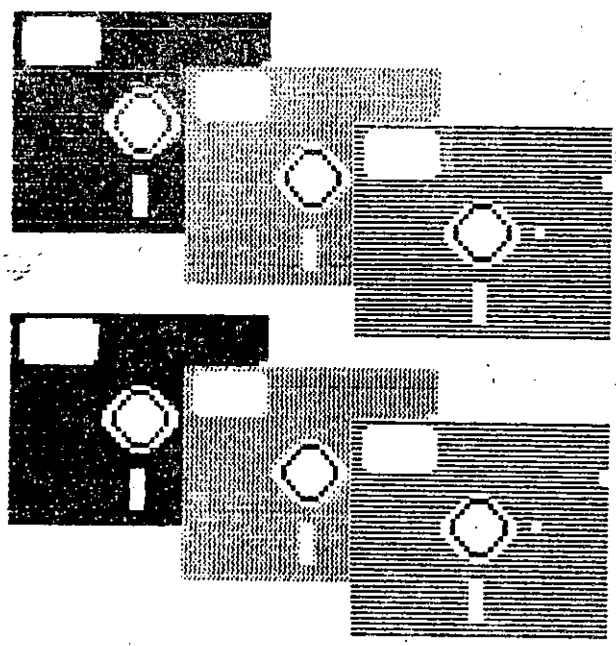
Table 2-3. Predefined Address Selections.

Number	Configuration Definition	Conflicting Devices
0*	IRQ 3, Device I/O Address 002A0h	COM2 (IRQ only)
1	IRQ 5, Device I/O Address 00280h	Tape Controller
2	IRQ 3, Device I/O Address 002E0h	COM2
3	IRQ 5, Device I/O Address 00320h	XT hard disk cont.
4	IRQ 7, Device I/O Address 00360h	LPT1
5	IRQ 3, Device I/O Address 00300h	COM2 (IRQ only)
6	IRQ 3, Device I/O Address 002C0h	COM2 (IRQ only)
7	IRQ 2, Device I/O Address 002C0h	EGA (IRQ only)

* Default

SOFTWARE Y SISTEMAS OPERATIVOS

GENERACION S.O. SERVER



NETGEN
SUPPORT
AUXGEN
GENDATA
DSK_DRV_001
LAN_DRV_001
UTILOBJ-1
UTILOBJ-2
ANDOBJ
ADOBJ
OSOBJ
OSEXE-1
OSEXE-2
UTILEXE-1
UTILEXE-2
DSK_DRV_209
LAN_DRV_207

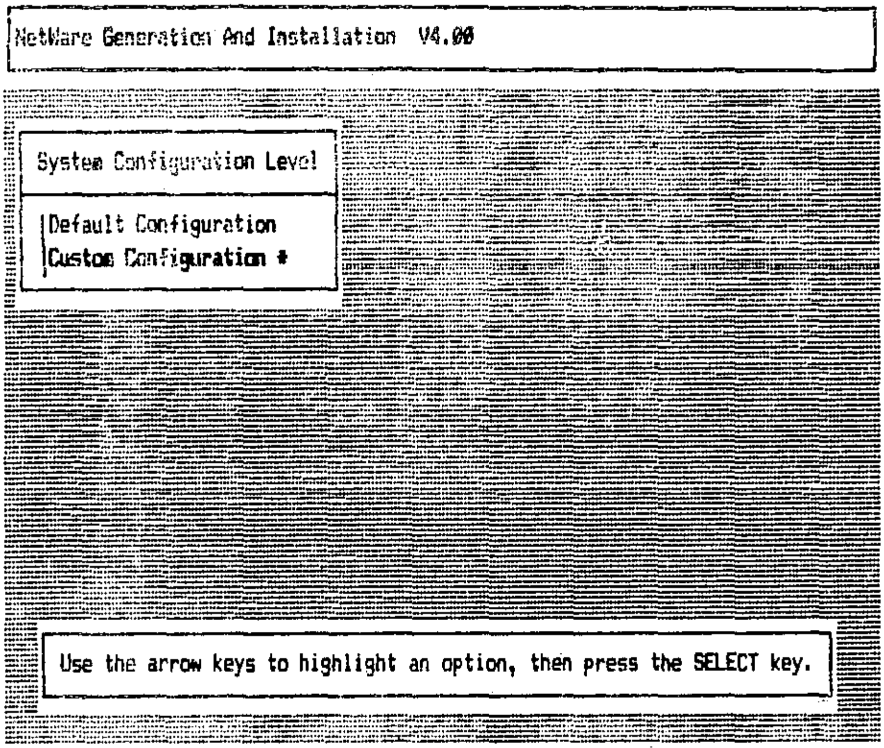
apuntes

GENERACION S.O. SERVER

```
A:\>dir

 Volume in drive A is NETGEN
 Directory of  A:\

NETGEN    EXE     37601   8-18-88   9:53a
VOLUMES   DAT        88   1-11-88   9:42a
$RUN      OVL      2400   7-13-89   9:30a
NINSTALL  EXE    142739   1-25-89   3:57p
UTILS     DAT       131   8-25-87   4:02p
CMPQ$RUN  OVL      2400   7-26-89  10:26p
IBM$RUN   OVL      2400   7-13-89   9:30a
INSTOVL   EXE    135514   5-04-92  10:00p
        8 File(s)     33792 bytes free

A:\>netgen/?
Usage:  netgen [-[n][c|d][s]]
        Where n = New System Generation
              c = Custom Configuration
              d = Default Configuration
              s = Standard Drive usage
A:\>netgen -n
Insert disk SUPPORT in any drive.
```

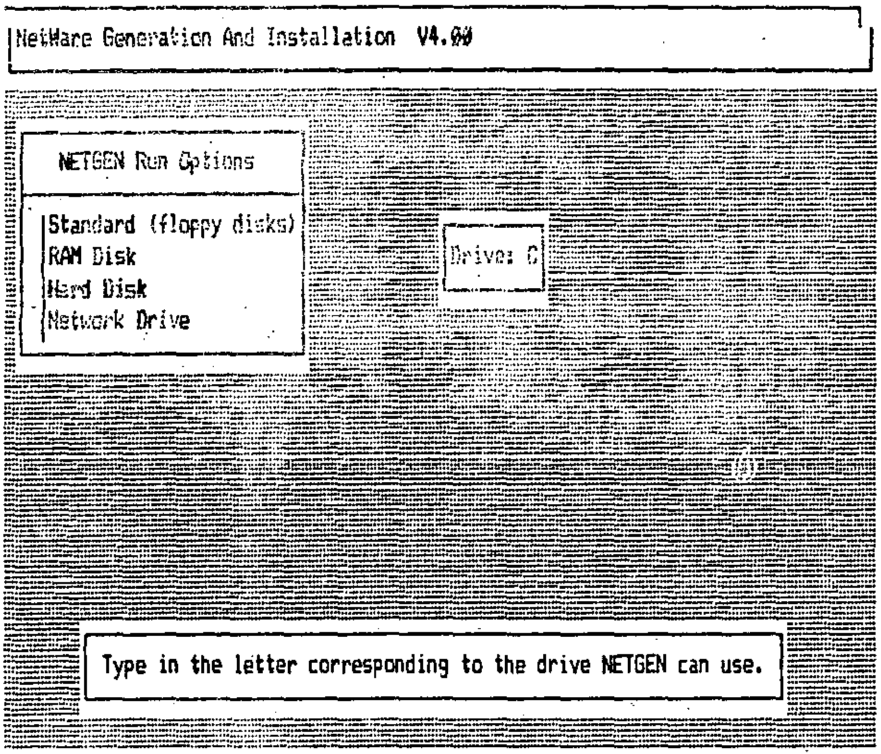
apuntes

GENERACION S.O. SERVER



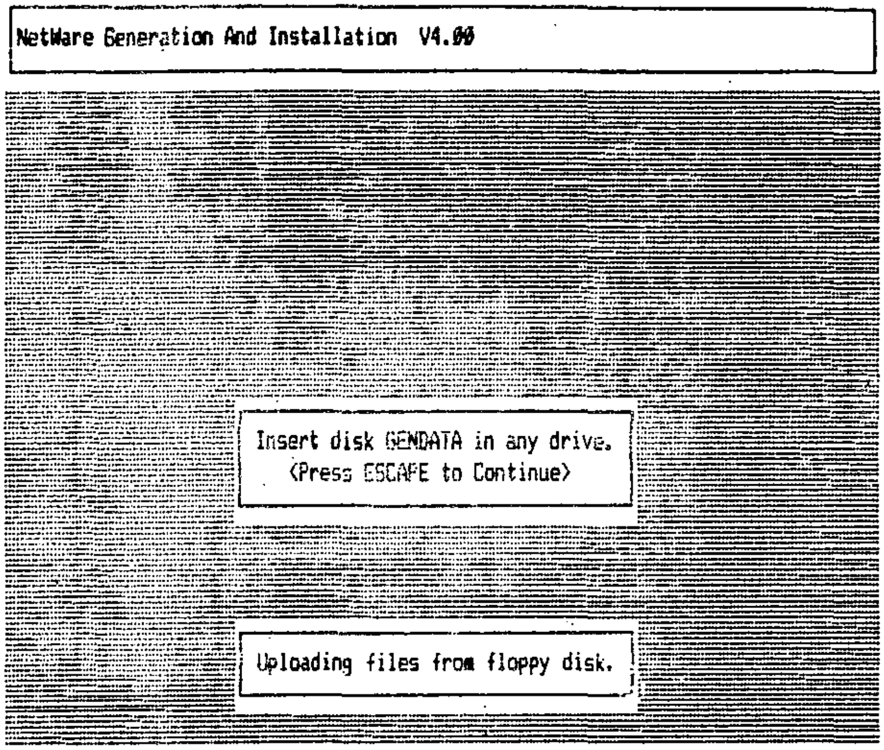
apuntes

GENERACION S.O. SERVER



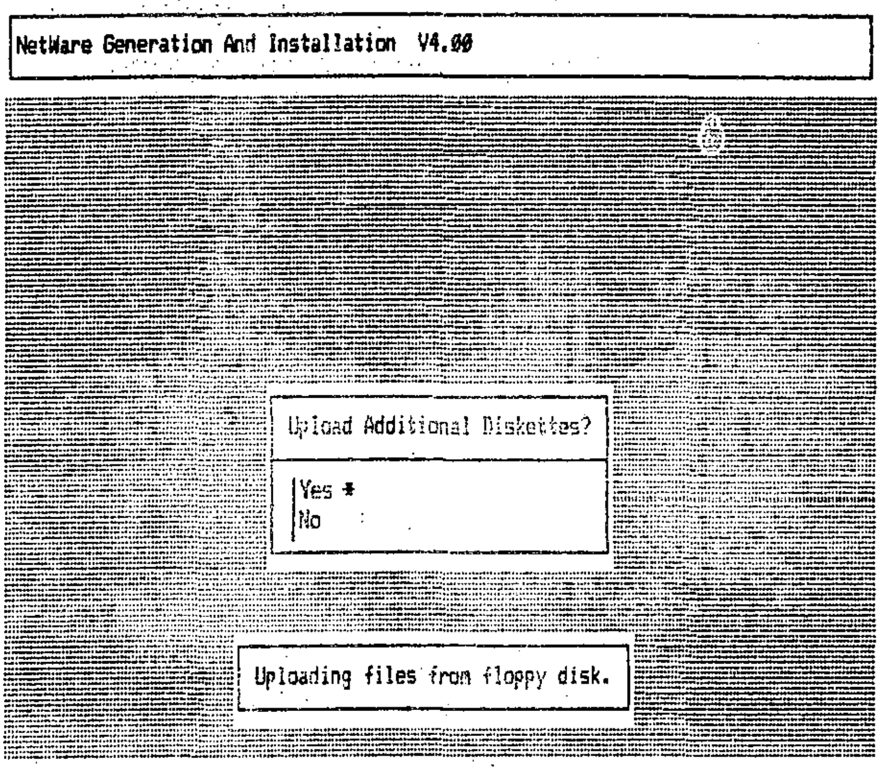
apuntes

GENERACION S.O. SERVER



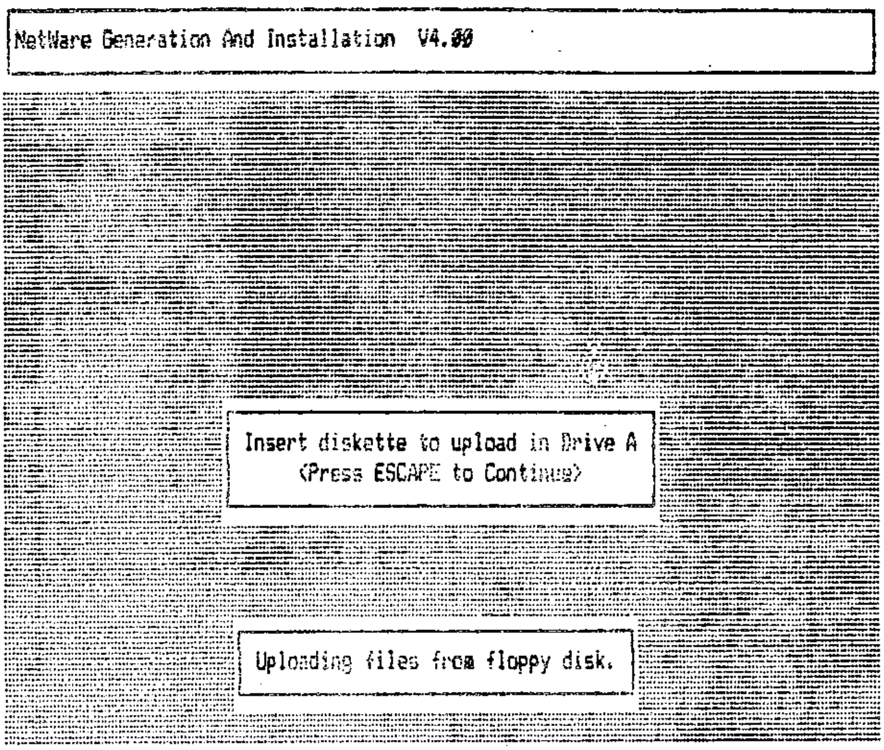
apuntes

GENERACION S.O. SERVER



apuntes

GENERACION S.O. SERVER



apuntes

GENERACION S.O. SERVER

NetWare Generation And Installation V4.60

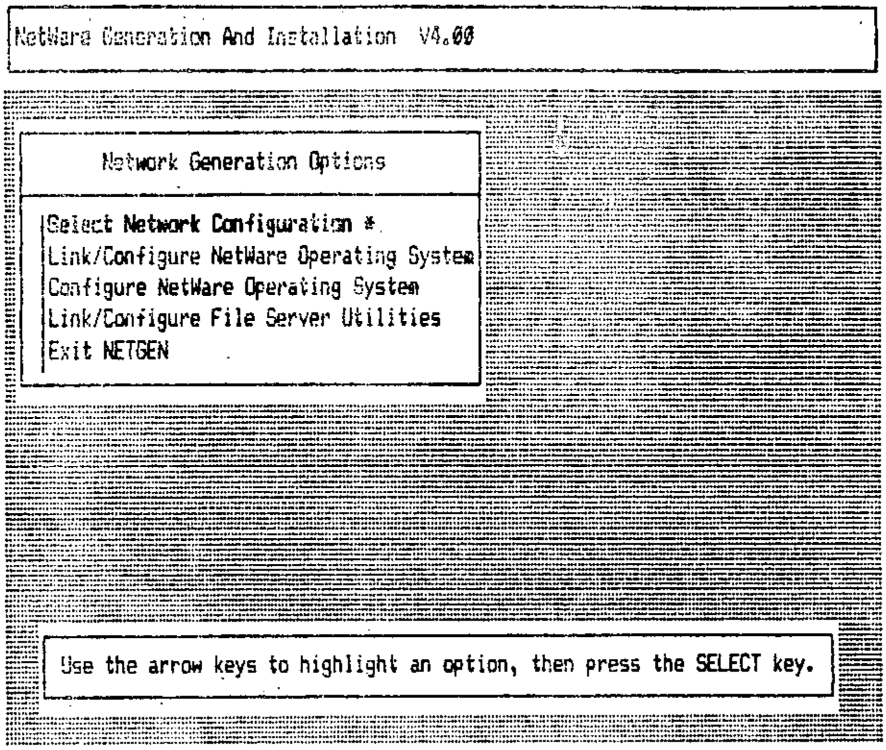
Network Generation Options

- Select Network Configuration
- Link/Configure NetWare Operating System
- Configure NetWare Operating System
- Link/Configure File Server Utilities
- Exit NETGEN

Use the arrow keys to highlight an option, then press the SELECT key.

apuntes

GENERACION S.O. SERVER



apuntes

GENERACION S.O. SERVER

Network Configuration V4.02 Wednesday July 11, 1990 12:53 pm

Available Options

- Set Operating System Options*
- Select Resource Sets
- Select LAN Drivers
- Select Disk Drivers
- Select "Other" Drivers
- Configure Drivers / Resources
- Edit Resource List
- Edit Resource Sets
- Save Selections and Continue

Set Operating System Options

- Advanced NetWare 286 / Dedicated*
- Advanced NetWare 286 / Nondedicated

Highlight an option, then press the SELECT key.

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02            Wednesday  July 11, 1990  12:55 pm

        Available Options

 Set Operating System Options
 Select Resource Sets
 Select LAN Drivers
 Select Disk Drivers
 Select "Other" Drivers
 Configure Drivers / Resources
 Edit Resource List
 Edit Resource Sets  *
 Save Selections and Continue

Use the arrow keys to highlight an option, then press the SELECT key.
```

apuntes

GENERACION 5.0. SERVER

```
Network Configuration  V4.02              Wednesday  July 11, 1990  12:56 pm

                          Resource Sets

 COM6 (Micro Channel Only)
 COM7 (Micro Channel Only)
 COM8 (Micro Channel Only)
 PS/2 Math Coprocessor
 IBM PS/2 Model 70 File Server
 Novell 386A or 386AE File Server
 IBM PS/2 Model 50 or 50Z File Server
 ISA or AT Compatible File Server

 SELECT (Enter)  Edit highlighted item.   INSERT (Ins)  Add new item.
 DELETE (Del)    Delete marked item(s).   MODIFY (F3)   Change item name.
 MARK   (F5)     Mark highlighted item.   UNMARK (F7)   Unmark all items.
     Press ESCAPE to save changes and return to the preceding screen.
```

apuntes

Network Configuration V4.02 Wednesday July 11, 1990 12:58 pm

Available Options

- Set Operating System Options
- Select Resource Sets
- **Select LAN Drivers ***
- Select Disk Drivers
- Select "Other" Drivers
- Configure Drivers / Resources
- Edit Resource List
- Edit Resource Sets
- Save Selections and Continue

Use the arrow keys to highlight an option, then press the SELECT key.

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02                Wednesday July 11, 1990  12:59 pm

                          Selected LAN Drivers

 Se
 Se
 Se                                                         <INS>
 Se
 Se
 Co
 Ed                       Available LAN Drivers
 Ed
 Sa   ACCTON ACC-10 Ethernet-8W Netware 2.15 Drive V2.00-R01 (03-21-19
      G/Ethernet AT by Gateway Communications, Inc., V2.A0
      G/Ethernet EC PC by Gateway Communications, Inc., V2.:

          Highlight a list entry, then press the SELECT key.
```

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.62            Wednesday, July 11, 1990  1:00 pm

                        Selected LAN Drivers

 |Se |A: G/Ethernet AT by Gateway Communications, Inc., V2.A0
 |Se |
 |Se |
 |Se |
 |Se |
 |Configure Drivers / Resources|
 |Edit Resource List
 |Edit Resource Sets          LAN Driver Options
 |Save Selections and Con
                             |Select Loaded Item #
                             |Load and Select Item
                             |Deselect an Item

  Use the arrow keys to highlight an option, then press the SELECT
  (Enter) key.  Press ESCAPE to save selections and continue.
```

apuntes

GENERACION S.O. SERVER

Network Configuration V4.02 Wednesday July 11, 1990 1:01 pm

Selected LAN Drivers

Se
Se
Se
Se
Se
Co
Ed
Ed
Sa

A: G/Ethernet AT by Gateway Communications, Inc., V2.A0

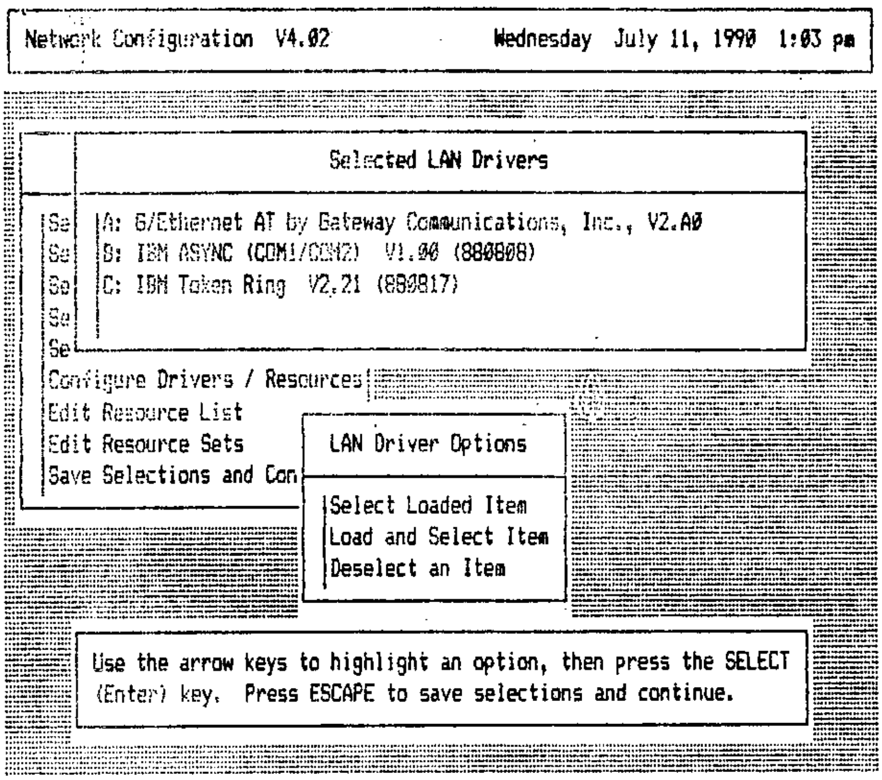
Available LAN Drivers

G/Ethernet AT by Gateway Communications, Inc., V2.A0
G/Ethernet EC PC by Gateway Communications, Inc., V2.:
IBM ASYNC (COM1/COM2) V1.00 (880808) *
IBM PCN II & Baseband (Alternate) V1.00 (881021)
IBM PCN II & Baseband (Primary) V1.00 (881021)

Highlight a list entry, then press the SELECT key.

apuntes

GENERACION S.O. SERVER



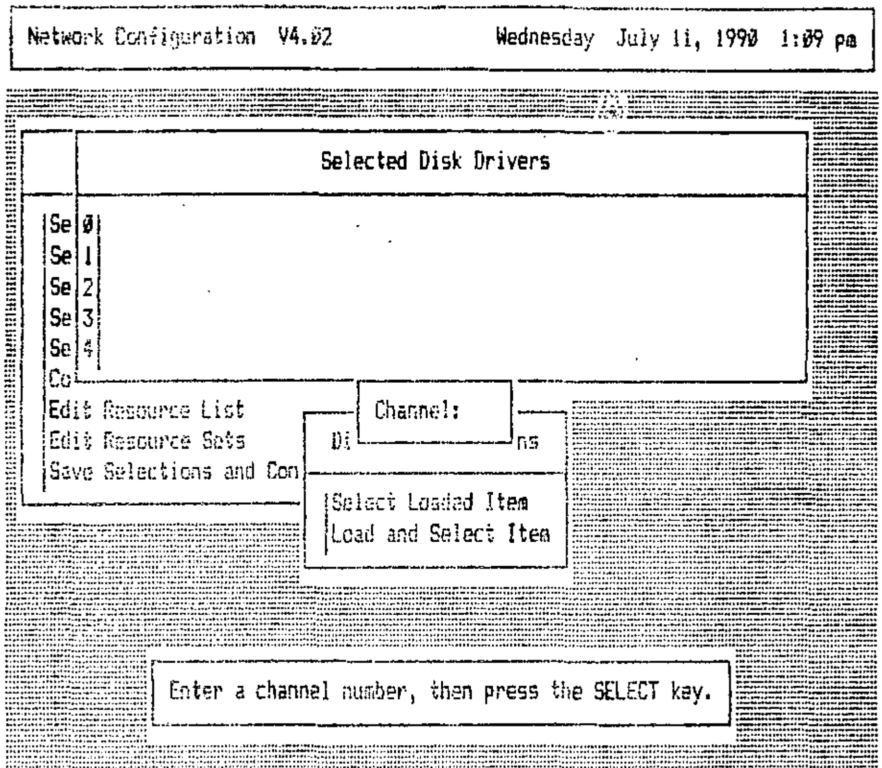
apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02            Wednesday  July 11, 1990  1:04 pm

   Available Options

  Set Operating System Options
  Select Resource Sets

  Select Disk Drivers *
  Select "Other" Drivers
  Configure Drivers / Resources
  Edit Resource List
  Edit Resource Sets
  Save Selections and Continue
```

apuntes

GENERACION S.O. SERVER



apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02               Wednesday  July 11, 1990  1:21 pm

              Selected Disk Drivers

|Se|0|
|Se|1|
|Se|2|
|Se|3|
|Se|4|
|Co
|Ed           Select Disk Driver Type
|Ed
|Sa |Adaptec AHA-154x/1640 Host Adapter ver2.1
    |IBM PS/2 Model 30 286 MFM disk controller  V1.01 (881028)
    |Industry Standard ISA or AT Comp. Disk Cont. V2.01 (890810) *

     Highlight a list entry, then press the SELECT key.
```

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02                Wednesday  July 11, 1990  1:26 pm

                         Selected Disk Drivers

|Se|0|Industry Standard ISA or AT Comp. Disk Cont. V2.01 (890810)
|Se|1|
|Se|2|
|Se|3|
|Se|4|
|Co
|Edit Resource List
|Edit Resource Sets          Disk Driver Options
|Save Selections and Con
                            |Select Loaded Item
                            |Load and Select Item
                            |Deselect an Item

  Use the arrow keys to highlight an option, then press the SELECT
  (Enter) key.  Press ESCAPE to save selections and continue.
```

apuntes

GENERACION S.O. SERVER

```
Network Configuration, V4.02            Wednesday  July 11, 1990  1:30 pm

        Available Options

  Set Operating System Options
  Select Resource Sets
  Select LAN Drivers
  Select Disk Drivers
  Select "Other" Drivers
  Configure Drivers /Resources
  Edit Resource List
  Edit Resource Sets
  Save Selections and Continue

Use the arrow keys to highlight an option, then press the SELECT key.
```

apuntes

GENERACION S.O. SERVER

Network Configuration V4.02 Wednesday July 11, 1990 1:39 pm

Available Options

- Set Operating System Options
- Select Resource Sets
- Select LAN Drivers

Configure Drivers / Resources

- Choose LAN Configuration
- Enter Server Information
- Release Disk Drive Configuration

Use the arrow keys to highlight an option, then press the SELECT (Enter) key. Press ESCAPE to save selections and continue.

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02            Wednesday  July 11, 1990  1:40 pm

                     Unconfigured LAN Drivers

A: G/Ethernet AT by Gateway Communications, Inc., V2.A0   *
B: IBM ASYNC (COM1/COM2)  V1.00 (880098)
C: IBM Token Ring  V2.21 (890817)

        Highlight a list entry, then press the SELECT key.
```

apuntes

GENERACION S.O. SERVER

Network Configuration V4.Ø2 Wednesday July 11, 199Ø 1:4Ø pm

Unconfigured LAN Drivers

Available LAN Configurations

Ø: IRQ = 3, I/O Base = 2AØh, no DMA or ROM
1: IRQ = 4, I/O Base = 28Øh, no DMA or ROM
2: IRQ = 5, I/O Base = 2EØh, no DMA or ROM
3: IRQ = 2, I/O Base = 32Øh, no DMA or ROM
4: IRQ = 1Ø, I/O Base = 36Øh, no DMA or ROM
5: IRQ = 11, I/O Base = 3ØØh, no DMA or ROM
6: IRQ = 12, I/O Base = 2CØh, no DMA or ROM
7: IRQ = 15, I/O Base = 34Øh, no DMA or ROM

Highlight a configuration, then press the SELECT key.

apuntes

GENERACION S.O. SERVER

Network Configuration V4.02 Wednesday July 11, 1990 1:42 pm

Available Options

Set Operating System Options
Select Resource Sets
Select LAN Drivers

Configure Drivers / Resources

Choose LAN Configuration *
Enter Server Information
Release LAN Configuration
Release Disk Drive Configuration

Use the arrow keys to highlight an option, then press the SELECT (Enter) key. Press ESCAPE to save selections and continue.

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02                Wednesday  July 11, 1990  1:42 pm

                       Unconfigured LAN Drivers

 C: IBM Token Ring  V2.21 (880817)

 Release Disk Drive Configuration

              Highlight a list entry, then press the SELECT key.
```

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02                Wednesday  July 11, 1990  1:43 pm

                         Unconfigured LAN Drivers

                       Available LAN Configurations

 0: Token Ring Primary Adapter, IRQ = 2, IO = A20h, Mem = CC00h & D800h *
 1: Token Ring Alternate Adapter, IRQ = 3, IO = A24h, Mem = CE00h & D400h
 2: Token Ring Alternate Adapter, IRQ = 7, IO = A24h, Mem = C400h & C000h
 5: Token Ring Primary Adapter, IRQ = 3, IO = A20h, Mem = CC00h & D800h
 6: Token Ring Primary Adapter, IRQ = 3, IO = A20h, Mem = CE00h & D400h
 7: Token Ring Primary Adapter, IRQ = 7, IO = A20h, Mem = C800h & CC00h
 8: Token Ring Primary Adapter, IRQ = 2, IO = A20h, Mem = C800h & CC00h
 9: Token Ring Alternate Adapter, IRQ = 7, IO = A24h, Mem = D200h & DC00h

          Highlight a configuration, then press the SELECT key.
```

apuntes

GENERACION S.O. SERVER

Network Configuration V4.02 Wednesday July 11, 1990 1:45 pm

Available Options

- Set Operating System Options
- Select Resource Sets
- Select LAN Drivers

Configure Drivers / Resources

- Enter Server Information *
- Release LAN Configuration
- Release Disk Drive Configuration

Use the arrow keys to highlight an option, then press the SELECT (Enter) key. Press ESCAPE to save selections and continue.

apuntes

```
Network Configuration  V4.02                Wednesday  July 11, 1990  1:47 pm

                         File Server Information

|Se|  A: G/Ethernet AT by Gateway Communications, Inc., V2.A0
|Se|        Network Address: 00000001
|Se|  B: IBM ASYNC (COM1/COM2)  V1.00 (880908)
            Network Address: 00000002
 Co|  C: IBM Token Ring  V2.21 (880817)
            Network Address: 00000003
|En|  Communication Buffers: 40
|Re
|Release Disk Drive Configuration|

 Use the arrow keys to highlight the desired field, then type in the
 desired data.  Press the ESCAPE key to save selections and continue.
```

apuntes

GENERACION S.O. SERVER

Network Configuration V4.02 — Wednesday July 11, 1990 1:48 pm

Available Options

- Set Operating System Options
- Select Resource Sets
- Select LAN Drivers

Configure Drivers / Resources

- Choose Disk Driver Configuration
- Enter Server Information
- Release LAN Configuration

Use the arrow keys to highlight an option, then press the SELECT (Enter) key. Press ESCAPE to save selections and continue.

apuntes

GENERACION S.O. SERVER

```
Network Configuration  V4.02          Wednesday  July 11, 1990  1:49 pm

                     Unconfigured Disk Drivers

 0: Industry Standard ISA or AT Comp. Disk Cont. V2.01 (890810

          Highlight a list entry, then press the SELECT key.
```

apuntes

GENERACION S.O. SERVER

Network Configuration V4.Ø2 Wednesday July 11, 199Ø 1:49 pm

Unconfigured Disk Drivers

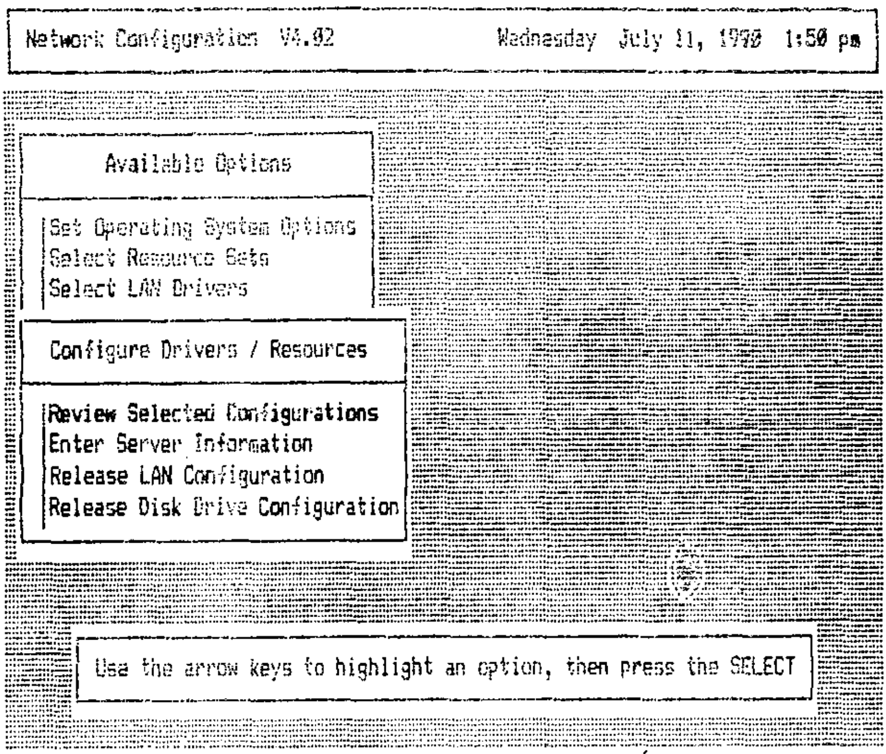
Available Disk Configurations

Ø:	ISADISK	PRIMARY	Verify=ON	I/O=1FØh	IRQ=14*
1:	ISADISK	PRIMARY	Verify=OFF	I/O=1FØh	IRQ=14
2:	ISADISK	SECONDARY	Verify=ON	I/O=17Øh	IRQ=11
3:	ISADISK	SECONDARY	Verify=ON	I/O=17Øh	IRQ=12
4:	ISADISK	SECONDARY	Verify=ON	I/O=17Øh	IRQ=14
5:	ISADISK	SECONDARY	Verify=ON	I/O=17Øh	IRQ=15
6:	ISADISK	SECONDARY	Verify=OFF	I/O=17Øh	IRQ=11
7:	ISADISK	SECONDARY	Verify=OFF	I/O=17Øh	IRQ=12

Highlight a configuration, then press the SELECT key.

apuntes

GENERACION S.O. SERVER



apuntes

GENERACION S.O. SERVER

```
                    Selected Configurations

LAN A: G/Ethernet AT by Gateway Communications, Inc., V2.AØ
       Option 2: IRQ = 5, I/O Base = 2EØh, no DMA or ROM
       Network Address: ØØØØØØØ1
LAN B: IBM ASYNC (COM1/COM2)  V1.ØØ (ØØØØØ8)
       Option Ø: COM1: IRQ = 4, IO Address = 3FØh, No DMA, No RAM, No ROM
       Network Address: ØØØØØØØ2
LAN C: IBM Token Ring  V2.21 (89Ø817)
       Option Ø: Token Ring Primary Adapter, IRQ = 2, IO = A2Øh, Mem =
                 CCØØh & D8ØØh
       Network Address: ØØØØØØØ3
Communication Buffers: 4Ø

Disk Chan. Ø: Industry Standard ISA or AT Comp. Disk Cont. V2.Ø1 (89Ø81Ø)
              Option Ø: ISADISK     PRIMARY      Verify=ON     I/O=1FØh
                        IRQ=14

Resource Set  1: ISA or AT Compatible File Server
   Resource  1: AT Auxiliary ROM
          Option  Ø: Mem EØØØh-EFFFh
   Resource  2: Western Digital Floppy Controller
          Option  Ø: IRQ=6, I/O Base=3FØh, DMA=2
```

apuntes

GENERACION S.O. SERVER

Network Configuration V4.02 Wednesday July 11, 1990 1:55 pm

Available Options

Set Operating System Options
Select Resource Sets
Select LAN Drivers
Select Disk Drivers
Select "Other" Drivers
Configure Drivers / Resources
Edit Resource List
Edit Resource Sets
Save Selections and Continue*

Continue Network Generation Using Selected Configuration?

No
Yes *

apuntes

GENERACION S.O. SERVER

```
NetWare Generation And Installation  V4.00

        Network Generation Options

 Select Network Configuration
 Link/Configure NetWare Operating System
 Link/Configure File Server Utilities
 Exit NETGEN

 Use the arrow keys to highlight an option, then press the SELECT key.
```

apuntes

SERVIDORES

TALLER DE REDES (LAN) DE MICROCOMPUTADORAS)

SUPERSERVIDORES

de Minería Calle de Tacuba 5 primer piso Deleg. Cuauhtémoc 06000 México, D.F. Tel.: 521-40-20 Apdo. Postal M-2285

SUPERSERVER ARCHITECTURES

Jeffrey V. Hudson
Vice President, Sales & Marketing
NetFRAME Systems Incorporated

The business strategy of NetFRAME is to provide a true superserver architecture that combines the best attributes of PC's, minis and mainframes, with emphasis on fault resistance, remote control, data integrity and scalability. All this is done within industry standards. What has changed? Why superservers ? And what are the implications? These are the three questions we are going to answer today.

Computing has evolved considerably in the last 4 decades. The 60's was the decade of organizational mainframe computing where everybody shared data. The 70's was the decade of the organizational minicomputer where people shared data. The 80's was the decade of personal computing where there was no sharing of data. The 90's decade of network computing takes us back full circle to one where organizational computing and sharing data is the norm. Networks need servers in the commercial computing environment and this evolution requires that the servers include a very high degree of data integrity. Data has evolved from alphanumeric data and text to multimedia with: graphics, text, image and sound. This requires capacity expansion, increased processing power and I/O throughput. Applications have evolved from office automation tools like word processing and spreadsheets to mission critical applications like accounting systems. This requires a high degree of fault tolerance in the networking environment. Platforms have evolved from host based applications where mainframes, cluster controllers and terminals work together, to geographically disperse LANs where small LANs replace cluster controllers. This evolution requires a high degree of remote control and security.

Everything is changing much faster than before because of the speed with which information flows, the speed at which transportation operates and increased competition. Microprocessors have increased 40 fold in speed in the last eight years. This increase in the rate of change requires that everything be done within industry standards. LANs have evolved from very simple file and printer sharing to larger LANs, where data was shared, to much larger LANs where servers started to multiply because the servers became bottlenecks. The question that arises when this type of implementation occurs, is how do various users on various servers share files. One way to address this business problem is to reduce the number of servers so that all of the users have access to common data without changing servers. The solution to this data management problem requires that data integrity, capacity expansion, fault resistance, remote control, security and industry standards all be present, and these requirements are all caused by evolution.

Users have two choices today in servers: either mainframes and minis or PC's. Mainframes and minis have the advantages of: reliability, data integrity, good security and capacity to expand. However, they are not that easy to use, they are not very flexible, they are not PC compatible and their cost structure is much higher than what the industry has embraced today. PC's on the other hand have the advantages of: ease of use, flexibility, compatibility and acceptable cost structure. However, PC's were never built to support multiple users so that the reliability and data integrity models are not robust. They lack adequate security and adequate capacity to expand. There was no complete answer and this void has caused the emergence of a new category of products that fulfill server requirements and support client server computing. This new category of products, called superservers, combines the best attributes of PC's, minis and mainframes.

Superservers, of which NetFRAMEs are an excellent example, provide ease of use, flexibility, PC compatibility and cost features of PC's while at the same time providing reliability, data integrity, security and the capacity of minis and mainframes. The requirements that were set forth for superservers need to be explored in detail. First, in terms of data integrity: data integrity is a guarantee that data does not change or disappear without notification. This is a mandatory requirement in a server. Data integrity must be guaranteed in the CPU, memory, bus and interfaces in the system. In a PC architecture, there is very little data integrity guarantee. There is no parity check in the busses and internal adaptors and there is no ECC memory. Another alternative architecture like that of the NetFRAME includes parity checking on all data transfers and includes ECC memory. This is very similar to the way mainframe and mini systems are designed.

Another criteria is that of fault resistance. Fault resistance is defined as a case where single failures do not interrupt service. Fault resistance needs to be applied across the system, and this strategy eliminates single points of failure. In a PC architecture, there are multiple single points of failure. In the NetFRAME architecture, by contrast, there are very few single points of failure. In fact, almost the entire system can be made redundant.

Another criteria is for capacity expansion, both in processing power and I/O throughput. A PC architecture like EISA or MCA is a single sequential bus which is very appropriate for a desktop architecture. The bus that connects the memory system to all the I/O cards is the element of the system that defines the total system throughput. A mainframe architecture, on the other hand, has multiple concurrent busses, which is very good at moving large amounts of data as in the IBM 3090 180E. The NetFRAME architecture is very similar to the mainframe architecture; however, it uses 386's and 486's to implement a multiple concurrent parallel bus architecture. The advantage of this kind of architecture is that by pruning branches on the tree, you can start with a very small, compact entry level system and grow it to a very large complex system. The performance envelope of the NetFRAME and this architectural approach, is best described along two dimensions: MIPS and I/O throughput.

The NF100 delivers 15Mb per second of I/O throughput, the NF300 delivers 25Mb per second, and the NF400 35Mb per second. Compared to the IBM 4381 which delivers 30 Mb a second for $800,000, the NF400 delivers more than that for approximately $100,000. Similar comparisons can be made to the VAX family and the Sun family where rather than I/O throughput being the major emphasis, the systems deliver very high MIPS ratings. The Compaq SystemPro delivers about 8Mb per second sustained I/O throughput. The throughput of a server has been measured by a number of objective third parties such as PC Week where they measured a number of different architectures. The benchmark showed that with one station active, the results were all about the same, however, with 32 stations active, you can see that the NetFRAME class of architecture far exceeded the capacity of all of the other servers tested.

The I/O advantage is best characterized in dollars per megabyte per second, and this is the fundamental breakthrough at NetFRAME. The NetFRAME delivers $2,000 per megabyte per second, compared to PC's and minis and mainframes that go up to $30,000 per megabyte per second.

One of the other criteria we discussed was remote control which was the ability to control a server resource without a physical presence. The NetFRAME, for instance, does not have a keyboard or display attached to the server. Any workstation on a LAN can act as the console device for the server. Because of this architecture, any PC on any network, even remotely situated, can act as a console device for any NetFRAME on the network. In the event that there is a problem with either the operating system or the hardware, the NetFRAME includes the concept of the service processor, where there is an independent 8088 that monitors the operation of the server. In case of a problem, the server activated maintenance hardware and software will take corrective action, restart the system and place telephone calls to user defined numbers to report problems in voice synthesized speech.

Security is an additional criteria and is defined as the ability to physically protect equipment and the data. Minis and mainframes use a separate control facility which is very expensive and PC's typically have no security. Neither strategy works well for servers in the networking environment. Security is best addressed by selectively allowing access to disk removal, media, on/off switch, cable connections and boards, where you can implement a completely secured system, allow access to media only, or allow full accessibility for maintenance.

Everything we've talked about must be done within industry standards for the reasons that we've described. Ethernet and Token Ring are the standards for network interfaces, the SCSI for disk tape and peripherals and SDLC and HDLC for wide area communications and NetWare 386, OS/2 LAN Manager and UNIX for the operating environments.

In summary, the evolution of computing, data applications platforms and expansion has increased and this increasing rate of change has caused the emergence of superservers. The criteria for superservers that we laid forth are best met by a product that was specifically designed to do that, and not a PC that was placed on the network as a server. A number of customer examples of how this technology is implemented is appropriate at this point. Seattle City Government has multiple NetFRAMES in the different departments all communicating with the IBM 3090. MCI, the telephone communications company where they have a small number of users but a very large data base tied into their E-Mail system. The public highway authority in Italy which uses a series of NetFRAMES to connect all of the badge readers at the ticket gates for all the highway entrances. Aldus Corporation which develops a number of software products for the PC industry has a number of NetFRAMES spread around the world to control their internal operations and development. The Internal Revenue Service, a federal taxing authority in the United States which uses NetFRAMES for the electronic tax filing system network.

So, in summary, there are some good reasons that this new category of product has evolved and emerged and there are a number of examples of customers that have taken advantage of the technology in their operations.

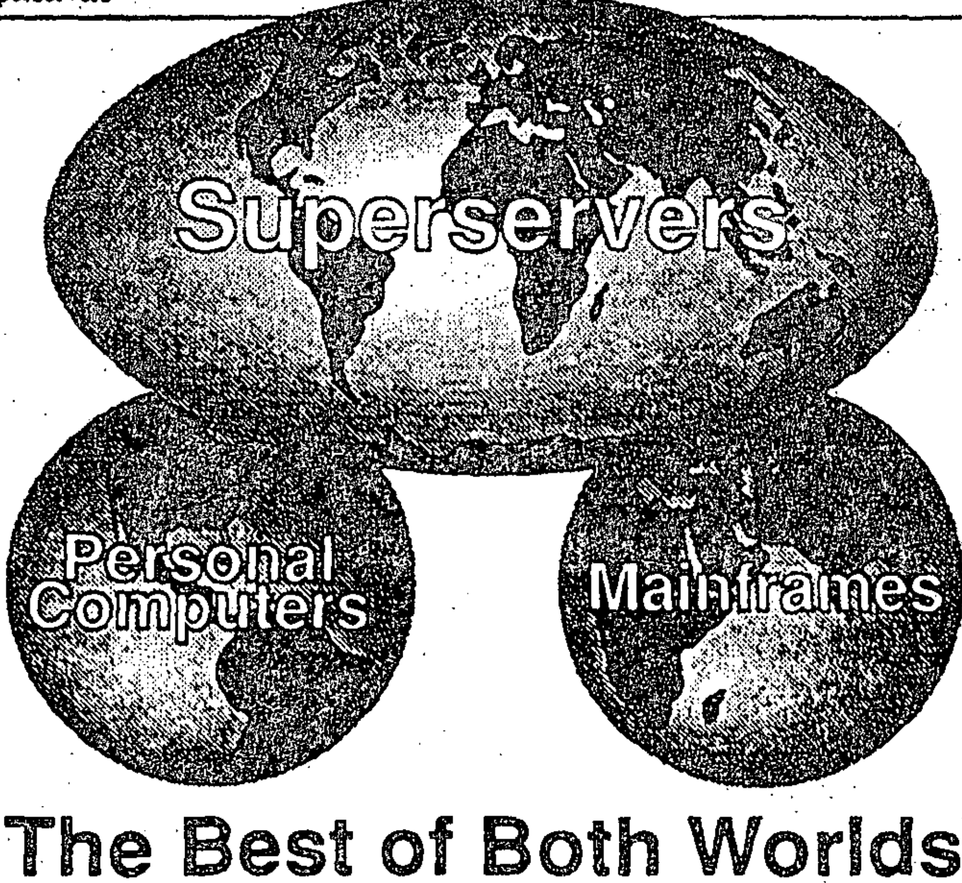
Why a network mainframe

1

Information. Communication. Time-to-action. These are critical requirements for business success in the 90s. In an arena of increasing global competition, information system investments made today will shape the success or failure of businesses for years to come.

Today's trends in information technology define the landscape on which winning strategies for the 90s will prevail. Innovation in microcomputer technology is accelerating to provide end-users unprecedented levels of speed, economy and ease of use. Networks are evolving to accomodate volumes of data and connectivity options unheard of just a few years ago. And new product cycles are shortening, highlighting the importance of standards, scalable architectures, and lasting value.

1-1 Superservers



At the intersection of these trends, personal computer networks are emerging as the strategic information system resource of the 90s. Workgroup based PC LANs initially purchased for casual PC connectivity are now pervasive, growing rapidly in both size and sophistication. As this growth spreads organizationally, such networks offer compelling advantages for enterprize level communications and distributed data processing. With the growing availability of LAN based development tools and applications, "downsizing" of minicomputer and mainframe systems to the LAN is taking place with dramatic results.

As PC networks assume this strategic role and become mission critical in nature, network uptime, integrity of data, managability and growth become ever more important factors. Network computers supporting such LANs must meet the levels of performance, fault tolerance, and managability demanded of such a strategic computing environment. Additionally, in order to integrate software and hardware from multiple vendors, such network computers must support standard PC LAN operating systems, applications and network hardware.

Recognizing the mission critical nature of PC LANs, NetFRAME Systems, Incorporated introduced the world's first family of superserver class computers in the fall of 1989. These systems, referred to as network mainframes or "NetFRAMEs", offer a new generation architecture designed especially for mission critical PC LANs. They combine the performance, scalability and fault tolerance features of minicomputers and main-frames with the flexibity and price advantages of PCs. They solve the capacity and network management challenges of rapidly growing PC LANs, and are the ideal platform for minicomputer and mainframe downsizing.

For corporate MIS directors, managers of LANs in departments, or small business managers, the NetFRAME family presents new computing options: smoother, easier LAN growth, better control of distributed LANs, and revolutionary price/performance for the most demanding applications. The result is faster and more cost-effective implementation of strategic systems and, ultimately, new levels of organizational productivity and business competitiveness.

Easier LAN growth

Better control of distributed LANs

Revolutionary price/performance

Mainframe class fault tolerance

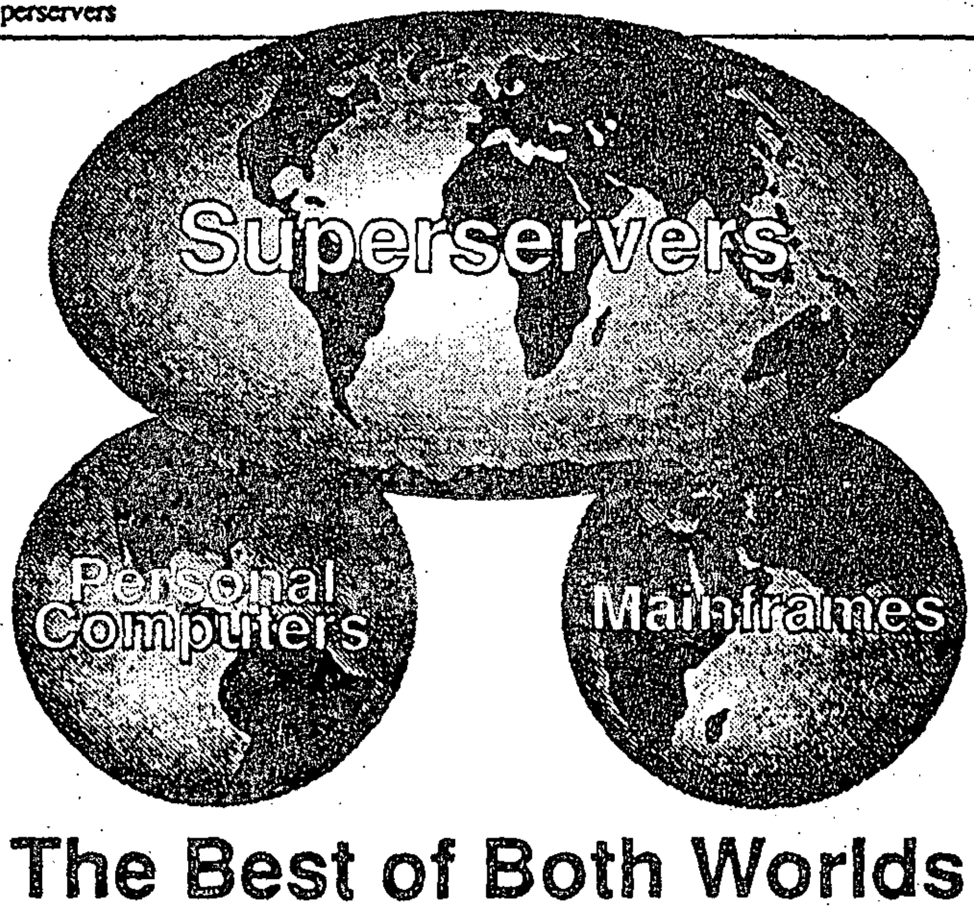
Why a network mainframe

1

Information. Communication. Time-to-action. These are critical requirements for business success in the 90s. In an arena of increasing global competition, information system investments made today will shape the success or failure of businesses for years to come.

Today's trends in information technology define the landscape on which winning strategies for the 90s will prevail. Innovation in microcomputer technology is accelerating to provide end-users unprecedented levels of speed, economy and ease of use. Networks are evolving to accomodate volumes of data and connectivity options unheard of just a few years ago. And new product cycles are shortening, highlighting the importance of standards, scalable architectures, and lasting value.

Figure 1-1 Superservers



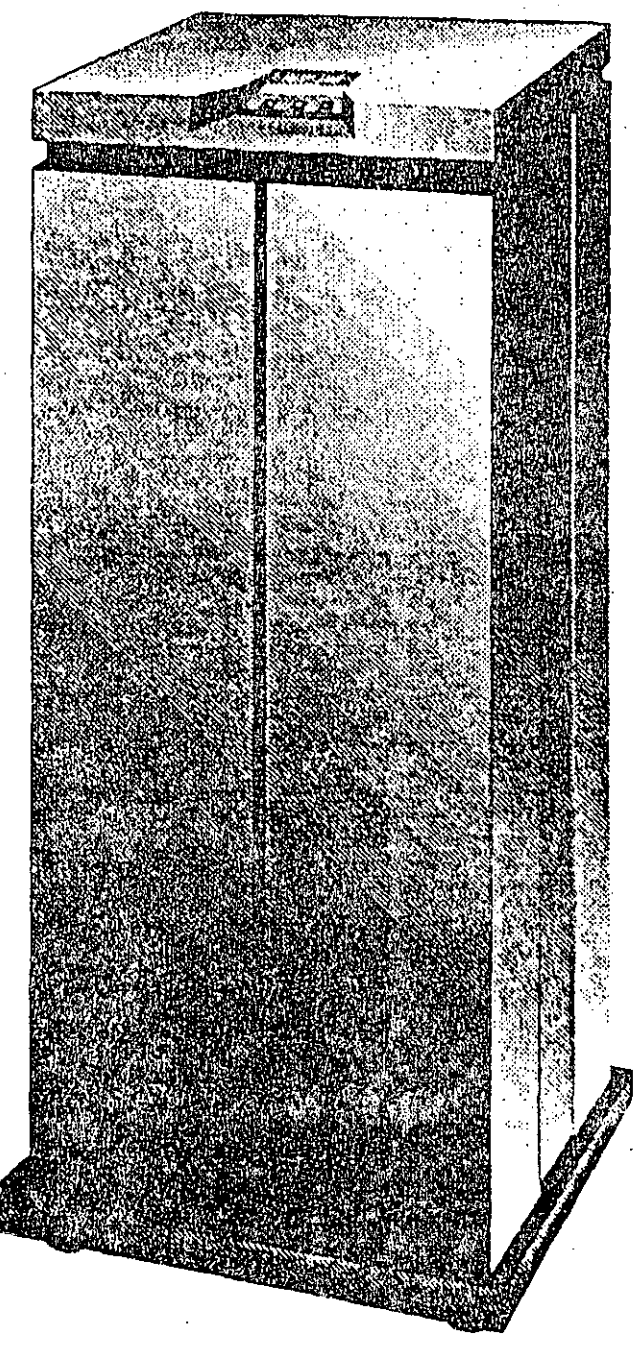


Figure 1-2 NetFRAME NF400

Departmental LANs

For a small business or department where LAN growth and uptime are important considerations, an entry-level NetFRAME is the ideal alternative to one or more PC class servers. For these LANs, a NetFRAME can offer greater reliability and capacity than PCs, at a lower cost of ownership. As LANs expand, the NetFRAME's input/output (I/O) and storage capacities keep pace, offering performance scalability without the administrative burden of multiple machines.

Server Consolidation

PC LAN growth is often characterized by the proliferation of PC class servers. Such piecemeal deployment of resources can lead to overly complex LANs that have low reliability and high management needs. NetFRAME provides, for the first time, the opportunity to approach LAN growth on a site-wide basis in which the deployment of LAN resources is centralized to yield greater economies of scale, lower operating cost, easier system managment, and superior uptime. With support for up to eight LANs and leading fault tolerance features, one NetFRAME can often consolidate up to eight or ten traditional PCs.

Mainframe System "Downsizing"

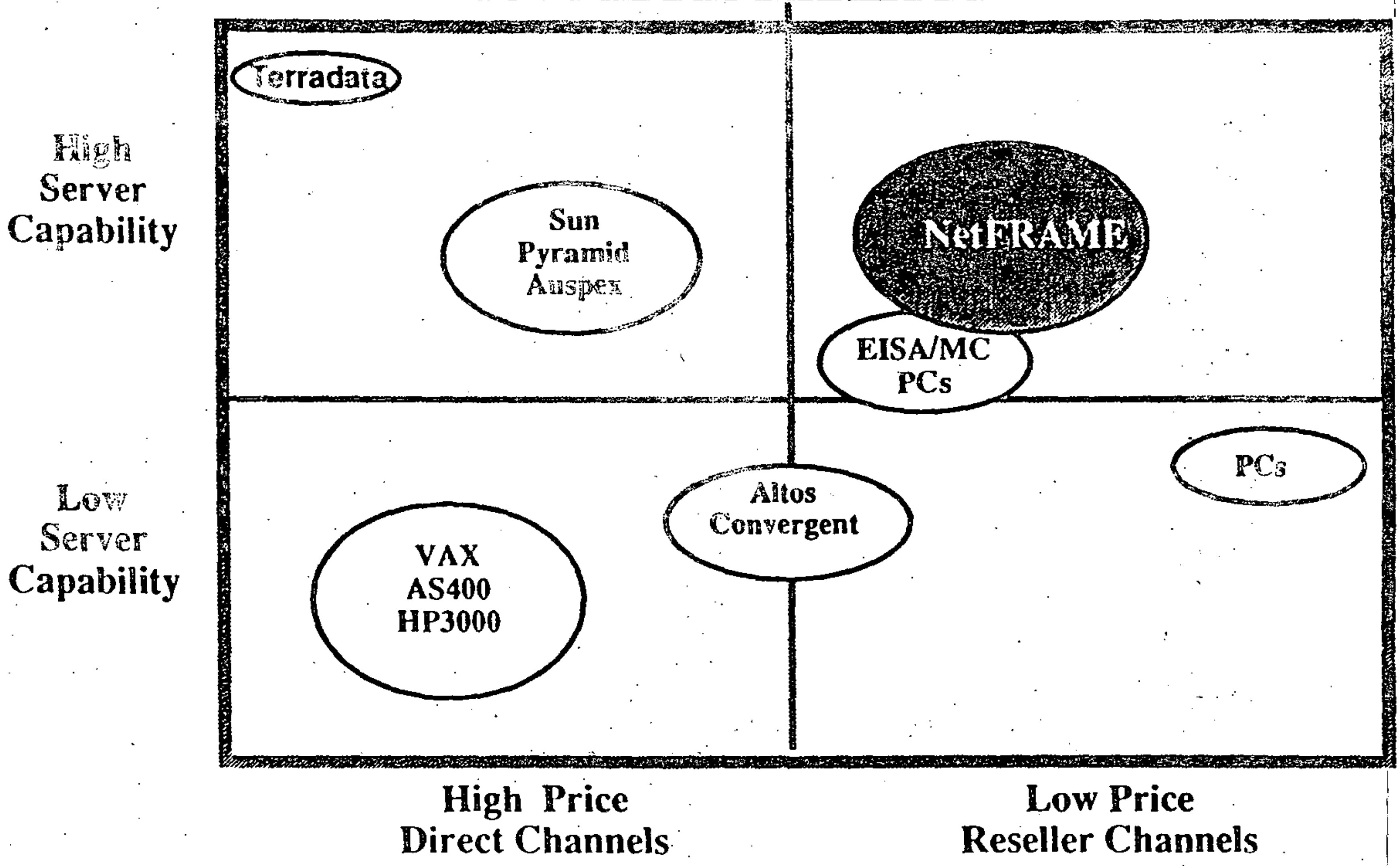
The NetFRAME family is the first viable alternative to minicomputers and mainframes for business critical applications on PC LANs. NetFRAME computers offer gigabytes of storage capacity, mainframe-level data integrity, and unprecedented fault tolerance and security features. Yet, a NetFRAME is significantly more cost-effective than minis and mainframes and provides more flexibility in expansion and software. Furthermore, the NetFRAME, since it runs standard PC LAN operating software, is superior to minis and mainframes at integrating PCs on a corporate scale.

New High Productivity Applications

Over the coming years, the true power of LANs will be realized in an emerging class of new organizational applications: image systems, filing systems and LAN-based office systems will become the backbone of business operations. NetFRAMEs, with their ability to move large amounts of information, are the ideal platforms for early adopters of such leading edge technology.

In short, the NetFRAME family is designed for the networks of the 90s that will speed information transfer and shorten decision reaction times. Use of NetFRAMEs will help businesses gain and keep a competitive edge for years to come.

Market Segmentation



Server Market Competitors

NetFRAME

PC/WORKSTATION MANUFACTURERS

COMPAQ
ZENITH
SUN
"CLONES"

MINI/MAINFRAME VENDORS

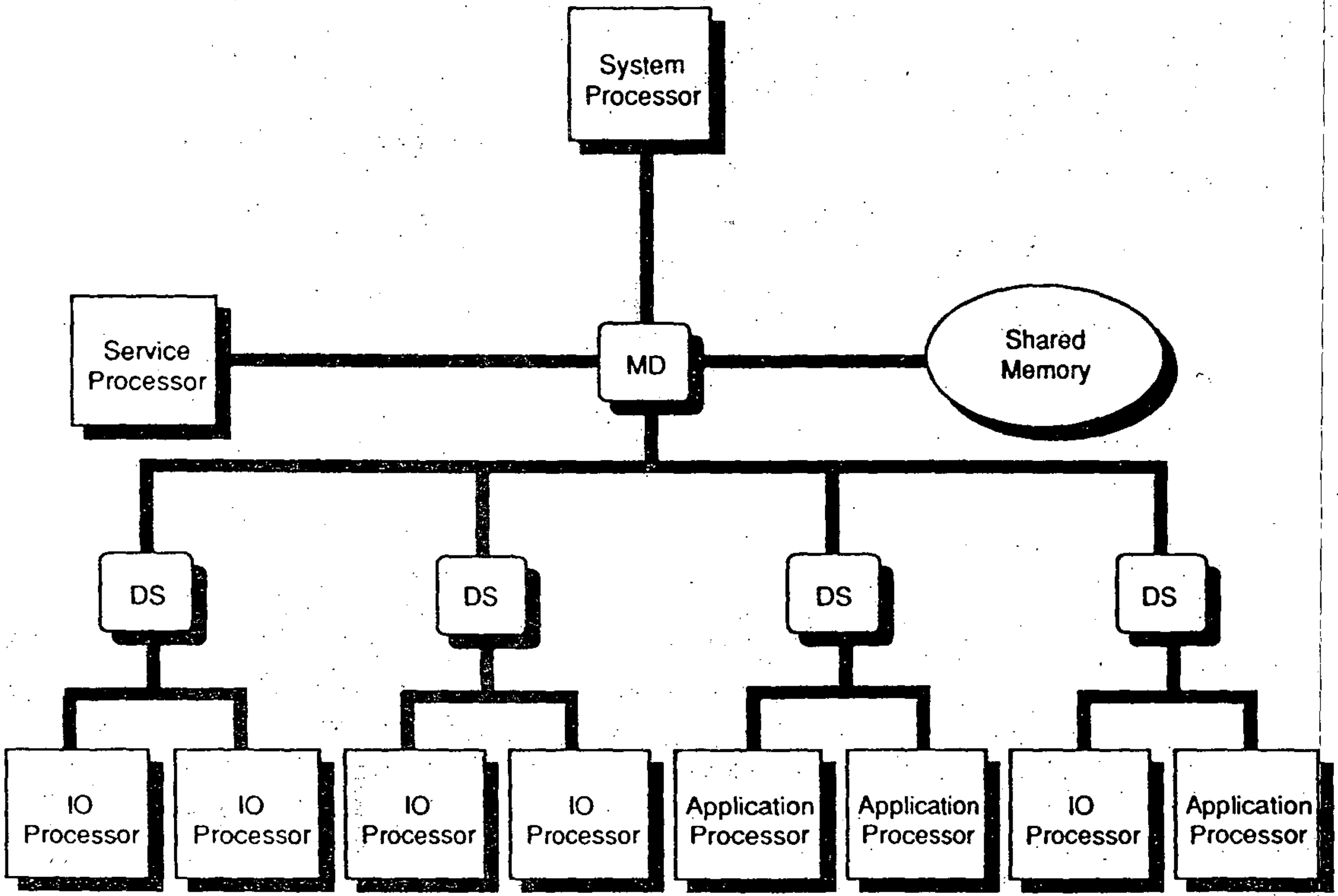
IBM
DEC
HP
ATT
NCR

SERVER COMPANIES

NETFRAME
AUSPEX
TRICORD

ALL TARGETING THE "SERVER" OPPORTUNITY

Multi-Processor Architecture



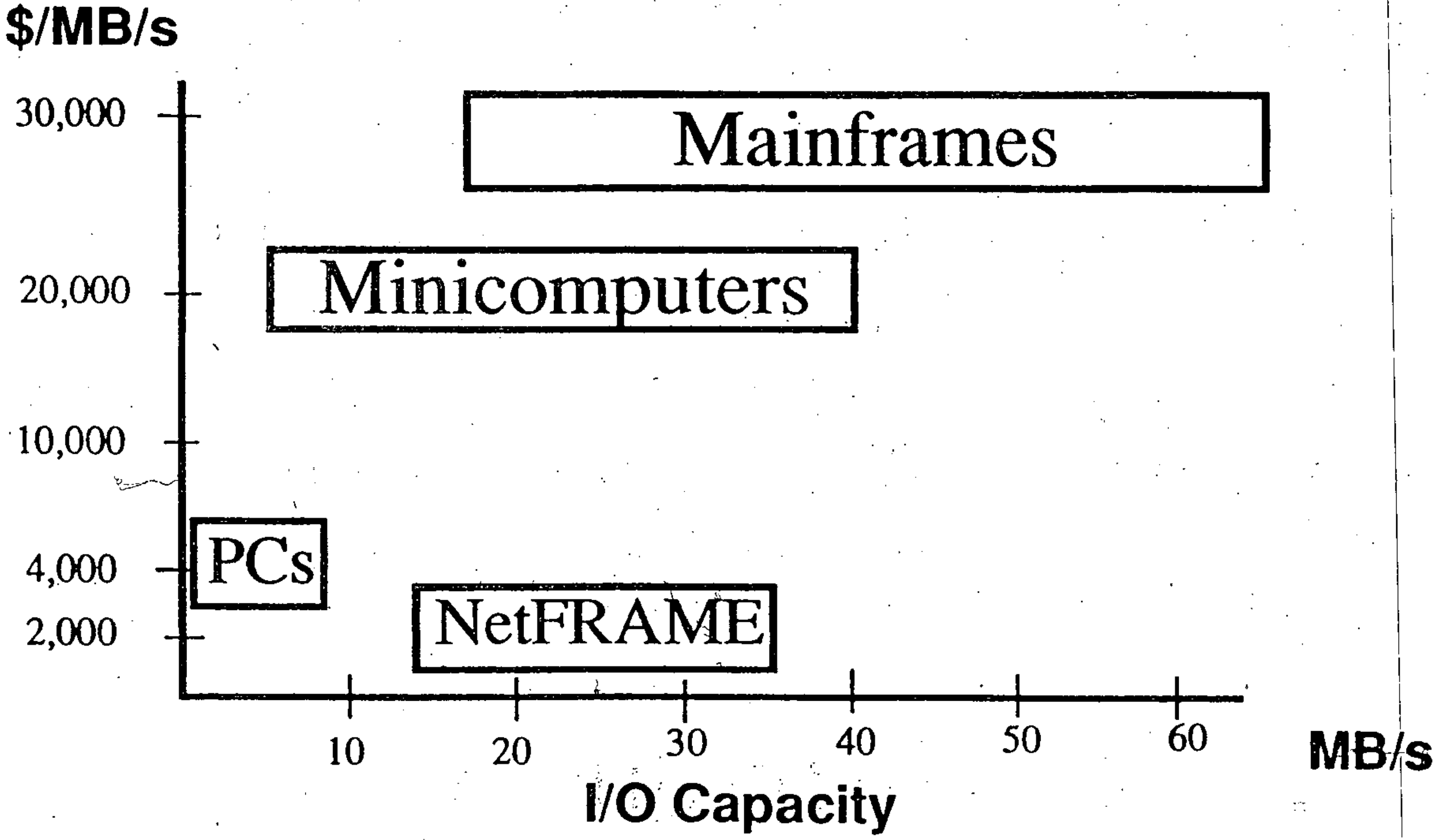
HIERARCHICAL BUS STRUCTURE

- Use Multiple multiplexed data buses to achieve high throughput
- Buses gets slower and narrower as it travels down the hierarchy

- Processor Data Bus	50 MB/sec	32 bits wide
- Cache Data Bus	200 MB/sec	64 bits wide
- Memory Data Bus	100 MB/sec	64 bits wide
- IO Data Bus	100 MB/sec	32 bits wide
- DS Bus	25 MB/sec	16 bits wide

NetFRAME's I/O

NetFRAME

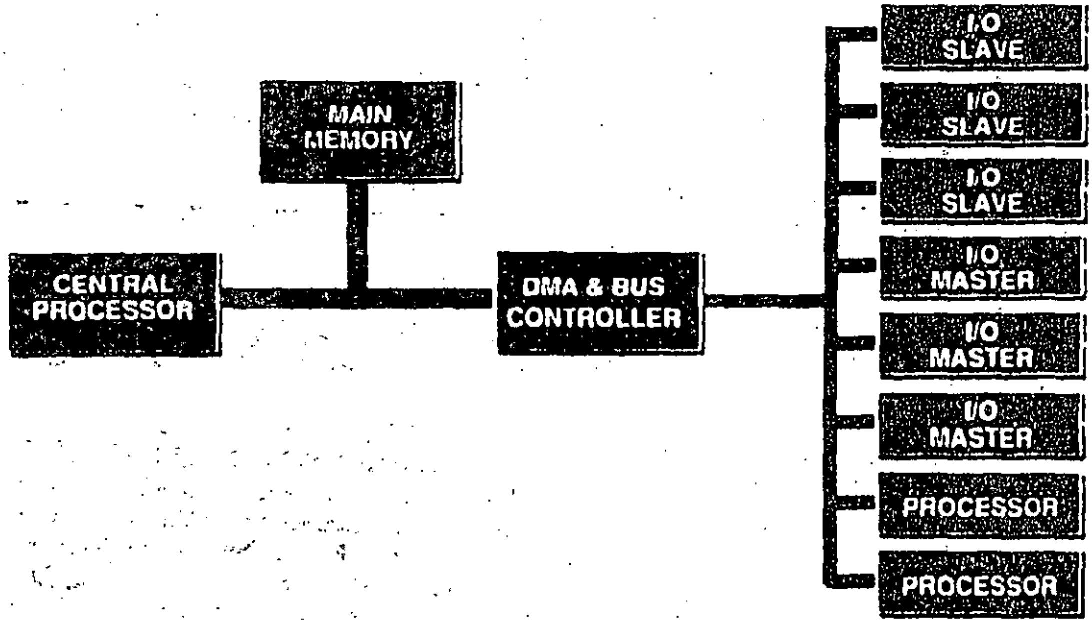


ARCHITECTURE

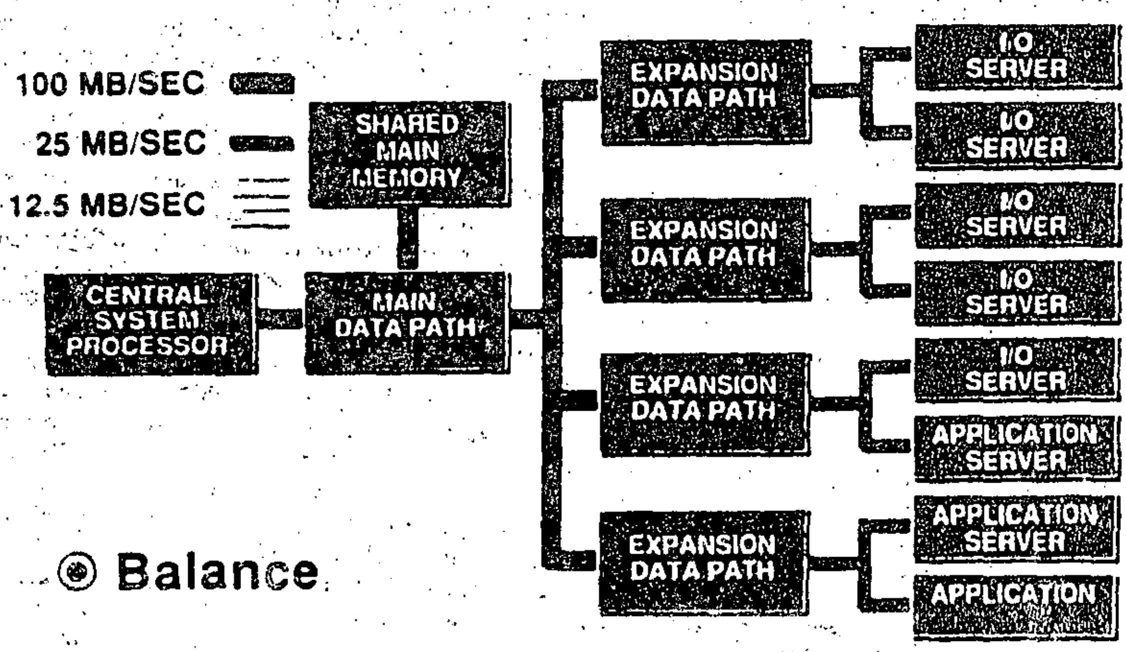
Multiple independent Processors with Private Local Memory communicate with each other through Shared Memory

- System Processor — 25 MHz Intel 80386 or 80486
- IO Processor — 16 MHz Intel 80376
- Service Processor — 10 MHz Intel 80188
- Application Processor — 33/50 MHz Intel 80486

MicroChannel, EISA



NetFRAME NF-300/400



- Balance
- Isolation
- Expandability

COMMUNICATIONS WEEK

The Newspaper For Network Decision Makers • June 11, 1990 • 304 • A CMP Publication

What Makes A Server Super?

BY ANNE KNOWLES

Every computer generation needs a "super" something. First there was the supercomputer, then the superminicomputer, then—falling somewhere in between those two—the minisupercomputer.

Now, there is the superserver. Just as the concept of client/server computing was beginning to sound familiar, the simple server has been elevated to super status. It is a new machine with new features that, like most of its super predecessors, crosses computer categories and promises more bang for the buck.

Most superservers are based on Intel Corp.'s 80386 and 80486 microprocessors, but they are designed and configured with multiple processors, a high-speed system bus and mainframe-like features, especially high-throughput input/output mechanisms and disk arrays. That makes superservers "more expandable and scalable" than their personal computer counterparts, said Laurie Strong, director of product marketing at Compaq Computer Corp., the Houston-based maker of the Systempro superserver.

MORE PCS, LESS MONEY

Being able to hook up more personal computers to the server for less money is what multiprocessing, disk arrays and increased I/O throughput mean for most network managers. Steven Brunner, for example, was using Compaq's Deskpro 386 as a file server at Fish Engineering & Construction Inc. Brunner is senior manager of computer services for Fish, a Houston company that builds petroleum and chemical processing plants. He was limited to 100 users by the system's operating system. But with NetWare 386, a local area network operating system from Novell Inc., and Compaq's Systempro, Brunner eventually will have 200 workstations running a materials management application hooked up to the system.

"Superservers are a bridge between personal computer technology and the minicomputer world," said Gary Tarantino, product manager for AT&T's StarServer E superserver, which was introduced last month.

"Superservers are hybrid personal computers and mainframes that are designed from the ground up to be servers," said Theodore Manakas, senior vice president of sales and marketing at Tricord Systems Inc., a superserver start-up based in Minneapolis, Minn.

If their multiprocessing and throughput capabilities distinguish superservers from personal computers, what distinguishes them from mainframes and minicomputers is price. Ranging from $16,000 to $45,000, superservers are cost-effective alternatives to their bigger brethren.

Compaq's Systempro, for example, contains a 32-bit Intelligent Drive Array controller and can be configured with two to four drive arrays. Drive arrays connect multiple disk drives and record sections of data on each disk—rather than putting it all on one disk—so the data can be accessed much more quickly later.

ENSURED RELIABILITY

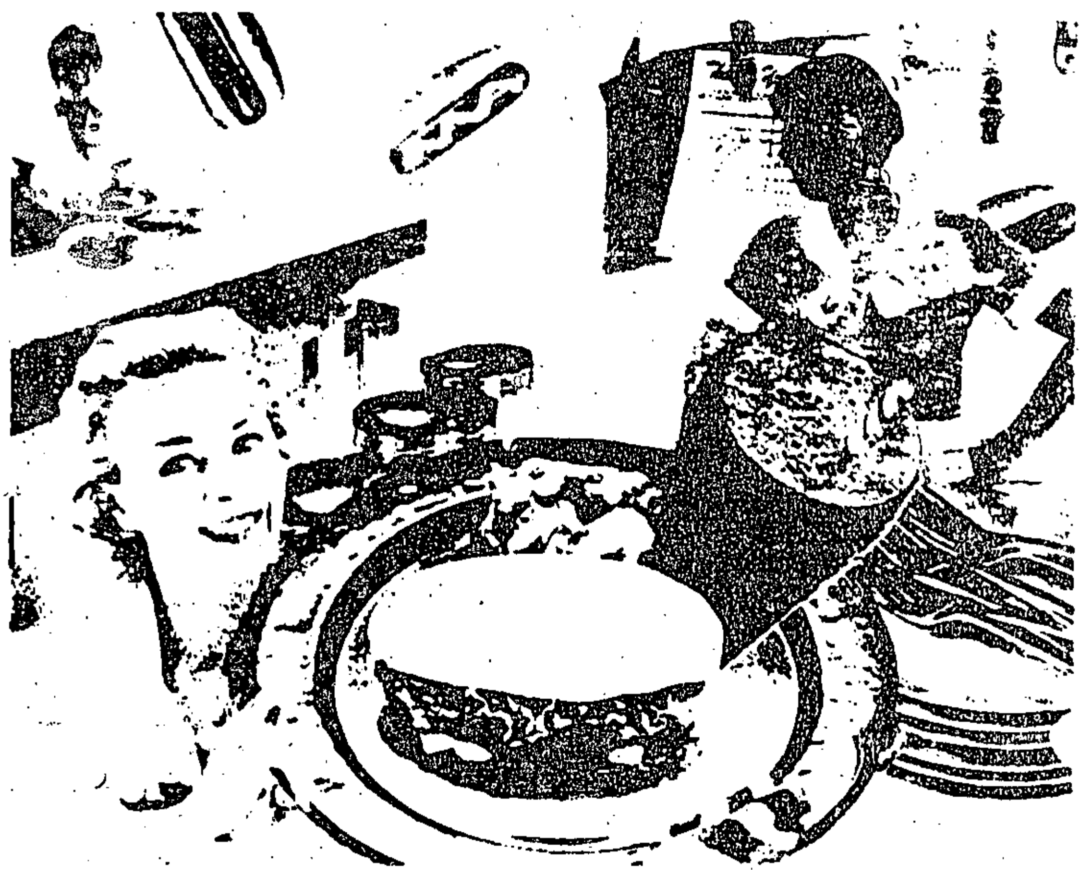
Most superservers use similar disk technology and, like Compaq's Systempro, ensure data reliability through such features as drive mirroring, which allocates half of each drive to mirror, or back up, another drive. Other systems, like AT&T's StarServer E and the NF line of superservers from NetFrame Systems Inc., another superserver start-up, based in Milpitas, Calif., use error correction and detection technology that spots and corrects single-bit errors in data.

A superserver's I/O capability is what places it in mainframe territory. "The difference between a personal computer and a minicomputer or a mainframe is not horsepower, it's input/output," said Frank Dzubeck, president of Communications Network Architects Inc., a consulting firm in Washington, D.C.

Again, the difference is the price of the equipment. The cost of connecting a network of personal computers to an installed mainframe would be about three times the price of two or three high-end superservers, according to Tom Glassanos, director of marketing at NetFrame.

Superior I/O was the deciding factor for Keystone Provident Life Insurance Co., according to Les Laputz, vice president of information services at the Boston-based company. Keystone was running a specialized insurance application that maintains a database on, and performs all related processing of, the company's insurance policies. Keystone wanted to process over 100,000 policies with the application, but it had hit a limit of 6,000 using a 386-based personal computer acting as a file server.

Keystone evaluated a NetFrame superserver and a Compaq Systempro, and considered using a Digital Equipment Corp. VAX 6210 that was already installed at the company. The fully configured NetFrame turned out to be the most expensive solution, but Keystone chose it, Laputz said, because it provided "the fastest throughput."



ELAINE CARD

WHERE THE I/O COMES FROM

T[illegible] superserver achieves its I/O capability varies from vendor to vendor. Tricord's PowerFrame servers, which are all based on Intel's 486 chip, dedicate a 386 chip to I/O processing. The Intelligent I/O Processor, developed by Tricord, can handle multiple, simultaneous I/O operations to multiple channels and, through them, to multiple disk drives. Each system can be configured with multiple I/O processors.

Most superservers use a proprietary high-speed bus. The PowerFrame, for example, contains a proprietary 32-bit, 100-megabyte-per-second bus called PowerBus. NetFrame sells its NF series of servers with a proprietary bus that runs 125 megabytes per second. The StarServer E has an internal bus structure that is actually two 64-bit data buses and one 32-bit [illegible] bus. AT&T claims the configuration is capable of a 267-megabyte-per-second sustainable data rate.

MULTIPROCESSORS BY DESIGN

Besides high I/O capabilities, the feature that distinguishes superservers is a multiprocessor configuration. In fact, International Data Corp., a market research firm in Framingham, Mass., defines superservers as "multiprocessor servers based on a personal computer hardware platform," said Susan Frankle, an IDC research analyst.

Multiprocessing allows either multiple users or multiple parts of a single user's program to be divided among several processors, making overall processing times faster. It also increases reliability: If one processor fails, the others keep working.

Multiprocessing is transparent to the user, according to AT&T's Tarantino. "It simply means more users will be able to be attached and there will be better reliability," Tarantino said. A network administrator can tweak the software for better performance, he said, but users won't know it.

Currently, however, multiprocessing technology is not as beneficial to superserver performance as it could be. What's missing, according to Tricord's Manakas, is software. As a result, Tricord sells mostly uniprocessor versions of its servers. "Multiprocessing software isn't as ready as it should be," said Manakas. "More specifically, OS/2 is late." Operating System/2, Microsoft Corp. and IBM's latest and most powerful microcomputer operating system, is not yet in widespread use, and applications for it are relatively scarce.

The Compaq, NetFrame and Tricord systems all will run OS/2 LAN Manager and Novell's NetWare 386. NetFrame will offer an as-yet-undetermined form of Unix in 1991; Compaq and Tricord currently offer a version of Unix System V from The Santa Cruz Operation, Santa Cruz, Calif. And AT&T sells the StarServer E with Unix System V. Both AT&T and Tricord provide symmetric multiprocessing, in which every processor is equal and can perform the same tasks under Unix.

Data Communications

By Gary Gunnerson

Consolidating Network Resources on Superservers

LANs typically grow incrementally. That's why so many corporate networks end up a hodgepodge of 286 servers, 386 servers running 286 software, 386 servers with full 32-bit network software, and a smattering of 486 CPUs running who-knows-what. That's also why corporate connectivity managers are forced to reckon with myriad file, communications, and special-purpose servers.

I've often thought that most sites could benefit from an integrated server that runs PC networking software and delivers the performance, security, and integrity of a mainframe, but so far the big-CPU vendors' LAN support falls short of what's needed.

Happily, my desires are moving closer to being realized with the network superservers from NetFrame Systems Inc. and Compaq Computer Corp. IBM's recently announced 25-MHz PS/2 Model 80, while not a superserver per se, also is a step in the right direction.

Don't mistake a superserver for a racehorse, though. It's more of a Clydesdale: It's not how fast it goes but how much it can pull that counts.

Superservers can handle many more client PCs and deliver far far more storage than today's existing servers, but evaluating them is no simple matter.

A key criterion is economics: knowing whether it makes financial sense to consolidate several smaller servers into a larger central one. A common baseline for network servers is a 25-MHz 80386 CPU, about 300 Mbytes of disk storage, and 8 Mbytes of RAM running NetWare/386.

A superserver with an advanced bus design, such as Extended Industry Standard Architecture (EISA) or Micro Channel Architecture (MCA), and several bus-master I/O cards can double or triple that capacity. To evaluate the most powerful servers, I set an arbitrary target capacity of 64 Mbytes of RAM, eight network interface cards, and 2.5 Gbytes of disk storage. Keep in mind that such a configuration can support 600 to 1,000 PC clients.

Super Server Cost Comparison

Manufacturer/ Model	IBM PS/2 80 386-A21			Compaq Systempro 386-840			NetFrame NF-300 16/760		
	Qty	Cost	Total	Qty	Cost	Total	Qty	Cost	Total
Base Units	4	$13,195	$52,780	2	$25,999	$51,998	1	$43,500	$43,500
Disk	4	$5,550	$22,200	2	$6,999	$13,998	3	$8,700	$26,100
Memory	4	$6,375	$25,500	2	$21,999	$43,998	3	$11,500	$34,500
Network I/O	8	$800	$6,400	8	$1,295	$10,360	7	$5,000	$35,000
			$106,880			$120,354			$139,100
Discount			$32,064			$24,071			N/A
Discounted Cost			$74,816			$96,283			$139,100

Each IBM PS/2 Model 80 supports a maximum 16 Mbytes of memory, so four units would be needed to meet the memory capacity (see table). Compaq's Systempro allows a maximum 1.68 Gbytes of disk storage in its chassis, so two units would be required. The NetFrame meets all requirements with a single unit.

IBM's Model 80, when equipped with bus-master disk controllers and network adapters, comes close to being a superserver, and LAN administrators are comfortable with the PC platform. Increasing capacity means adding another PC server, and replacement components are readily available.

Compaq's EISA implementation uses a custom memory/CPU bus that accommodates two 33-MHz CPUs. The advanced EISA bus-mastering disk controller interleaves disk reads and writes for high throughput. The Systempro addresses 256 Mbytes of memory.

NetFrame's custom bus architecture offers very high performance, balancing system I/O between the I/O processors and main system memory. A recent test pitting the Compaq against the NetFrame indicated that while both maintained the same high I/O levels, NetFrame did so with less impact on the central CPU, running at 6 percent utilization as compared with the Compaq's 25 percent utilization.

COMPLEX ECONOMICS

To determine the retail prices in the table, I've added the least amount of disk, memory, and I/O to the standard base units. Current discounts for the IBM PS/2 Model 80 are around 30 percent; for Systempro, around 20 percent; NetFrame offers no discounts. Given the number of considerations, pricing superserver configurations can be just as complex as evaluating performance.

For instance, in large metropolitan areas, real estate rentals contribute heavily to overall budget. A site with several hundred users configured with standard 386 servers requires almost a dozen file servers, plus all the associated supplementary communications servers, consoles, power supplies, wire racks, tape drives, and so on. This adds up to quite a bit of office space. A single superserver requires a fraction of the floor space, air conditioning, security, and cabling.

The initial hardware cost of NetFrame appears high, but the multipurpose I/O adapter contributes about $25,000 to the variance. Given its reported performance statistics (such as its showing against the Systempro), fewer I/O adapters may be required with NetFrame; the target configuration would need as few as four interface cards. Though NetFrame doesn't discount hardware yet, the company has just cut the price of its low-end NF-100 and the 380-Mbyte disk drives, and reductions on the higher units are to be expected.

Other variables are harder to plot. For instance, I'm trying to plan my LAN expenses for next year now, and I don't know how much software will cost because Novell and others have not released a pricing policy for servers with more than 250 users.

This is a rare case of technology moving so fast that the marketing folks—and their pricing structures—have been left behind. In fact, a Novell representative recently claimed that there is no demand for a Netware/386 license for more than 250 users. But corporations are budgeting now for next year, and it takes vision to see how this demand will take shape.

The concept of consolidation, the essence of the superserver, is itself not cut-and-dried. Configuring more servers for a given user population, a safeguard offered by the IBM and Compaq units against the possibility of having a single point of failure, has its advantages. In our configuration, if one Model 80 goes down, only one-quarter of the users lose service. An outage with Compaq would effect half the users, and the NetFrame brings everyone down when it fails.

None of these systems offers complete hardware fault tolerance. An internal component failure requires bringing the server down. The NetFrame system does support automatic switching to a redundant power supply, but sooner or later, repairs must be made.

Fewer servers, on the other hand, means less software maintenance. People costs remain high and continue to increase. Any reduction in staff costs pays extra dividends over time. Also, with network operating systems such as Novell's, which doesn't have a strong distributed-naming service (as Banyan's Vines does), distributed applications create the sort of maintenance headaches that encourage consolidation. Also, application software metering encourages pools of single-user or server licenses. When more licenses are pooled, fewer licenses are required, reducing total systems costs.

As I said at the outset, superservers are starting to show, which means that the market is heating up. Stay tuned. ■

Gary Gunnerson is manager of end-user computing for a *Fortune 500* company. He can be reached at GGUNNERSON on MCI Mail.

R E P R I N T E D F R O M
NETWORK WORLD

Superserver lets law firm centralize nets

NetFRAME's NF300 has simplified local net administration and eliminated server bottlenecks.

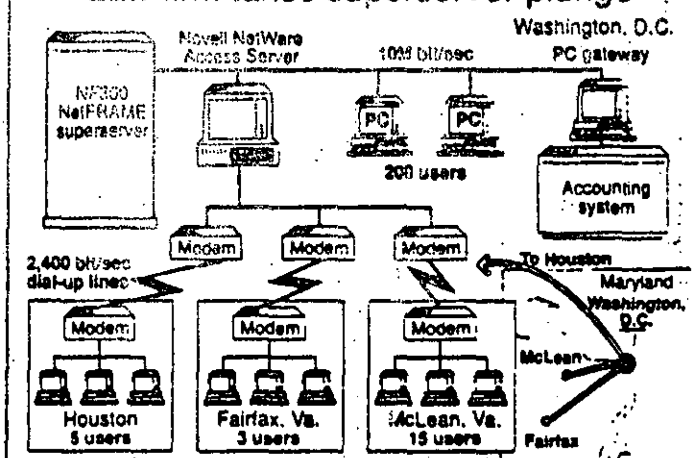
By Bob Brown
Senior Editor

WASHINGTON, D.C. — The dawn of the "superserver era" arrived just in time for a large law firm here, which recently installed a NetFRAME Systems, Inc. superserver to simplify management of its expanding local-area networks.

Verner, Liipfert, Bernhard, McPherson and Hand, one of NetFRAME's first customers, installed a midsize NF300 system to replace four personal computer-based Novell, Inc. file servers at its headquarters here.

NetFRAME, a Sunnyvale, Calif., start-up, announced its family of superservers last fall ("NetFRAME ushers in superserver era," *NW*, Oct. 2, 1989). The machines have multiple processors and a mainframe-like I/O architecture that eliminates bottlenecks associated with traditional network file servers.

Law firm takes superserver plunge



A law firm replaced four Novell, Inc. servers with NetFRAME Systems, Inc.'s NF300 superserver. The network supports about 220 users in four locations and is used for word processing, electronic mail, data base management and other applications.

SOURCE: VERNER, LIIPFERT, BERNHARD, MCPHERSON AND HAND, WASHINGTON, D.C.
GRAPHIC BY SUSAN J. CHAMPENY

Verner, Liipfert's NF300 has enabled it to centralize and simplify LAN administration and centralize applications on one server so users do not have to access multiple devices to retrieve files or data.

The NetFRAME-based network runs Novell's NetWare 386 network operating system and supports about 200 personal computer users locally and another 23 users at three remote sites. A variety of applications are supported, including word processing and data base management.

The firm also expects to take advantage of the superserver's greater processing power to support CPU-intensive applications such as image processing, which is a top priority. Next year, Verner, Liipfert expects to begin to transfer legal books into network files in an effort to save precious library space, said Ava Davis, the firm's network manager.

"We wanted to begin running more advanced applications on the network, and that meant we had to expand beyond four file servers," Davis said. "We had a choice between adding another body to help me manage the extra file servers or buying the NetFRAME system. So we went with NetFRAME."

Now if Davis needs to install a new version of a program, she simply loads it onto the superserver, rather than upgrading each network server scattered around the company. Similarly, administration of the net has been made easier in that Davis only has to back up files on one server instead of four, she said.

The process of transferring users from the Novell servers to the NetFRAME server is nearly complete and has gone smoothly, she said.

According to Jeff Hudson, NetFRAME's vice-president of sales and marketing, Verner, Liipfert is typical of the type of customer that will use superservers. "I call it the 'expanding

PC LAN environment,'" Hudson said. "They have the need to expand disk capacity and grow the number of PCs on their network."

NetFRAME's support for NetWare 386 was of particular interest to Verner, Liipfert because the company was already using the network operating system, Davis said. "We're still using NetWare on the NetFRAME system, so users [haven't seen much] change."

But users are "seeing more speed when it comes to accessing files and features," she said. Ease of use is also noticeable. Instead of having to access separate file servers, users can save time by retrieving files from a single server. "Users can now move more freely around the network," she said.

Another reason for choosing the superserver was increased reliability, Davis said. The firm cannot afford much downtime since the network is integral to the business, she said. To guard against the superserver representing a single point of failure,

"We had a choice between adding another body or buying the NetFRAME system."

▲▲▲

Davis plans to use one of the existing Novell servers as a backup server.

About 20% of the NetFRAME systems' chips are dedicated to error checking, compared to less than 1% of those chips in a personal computer-based server.

"Verner, Liipfert recognized that its network is mission-critical," said NetFRAME's Hudson. "If its word processing capability isn't working, then the firm's got a problem."

As for the existing Novell servers, the law firm plans to use one for archives and backup, transfer another to a remote office in McLean, Va., and perhaps unload the others, Davis said.

The law firm will enable users in its Houston and in its McLean and Fairfax, Va., offices to access the NetFRAME system via a NetWare Access Server. They can conduct electronic messaging via an E-mail server gateway attached to the NF300, and they can tie into the main office via 2,400 bit/sec dial-up links. ☐

NetFRAME™

NetFRAME Systems Incorporated
1545 Barber Lane
Milpitas, California 95035

REPRINTED FROM PC WEEK MAY 14, 1990

NetFrame NF-400 Writes a New Chapter in Network Computing

By Barry Gerber

NetFrame Systems Inc.'s NF-400 super server makes a frontal attack on both traditional mainframe and PC-based approaches to networking.

The 25MHz 486 machine challenges heavy-duty mainframes in such areas as disk I/O speed, maintainability and reliability. At the same time, it retains the ability to support PC-based software, including Novell Inc.'s NetWare 386. (See PC Week's comparison of the NF-400 and Compaq Computer Corp.'s Systempro, May 7, Page 1.)

The system can accommodate as many as eight of the company's bus-master adapters, called I/O Servers, which support standard SCSI I and II disk drives as well as network communications (Ethernet or Token-Ring, and RS-232C, RS-432 and AppleTalk). Each I/O Server operates on its own 12.5M-byte sub-bus.

The same bus that handles I/O Servers can accommodate NetFrame's Applications Servers. These are self-contained computers that can support an operating system or various functions such as a database or specialized network communications. Applications Servers can use any CPU architecture and supporting operating system (for instance, RISC and Unix) as long as they conform to the NF-400's hierarchical bus structure.

The NF-400's centrally arbitrated, multiple-bus architecture was designed to let NetFrame servers grow with the computing load without requiring an extensive hardware redesign.

Carl Amdahl, who designed NetFrame's servers, argues that, in high-traffic environments, a file server has to be at least one or two steps faster than the workstations it supports, or it will be hard pressed to meet the I/O demands of more than a few workstations.

The weakness of current single-bus PC architectures, he contends, is that performance increases can be obtained only by increasing bus width and speed, which often makes older adapter technologies obsolete. The history of PCs has certainly proven Amdahl to be correct.

With NetFrame servers, increased performance can be obtained without changing the basic architecture by increasing the number of 12.5M-byte sub-buses.

Worth the Incompatibility

Some concern has been expressed about the compatibility of the NF-400's unique bus with other PC-based buses and its requirement of a customized version of the NetWare operating system available only from NetFrame.

But this concern is unwarranted. First, the machine's performance and growth potential are worth every ounce of incompatibility and can be achieved only by departing from existing PC bus standards. Second, as NetFrame officials argue, while the XT and AT buses may have been standards, it is not clear today that either MCA or EISA buses will become technical or de facto market-driven standards.

Two of the most interesting and unique features of the NF-400 are its hardware-based remote system-maintenance capability and its redundant power supplies.

The NF-400 server can place a telephone call to any of a group of network managers and, using voice synthesis, verbally report system faults. It can also warn maintenance personnel who carry alert beepers. System-support staff can dial in and remotely diagnose and fix most system problems.

As many as three 600-watt power supply modules can be installed in the NF-400. Should one of the modules fail, the other two are capable of powering a fully populated machine, and the failure is reported by the NF-400's remote system-maintenance feature.

The NF-400 is a whole new chapter in the book of network computing. Both mainframe- and PC-oriented computing managers would be wise to study NetFrame's approach. ■

REPRINTED FROM

MAY 22, 1990

PC WEEK

Some Network Hardware Is Worth Sinning For

I don't know about you, but I often find myself getting excited about a particular piece of computer hardware or software. I'm talking hard-core excitement here. I would do anything, short of committing one of the seven deadly sins, to get one of these products onto my network.

In the belief that talking about it can help one cope with unrequited love, let me discuss my current hot list which contains two items: IBM's RISC System/6000 Unix machines and NetFrame's NF-400 NetWare 386 server.

NET ASSETS

BARRY GERBER

The RS/6000s deliver the most performance for the dollar of any Unix workstation/server line in today's market. They even run circles around some mini and mainframe computers. The RS/6000s are built around a set of processor chips that can execute as many as five instructions per clock cycle. This lets them deliver near-supercomputer performance at prices closer to those of high-end PCs.

I reported my first hands-on experience with the PowerStation 320, the low-end machine in the RS/6000 line, in the April 9 issue. There I noted that a single-processor 3090 mainframe completed a complex number-crunching task less than twice as fast as the PowerStation 320. A 3090 will set you back at least a couple of million dollars. The PowerStation 320 I tested retails for around $22,000.

I've just finished reading a report on some RS/6000 tests done by Margaret Simmons and Harvey Wasserman at the Los Alamos National Laboratory in New Mexico. They found that higher-end RS/6000s came close to or equaled the performance of much more costly machines—like the Convex C-240 and the Cray Y-MP8/832—when running most of the compute-intensive applications in their tests.

The RS/6000s lost only when running code that benefitted from the heavy-duty vectorization that the Convex and Cray do so well.

I've got all kinds of plans for the RS/6000s. A group of them attached to the network would readily serve the needs of our growing legion of statistical and mathematical number-crunchers. Also, because they support very fast disk I/O, one of the RS/6000s would make a super database server.

Don't tell anyone I told you so, but it looks like someone is thinking about turning these speed demons into servers for PC networks. I'm not talking about porting server code to run under Unix as Novell is doing with Portable NetWare. I'm talking PC network operating systems that are compiled to run directly on the RS/6000 processor. Talk about super servers.

Then there's the NetFrame NF-400. You may have seen my pieces on it in the May 7 and 14 issues. If you did, you know I'm pretty high on the machine.

Like the RS/6000 line, the NF-400 is a super performer in its niche. It delivers disk and LAN I/O at speeds comparable to Compaq's Systempro, and it can deliver a lot more of it.

I saw an NF-400 put out 8M bytes of Ethernet LAN I/O and 25M bytes of disk I/O while using 75 percent of NetWare server CPU. That's mainframe stuff.

The NetFrame line is based on a hierarchical bus. The upper end of the bus can handle as much as 100M bytes of data per second. The lower end is composed of eight sub-buses, each with a capacity of 12.5M bytes per second. Into any of these sub-buses you can plug a combination LAN and disk I/O adapter or an application processor, which is a separate CPU with its own memory.

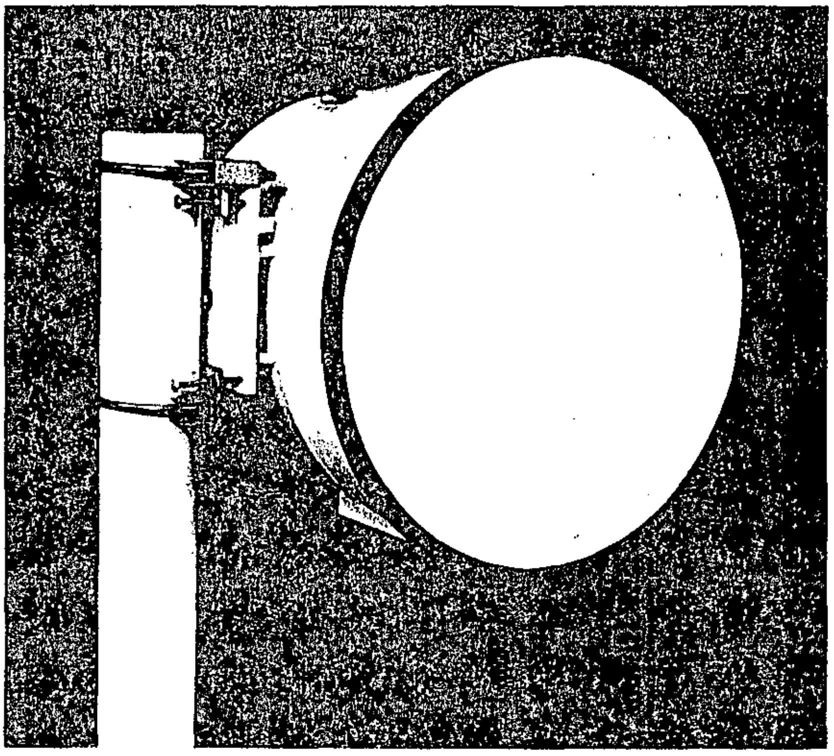
So that's how they get all that disk and LAN I/O. And those application processors position the NF-400s to take on all kinds of functions in the future: database, support for RISC-based Unix, you name it.

Come to think of it, maybe just one of those seven deadly sins wouldn't hurt. ∎

ENLACES VIA MICROONDAS

ETHERWAVE LAN RADIO ®

Microwave Bypass Systems' Etherwave LAN Radio is the systems choice for full bandwidth connectivity of local and remote Ethernets. Combined with the Etherwave Transceiver, the LAN Radio is completely transparent and acts as an extension of the Ethernet backbone or segment. As a fully compliant 802.3 transmission medium, the microwave can span single hop distances of up to 8.6 miles and support full 10Mbps Ethernets with reliability of up to 99.999%. As distance limitation is a function of Ethernet timing constraints, greater distances may be achieved through the use of Ethernet and radio repeaters.



The microwave operates at the 23GHz frequency band and connects via two 75ohm RG6 coaxial cables to an indoor, rack mounted Etherwave Transceiver. A standard 15-pin AUI port at the rear of the Etherwave Transceiver is then connected to any 802.3 Ethernet repeater, bridge or router for retiming, packet filtering, network management, protocol routing, or other desired internetwork functionality.

In addition to Ethernet capability, the Etherwave LAN Radio may also be ordered with a T1 or E1 modem to support one Bell standard T1 or E1 carrier for up to (24) voice or data channels. As a plug in modem, the T1 / E1 option further cost justifies the radio connection by providing multi-channel voice and data service at a low incremental cost. To facilitate approval criteria and trouble-free integration, the Etherwave LAN Radio conforms to and meet CEPT standard CCITT G.704.

The Etherwave LAN Radio is designed as a compact, self-contained integrated system which is easy to install and offers maximum protection against hostile climatic conditions. To prevent rust, corrosion and wind damage, all cables and connectors are run in sealtite conduit and terminate inside a weatherproof RF housing which attaches to a 17", 27" or 48" parabolic antenna with protective radome. This innovative design speeds installation and virtually eliminates service calls due to deterioration in microwave cable integrity, resulting in improved reliability and maximum uptime.

All Microwave Bypass Systems, LAN Radios are factory tested and calibrated to ensure long-term reliability and peak performance. Beyond the usual factory "box testing", MBS conducts an in-house integration, system test and burn-in of the entire Etherwave LAN Radio link including the Etherwave Transceiver along with customer selected bridges or routers.

As the pioneer and leader in LAN microwave applications, Microwave Bypass Systems continually strives to offer the highest quality products and systems engineering, responsive customer service, and unmatched price/performance value. For total convenience and support, end users may avail themselves to MBS' comprehensive turn-key services (worldwide) including: frequency coordination, FCC licensing, path calculation data, systems integration, final test, customer training and after install service and maintenance.

Utilizing modern 23GHz microwave technology, the Etherwave LAN Radio is the high-performance, low cost solution for primary or backup Ethernet connectivity. Redundant configurations are also available for automatic switchover to a co-located radio link, leased line or fiber medium. A comprehensive one year warranty is standard on all Microwave Bypass System's products.

In addition to Ethernet, MBS also offers T-Carrier (T1, T2, and DS3), video and Token Ring radios to meet other application requirements. Contact Microwave Bypass Systems for more information.

SPECIFICATIONS

GENERAL

System Capabilities:
10Mbps LAN
10Mbps LAN + T1
10Mbps LAN + CEPT1

System Gain:
Radio w/17" (43cm) ant: 179db
Radio w/ 27" (69cm) ant: 185db
Radio w/48" (122cm) ant: 193db

Modulation: FM

Frequency Band:
21.20-23.60 GHz
Part 21/Part 94 - All Channels

Equipment Authorization:
FCC Type Number: B2N9CL10050
FCC Type Accepted: Part 94 and 21
FCC Emission designator: 3380F9
Other worldwide authorizations granted.
Contact your local Microwave Bypass Systems representative.

TRANSMITTER SECTION

Power Output:
Typical: 65mW (+ 18dBm)
Frequency Stability:
Better than + .02% of carrier frequency (-30°C to 55°C)
Auto temperature - controlled source.

RECEIVER

Type: Superheterodyne
IF Bandwidth: 33MHz
IF Frequency: 70MHz
Noise Figure: 12 dB nominal
Threshold: (@ 10-6 BER):
LAN Only: -65dBm
LAN w/ T1/CEPT1: -60dBm
T1/CEPT1 w/ LAN: -70dBm

ANTENNA

17" Diameter, 25lbs, w/ 38dB Gain
27" Diameter, 45lbs, w/ 41dB Gain
48" Diameter, 90lbs, w/ 46dB Gain

Polarization: Vertical or Horizontal
Beam width (3dB):

17" antenna	1.7°
27" antenna	1.3°
48" antenna	0.7°

Alignment: Includes coarse and fine adjustment.
Radome: Supplied with all antennas.

POWER REQUIREMENTS

Power Consumption:
Power On: 65 watts
Operating: 40 watts
Input Voltage: 120/240 VAC 50/60Hz
Input to 24VAC remote transformer (included).
-48 Vdc optional
-24 Vdc optional

ENVIRONMENTAL

Temperature Range:
RF Operating:
-30°C to +50°C (-22°F to 131°F)
RF Storage:
-40°C to +60°C (-40°F to 140°F)
Indoor Controller Operating:
-10° to +40°C
Indoor Controller storage:
-30° to +50°C

MECHANICAL

Material:
White, all-weather aluminum coated to MIL C/5541 with stainless steel mounting hardware.

MECHANICAL Continued

Shielding:
Built in conducted and radiated RFI shielding.
Mounting:
Attachment to 3.5" (8.9cm) or 4.5" (11.5cm) O.D. vertical pipe (± 10%)

STATUS INDICATORS

Loss of RF
Loss of Baseband Input
Loss of Baseband Output
Power
Automatic Gain Control (AGC)

INTERFACE

LAN:
BNC-75 ohm (coax)
T1 / E1:
110 ohm balanced (twisted pair).

OPTIONS
(Contact Microwave Bypass Systems)

Hot Standby
Status Indicator Panel
Dual Polarized Antennas
T1/E-1 Multiplexer
Optional Spare Parts Kits
Transportable Antenna Mounts

OPTIONAL SUPPORT SERVICES WORLDWIDE

Frequency Coord./FCC Licensing
Path and Systems Engineering
Installation and Systems Integration
24 Hour Technical Support
Extended Warranty Program

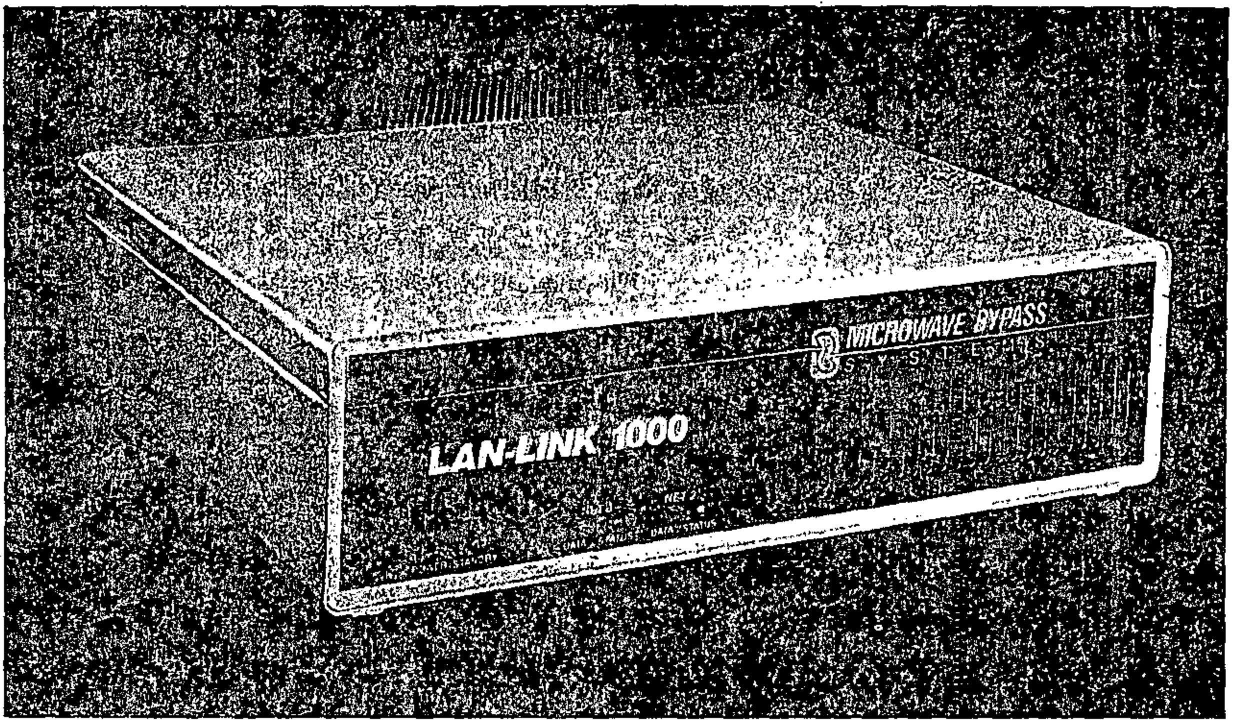
For more information about this and other Microwave Bypass Systems products contact:

MICROWAVE BYPASS
SYSTEMS
25 Braintree Hill Park, Braintree, MA 02184
TEL: 617/ 843-8260 FAX: 617/ 843-6021

File: MBS RADIO SPEC v2.PM4
Printed in USA / October 1991

MICROWAVE BYPASS
S Y S T E M S

LAN-LINK 1000



DESCRIPTION

The LAN-LINK 1000 offers the most efficient and reliable means of connecting local and remote Ethernet segments to form an extended Local Area Network.

The bridge operates at the Data Link layer and is protocol independent. Protocols such as XNS, DECNET, TCP/IP, and others occupy only the data field of an Ethernet packet and pass intact allowing simultaneous transmission of multi-vendor traffic. No external software is required.

Packet filtering in the LAN-LINK 1000 further ensures peak network performance by minimizing inter-LAN traffic. The bridge automatically learns the addresses on each network and forwards only remote data traffic while keeping local traffic from passing through. To provide further control and management of network addresses, a variety of filtering modes and options are available. Other features, such as fault lamps, temperature monitors, battery backed RAM and dual UV and EEPROMs ensure maximum reliability and trouble-free operation.

The LAN-LINK 1000 is optimally designed to meet the expanding needs of the network user providing the throughput, network management and flexibility required in multi-vendor multi-segment LAN environments.

FEATURES

> *High throughput provides transparent connectivity between local and remote network segments*

> *Supports multi-vendor traffic*

> *Cable and transceiver fault lamps on front panel*

> *Automatic learning and/or fixed address entry modes*

> *Battery backed RAM maintains parameters and filter table contents during power outages*

> *Internal thermal monitor shuts unit down to prevent damage from excessive temperatures*

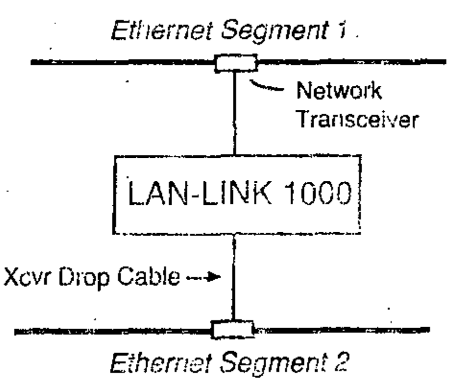
> *Comprehensive network management features report packets transmitted/received, packet error statistics and enable control of filtering parameters*

> *Dial up software enhancements available through a modem attached to RS-232 port*

> *Microwave interface available for 10Mbps Ethernet connectivity between local and remote network segments up to 4.3 miles apart*

SPECIFICATIONS

Architecture:	Data Link Layer (MAC Level) Bridge 82586 Based LAN Coprocessors 68000 16MHz Based CPU 128k Bytes Shared Memory AMD 99C10 CAMs Hardware Filter Assist Storage Capacity-512 addresses per channel 32k Bytes UV and EEPROM Based Parameter Storage Battery Backed RAM (16k byte parameter storage)
Interfaces:	Two IEEE 802.3 or Ethernet 2.0 AUI Connections RS-232 Network Management/Modem Connection
Performance:	7,500 pkts/sec. at 64 bytes (see manual for test information) Filtering rate of 14,000 pkts/sec.
Net Management:	Front Panel Indicators: Power, Tx/Rx Data, Network Status, and Standby Standby lamp indicates self-test and full bridge functionality Network Status lamps indicate transceiver or cable faults Network Monitor Features: •#Packets transmitted and received •#Addresses in each channel filter table •Packet error statistics including collisions, CRC errors, alignment errors, resource errors and overruns
Power:	115v @ 3 amps max. 220v @ 1.5 amps max.
Temperature:	0°C to 40°C (internal thermal monitor)
Humidity:	0% to 80% non-condensing
Altitude:	10,000 feet
Cooling:	Forced air, front to back



The LAN-LINK 1000 extends baseband, broadband, twisted pair, thin-net, and fiber networks.

For more information about this and other Microwave Bypass Systems products contact:

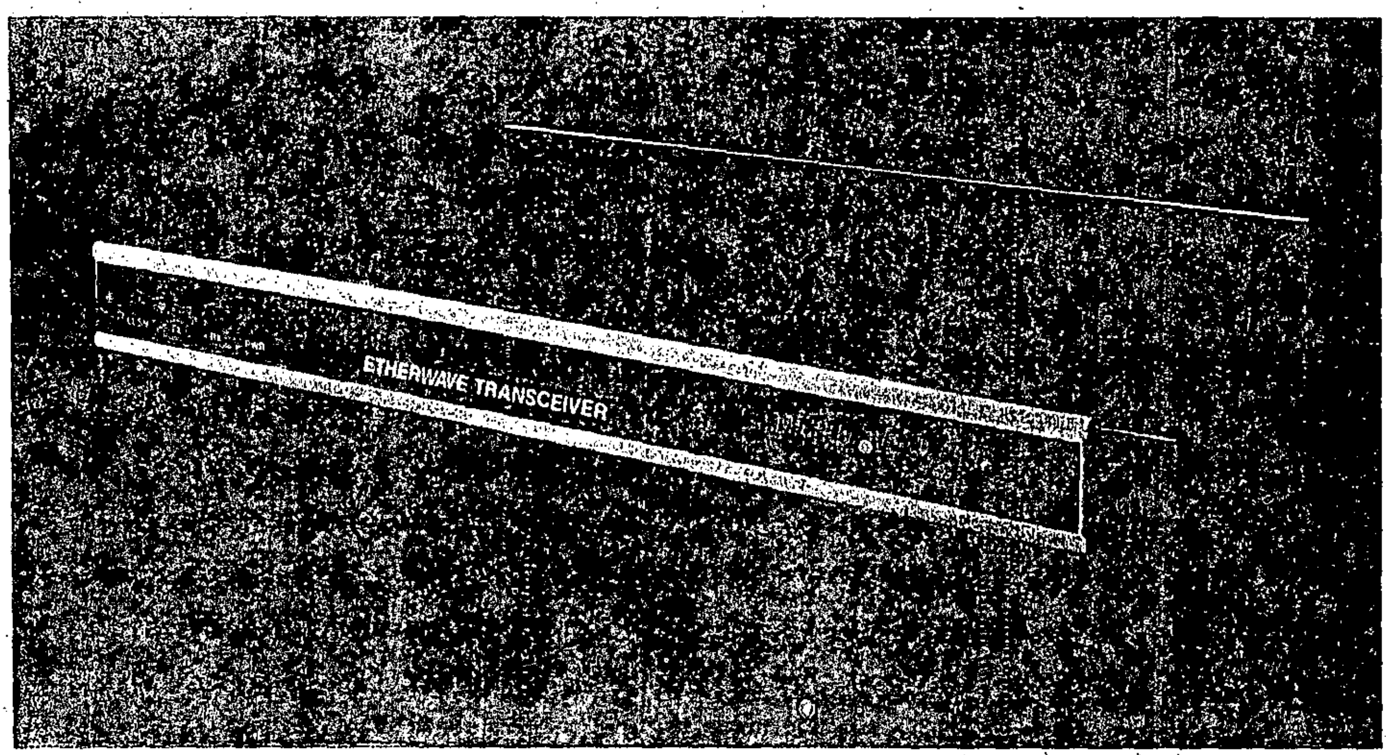
MICROWAVE BYPASS
S Y S T E M S

Microwave Bypass Systems, Inc.
25 Braintree Hill Park, Braintree, MA 02184
TEL: 617/843-8260, FAX: 617/843-6021

2 8

MICROWAVE BYPASS
SYSTEMS

ETHERWAVE TRANSCEIVER®



DESCRIPTION

The Etherwave Transceiver is a LAN/Microwave interface, which combined with the appropriate bridge, repeater, or router provides the Ethernet LAN user with 10 Megabits per second LAN Extension between facilities miles apart. The Etherwave Transceiver acts as a standard 802.3 network transceiver and with the microwave supports transparent transmission of multi-vendor Ethernet LANs at the full 10Mbps data rate.

Links up to 5 miles apart may be supported in a single transmission with link reliability of up to 99.999%. Distance limitation, due to Ethernet propagation delay (46.4µs), allows microwave transmission at 10Mbps for up to 5 miles per link. For longer paths (up to 14 miles) microwave repeaters may be used. Other techniques, involving separation of Tx and Rx paths through the Etherwave Transceiver, can provide 10Mbps transmission for double the single link distance.

The Etherwave Transceiver connects to a bridge, repeater or router via a standard 15-pin AUI connector. The Etherwave then converts the signal to operate directly with the analog input and output of a broadband microwave radio. As in a standard Ethernet transceiver, the Etherwave obtains its power from the repeater or bridge. Four front panel LEDs provide visual indications of transmit and receive data, collision detect and power.

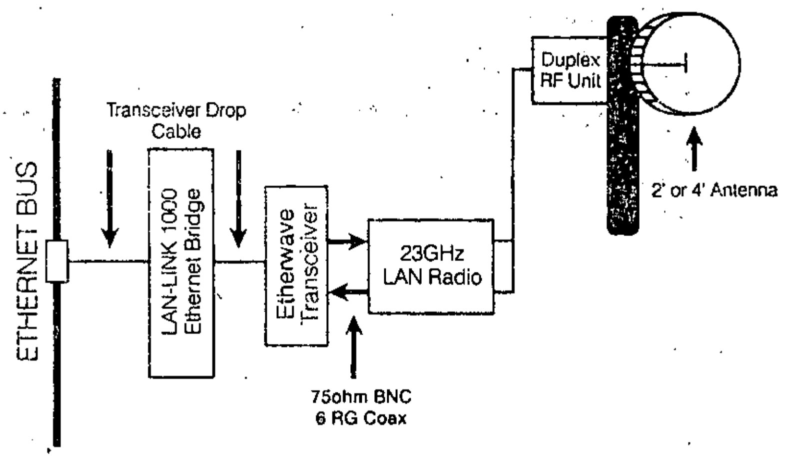
SPECIFICATIONS

System:	Allowable round trip propagation delay: 46.4µs Typical link separation: up to 5 miles per link Bit error rate: approx. 1 in 10/9
Radio Interface:	Transmitter — Baseband output to transmitter — 1 volt pk to pk into 75ohms Signal Encoding — Baseband Manchester Receiver — Baseband input from receiver — 1 volt pk to pk into 75ohms Signal Encoding — Baseband Manchester Signaling Bandwidth — 20MHz
Device Interface:	Conforms to Ethernet 2.0/802.3 (Ref. "The Ethernet", Digital Intel Xerox, Version 2.0)
Power Requirements:	+12volts to +15volts ±5% @ 0.5amps. (Power supplied through the device connector)
Front Panel:	Four Status Indicators: Power — Receive — Transmit — Collision
Rear Panel:	Output to transmitter — BNC female Input from receiver — BNC female Device connect — DB — 15-pin male with slide lock posts
Mechanicals:	Height: 1.75" Mount: 19" Standard E.I.A. rack compatible

DIAGRAM OF TERMINAL END

10Mbps LAN Extension over wideband microwave

Example of equipment configuration for baseband LAN transmission



Etherwave Transceiver and LAN-LINK 1000 are registered trademarks of Microwave Bypass Systems, Inc.

Microwave Bypass Systems believes the printed matter herein to be accurate from date of publication and reserves the right to make changes to its contents without notice.

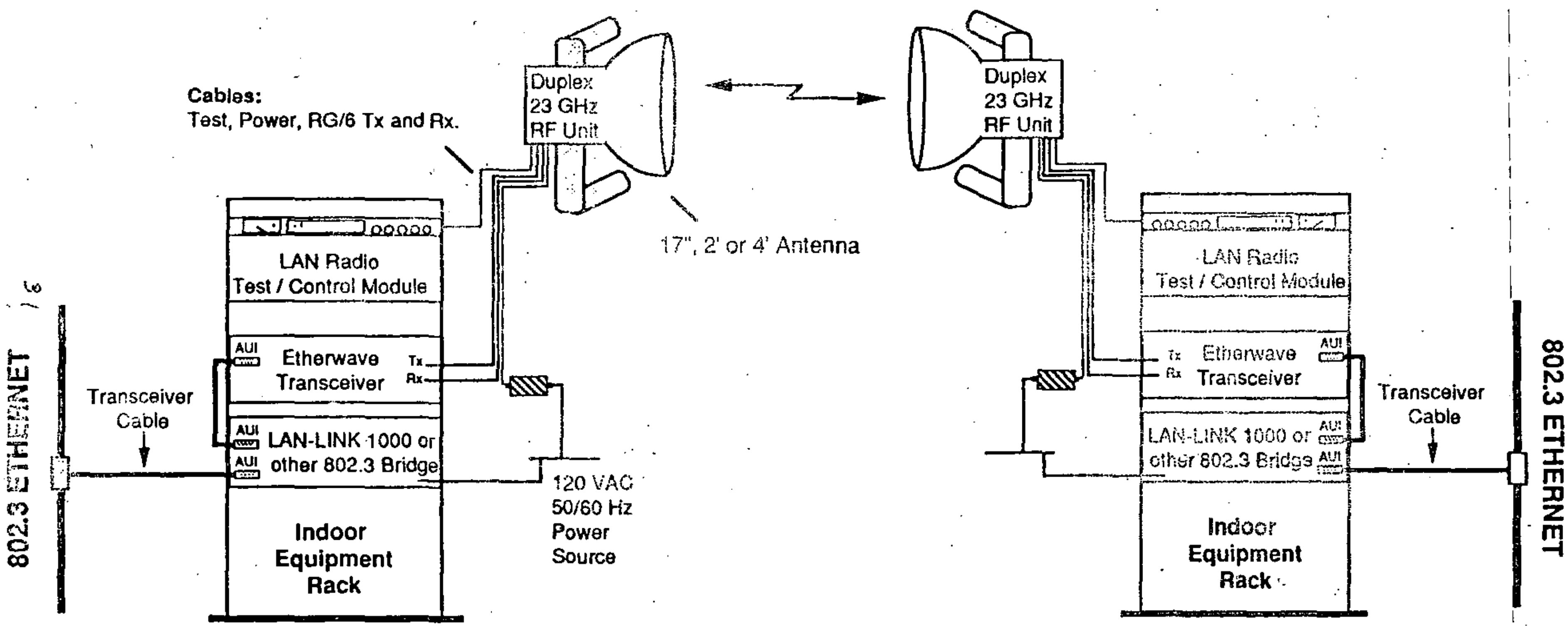
For more information about this and other Microwave Bypass Systems products contact:

MICROWAVE BYPASS SYSTEMS

Microwave Bypass Systems, Inc.
25 Braintree Hill Park, Braintree, MA 02184
617/843-8260 FAX 617/843-6021

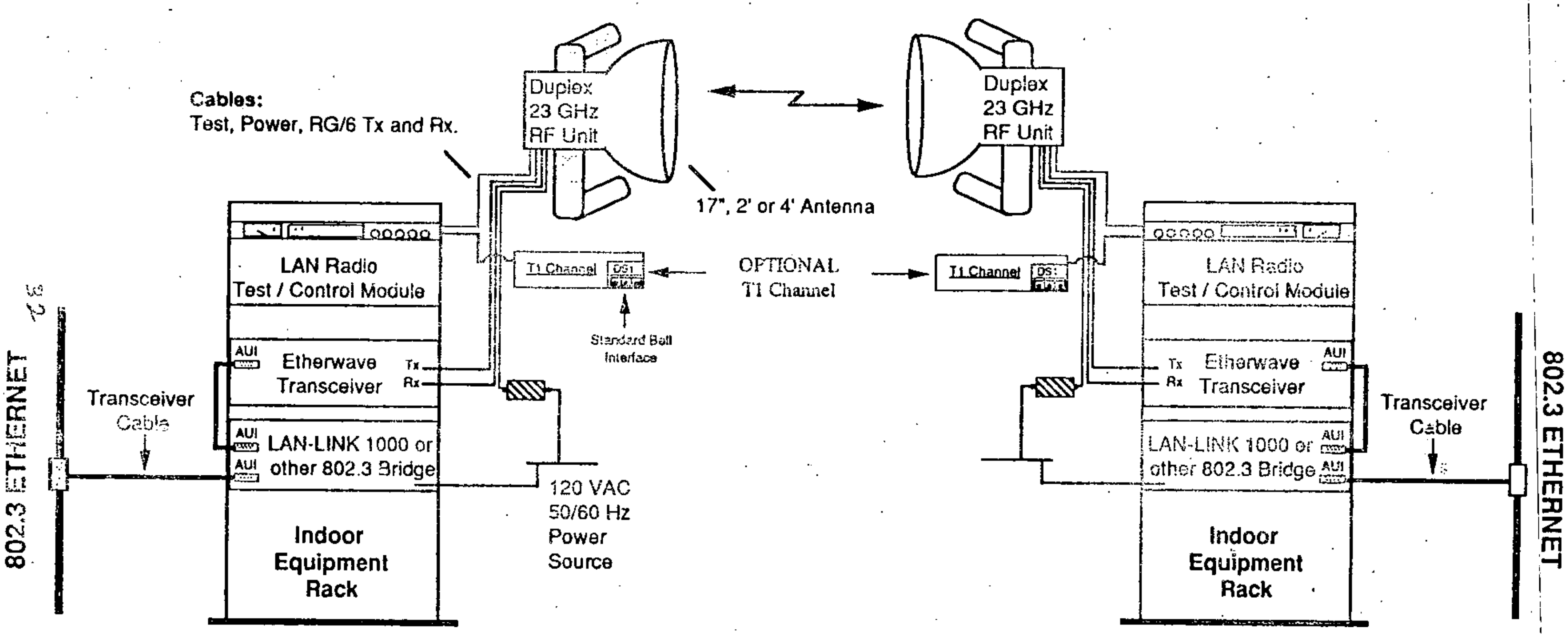
Standard System Configuration

10Mbps Ethernet
over Wideband Microwave



Standard System Configuration

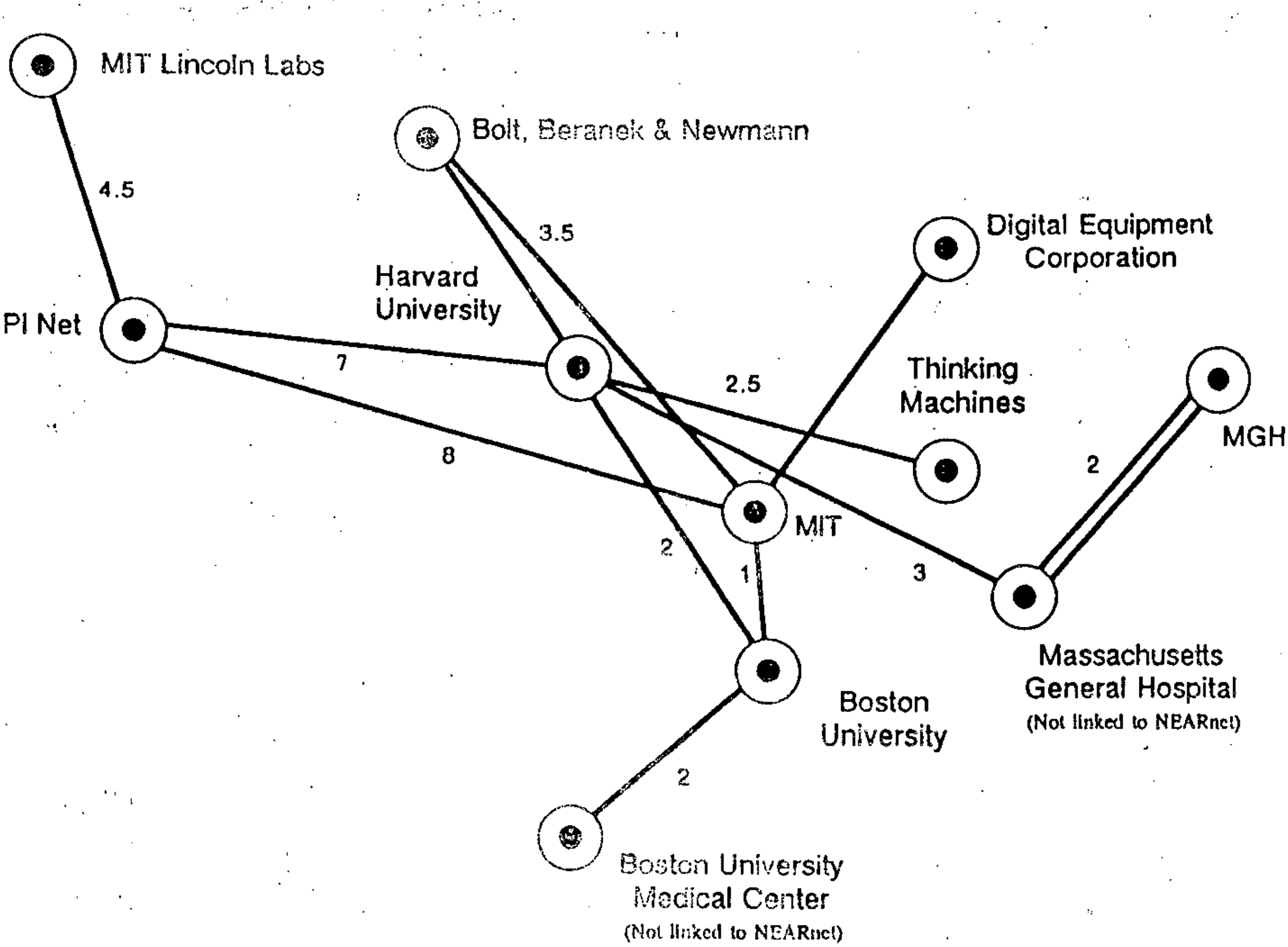
10Mbps Ethernet + T1
over Wideband Microwave



Microwave Bypass Systems, Inc.

Application Note: NEARnet Configuration

New England Academic Regional Network
Full Bandwidth 10Mbps Ethernet over Microwave



Note:

Numbers shown indicate approximate distance in miles.

All 10Mbps Ethernet Microwave Links configured, installed, serviced and supplied by Microwave Bypass Systems, Inc., 25 Braintree Hill Park, Braintree, MA 02184 Tel: 617/843-8260, FAX: 617/843-6021.

Millas

LAN TIMES®

OCTOBER 21, 1991 McGRAW-HILL'S INFORMATION SOURCE FOR NETWORK MANAGERS VOL. 8, ISSUE 20

LAN TIMES **ENTERPRISE NETWORKING**

Microwave Proves Beneficial for Networks

Provides LAN bandwidths, high reliability for fraction of the cost of laying fiber

BY DAVID S. THEODORE

The overriding factor when considering a transmission medium is bandwidth. Bandwidth is money, but the cost of the transmission medium is not just the expense of installing or maintaining the connection. Too much bandwidth can be a waste of money, but too little bandwidth can cost even more in terms of impaired user productivity. Also, what may seem like a savings up front can be wiped away in minutes with a single outage on a critical data path.

What is the practical relationship between network efficiency, uptime, and cost of the transmission medium? There is no absolute answer to this question. Every network manager is faced with a different set of circumstances and must make an independent evaluation when deciding how to connect local and remote networks. For instance, certain transmission mediums may be unavailable in a particular area or could vary in price.

REVIEWING THE SITUATION. First, to set the groundwork, the preferred LAN transmission options are leased T-1 lines, fiber-optic cabling, and microwave. These are the more robust and reliable options, although connections across streets or parking lots are also made with infrared and laser.

Each transmission option has its own benefits and drawbacks in terms of price, delivery, bandwidth, and reliability. Since the advent of LANs, the most widely available and accepted mediums have been leased Bell services and fiber optics. Unfortunately, leased lines and fiber (leased or owned) are at extreme opposite ends of the transmission spectrum in terms of bandwidth, cost, availability, and installation.

tech tutor

Leased lines are most convenient in terms of delivery and installation. Just call Bell and order a T-1, select a vendor to provide the appropriate LAN-to-T-1 interface, and 60 days later your networks can be changed over to T-1. While T-1 connections are easy to install and convenient, bandwidth is not up to LAN speeds and first year costs can be nearly $30,000 for a two-mile connection.

As for fiber, if it is not cost prohibitive, it offers plenty of bandwidth and high reliability. Installation, however, can

'The overriding factor when considering a transmission medium is bandwidth.'

be an arduous task. Prior to physical implementation you may spend a good deal of time planning and doing the political lobbying necessary to secure local or state authorization to cross certain public ways. Finally, fiber installations tend to be permanent and therefore less practical for connections to leased buildings or temporary sites.

Microwave, by contrast, is almost always more convenient and cost effective for path distances of up to 20 miles. While line of sight is necessary for microwave, it is generally easier to obtain than getting right of way for fiber.

A LITTLE BACKGROUND. Microwave has proven its benefits and enjoyed wide user acceptance for telecommunications since the mid-1980s. Network managers, however, are just now beginning to consider it as a viable option for extending their networks. This may be partly attributed to misconceptions surrounding radio technology, but is mostly due to the fact that in the past microwave could only offer T-1 speeds for LAN transmission.

This is no longer the case because radios now provide transparent support for full-bandwidth Ethernet and token-ring networks. This is achieved through the combination of wider bandwidth radios and the appropriate microwave-to-LAN interface devices. Network managers should no longer feel compelled to grudgingly accept slower speed T-1 lines simply because cost or right-of-way issues prohibit the installation of fiber.

Today, many of the nation's most prestigious hospitals, universities, and corporations are relying on microwave radio technology to complete critical network paths. Universities such as MIT, Harvard, Princeton, and Boston University are connecting campus networks and linking to regional spurs of the Nsfnet to share academic and research information. Support of real-time medical imaging between hospital facilities saves millions of dollars in personnel hours while helping to maximize the use and benefits of expensive medical diagnostic equipment. Finally, LAN vendors such as Banyan, Digital Equipment Corp., Data General, [illegible] Software, and Thinking Machines use wireless LANs to support their own networking requirements.

LOOKING AT THE BENEFITS. Any thorough analysis of wireless LAN interconnection must take into account the benefits and uses of the technology as well as its limitations. It may be a monumental understatement to say that the limitations have less to do with the technology than with the microwave industry itself. Put simply, radio vendors did not make a successful migration into the end-user market when AT&T's divestiture provided the ideal opportunity. Most radio manufacturers still do not know how to relate to the end user and this has resulted in many unfortunate examples of neglect. I will examine this issue further.

First, let's look at what microwave will do. I will confine my examples to Ethernet applications since they comprise over 80 percent of the wireless LAN interconnects made to date. Microwave will extend full 10Mbps Ethernets between local and remote sites for up to 8.6 miles in a single transmission. At 8.6 miles, the Ethernet propagation delay allowance is exhausted and requires that the Ethernet be retimed through a repeater, bridge, or router. To date, the longest wireless 10Mbps Ethernet connection spans just over 20 miles through the use of microwave repeaters.

As for reliability, a properly configured radio link will offer far higher reliability than Bell's standard 99.85 percent, typically reaching 99.999 percent. Virtual 100 percent uptime may be achieved through various automatic backup schemes. For instance, on short distance paths where hardware failure is the only concern, a backup microwave link may be recommended. Another technique involves closing a loop between three or more sites in such a way that traffic may be rerouted to an available path in the event of an outage. In this scenario any single path outage will have no noticeable effect on the user's ability to communicate to any segment. Other backup schemes may involve an automatic switchover to an alternate media such as leased lines or fiber.

Another advantage of microwave is that it offers the bandwidth and flexibility to be configured for very high bandwidth applications. While microwave does not support FDDI speeds, it would be a mistake to dismiss its high bandwidth capabilities. Microwave comes in many bandwidth options, from a single T-1 to 10Mbps and DS3 radios. In addition, numerous radios may be multiplexed onto a single set of antennas for multiple Ethernet, token-ring, video, and T-carrier channels between the same two locations.

Installation is also a plus. An Ethernet microwave link can be delivered in about 60 days. Installation, final test, and cutover of a typical point-to-point link can be completed by two people in three days.

Finally, a fully installed and licensed 10Mbps Ethernet link may be purchased for between $35,000 and $40,000 depending on whether repeaters, bridges, or routers are used to retime and manage data at each end of the link. Just as with fiber optics, the microwave simply acts as a transmission pipe while the retiming device provides all the functionality required between local and remote networks. A microwave link will support packet filtering, protocol routing, SNMP, spanning tree, and other features.

POSSIBLE LIMITATIONS. Now for the limitations, real and imagined. First, many people believe that finding a set of available frequencies is difficult. This is too broad a statement and it is simply not the case for the higher frequencies reserved for LAN radio applications. There are dozens of radio frequency bands. The FCC reserves some of them for government agencies and common carriers while allocating others for private users. LAN radios operate at either 18GHz or 23GHz. The 23GHz band alone has over 22 pairs of frequencies and each may be vertically or horizontally polarized, thereby doubling the pool of possible frequencies. A pair of frequencies may even be shared by two or more radios from the same rooftop, as long as their path angles are separated by at least 10 degrees.

Another misconception is that a microwave path is impaired by adverse climatic conditions. Microwave should not be confused with other, less robust wireless technologies such as laser and infrared. Microwave is impervious to fog, smoke, snow, smog, and all but the most severe rainstorms, whereas laser and infrared must have clear air for reliable transmission. A half-mile 23GHz microwave link in New England will have a path reliability percentage in excess of 99.999 percent, while the same path with laser or infrared will be under 99 percent. These numbers seem close, but as an actual representation of downtime they mean the difference of less than five minutes in annual downtime for microwave versus over 90 hours for laser or infrared.

As I indicated earlier, the downside of microwave has much more to do with the radio industry itself than with the technology. It is easy to understand the problem when you consider the radio market prior to AT&T's divestiture. There was no end-user "bypass" market and the customer profile was vastly different from what it is today.

For decades, radio manufacturers were selling mostly to other radio engineers at AT&T, government and defense agencies, and radio and television stations. Not long ago, in the days of copper cable, radio technology was absolutely vital to the day-to-day business operations of these customers. They staffed their own radio engineers and installers and invested heavily in microwave test equipment and spares. Because their customers were so self-sufficient, radio manufacturers could afford to be "box vendors." Also, these customers tended to purchase dozens of radio links at a time.

Today's end-user market is much more challenging as compared to the traditional market. The average end user purchases only one or two radio links, but requires more service and support than customers in predivestiture days. While a microwave link may be just as critical to business operations of today's users, users cannot afford nor are they inclined to maintain their own radio engineers and test equipment. If their link goes down, end users expect the vendor to provide speedy and responsive service.

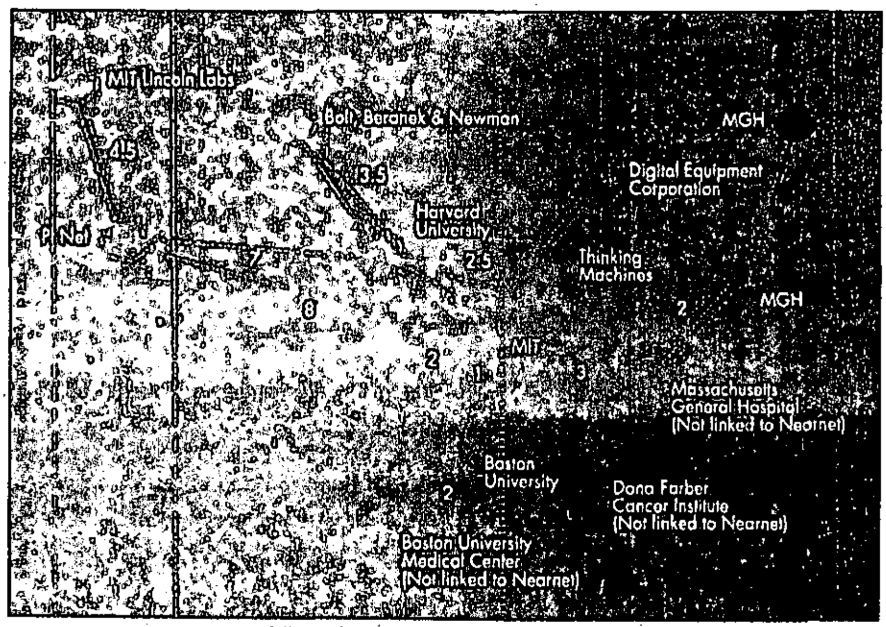
Finally, while traditional users took care of their own frequency coordination, FCC licensing, and installation, today's user has no experience in such areas and needs the vendor to provide these services. Radio vendors who want to succeed in this market should understand that turn-key installation and responsive service and support must be provided.

'The downside of microwave has more to do with the industry than the technology.'

Perhaps the most significant decision when purchasing a LAN microwave link is to select the right vendor. Important considerations are the vendor's qualifications and experience in both the LAN and microwave arenas. Can the vendor properly differentiate a network or bridge failure from a radio problem? Also of importance is the vendor's ability and willingness to provide turn-key services and assume total system responsibility. From configuration to installation and cutover, the right vendor will ensure the successful implementation of a LAN microwave link and help you to gain the most benefits from the technology.

Microwave may not be the best solution for every internetworking requirement, but it could solve the old cost/bandwidth tradeoff between leased lines and fiber. For short-haul applications, microwave provides LAN bandwidths and high reliability for a fraction of the cost of laying fiber. It also serves as a low-cost complement or alternative backup medium to existing fiber connections. Network managers who are evaluating LAN transmission options should make microwave a part of that process. ◘

David S. Theodore is the president and founder of Microwave Bypass Systems Inc., which pioneered and now specializes in LAN microwave connectivity. The company can be reached at (617) 843-8260.



MICROWAVE. Nearnet runs full-bandwidth 10Mbps Ethernet over microwave. Distance is in miles.

3 C

LAN TIMES

JANUARY 21, 1991 McGRAW-HILL'S NETWORK COMPUTING PUBLICATION VOL. VIII, ISSUE II

Charting the '90s Top LAN Contenders

MBS, Retix, and Articulate Systems are key players to watch

BY LAURA DIDIO

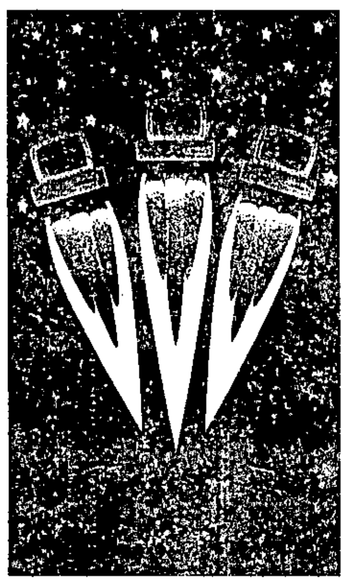
In the second of a three-part series, *LAN TIMES* profiles some of the key LAN companies to watch in 1991. Several of the firms have been on the scene for years and are just now beginning to experience exponential growth. Others are startups that have yet to introduce their first products. But whether they're veterans or newcomers, located on the East or West Coast, they share a number of common attributes.

All are in the sizzling interconnectivity market, all boast corporate managers with impeccable credentials (affiliation with the Massachusetts Institute of Technology [MIT] cropped up often), and despite the current economic recession, all have been courted by venture capitalists who want to get in on the ground floor of these companies on the chance they could be the next Microsoft or Novell. One such company is Microwave Bypass Systems Inc. (MBS).

MBS owes its existence to the ingenuity and ambition of 29-year-old founder and president David Theodore, who took 1950s microwave radio technology and gave it new life in the 1990s as a transmission medium to connect remote 10 megabits per second (Mbps) Ethernet LANs located at distances up to 10 miles apart.

While there are several other microwave companies in the market, Microwave Bypass distinguishes itself from the competition by being the only microwave company that is also a LAN company, offering users full Ethernet/microwave systems as well as service and support, according to Doug Gold, director of local area network communications research at International Data Corp. (IDC), of Framingham, Mass.

Theodore, a political science major at Boston College, likes to say that his business has been built the old-fashioned way: lots of hard work (he does at least six installations a year himself), a commitment to service (he often gives customers his home phone number, works weekends, and vows to get to an outage site within hours after a report of trouble), and old-world trust (Theodore has been known to consummate deals with just a handshake).



BLAST OFF. Several LAN companies are poised for stellar growth.

> **Microwave Bypass Systems Inc.**
> Braintree, Mass.
> Founded: 1985; privately held.
>
> **Management:**
> David Theodore, founder, president and CEO.
>
> **Products:**
> 10Mbps Ethernet systems that utilize microwave transmissions, including the Etherwave Transceiver and the LAN Link 1000, a Data Link Layer bridge with network management capabilities.

Theodore had no background in engineering and not the slightest notion of getting into the LAN arena. It was in his first job out of college selling leased line services for MCI, that Theodore realized that microwave could often prove to be a technically more feasible and economical way to link remote local area networks over short- and medium-haul distances than telephone lines.

In 1984, Theodore managed to wangle a six-month consulting contract from Macom, which allowed him to start marketing and selling microwave equipment "to anyone who would give me the time of day," Theodore recalls.

"This was just after the AT&T divestiture, and for the first time, telephone company customers had the option to go with alternative, less expensive technologies," Theodore said. "I was basically acting like a vacuum cleaner salesman; I just kept knocking on the doors of prospective customers."

Within a few months he made his first few sales and incorporated Microwave Bypass Systems. Among the fledgling firm's first customers were Massachusetts General Hospital and Harvard and Boston universities.

David Murphy, the network and systems manager at Massachusetts General, said the hospital became Microwave Bypass' first customer for very practical reasons.

"We went with microwave technology because we had no other alternative," Murphy said. "We couldn't lay fiber-optic cable between the main hospital facility in Boston and our Cardiac Care and Computer Center in Charleston because the two facilities are separated by water, and the cost would have been prohibitive. The microwave link only cost us $35,000. And at 1.54Mbps, T-1 lines were too slow; we needed the full 10Mbps bandwidth."

Murphy said the hospital was willing to take a chance and give Microwave Bypass its business over a large, established systems vendor because the hospital was confident of the microwave technology and because MBS pledged better service and support.

AMBITIOUS. MBS' Theodore has combined microwave technology with Ethernet LANs.

"The hardest part was doing the interface between Ethernet and radio equipment; and we figured we'd get better service," Murphy said. "Over the past several years, MBS has given us exemplary service and support; the microwave equipment reliability is excellent."

Murphy said that Massachusetts General Hospital has experienced "some weather-related outages due to heavy rain," but he added that "it was partially our own fault in terms of where we installed the microwave dishes; we've since corrected the problem."

Microwave Bypass has come a long way since that first sale to Massachusetts General. It boasts customers in eight countries. In the U.S. its users include MIT; the Smithsonian Institution; Reynolds Aluminum Co.; Smith, Kline & Beecham; and the University of California at Berkeley.

Additionally, it has ongoing relationships with large systems vendors like Data General Corp. and is pursuing strategic relationships "with all of the top router vendors," according to Theodore.

Among MBS' major accomplishments is the fact that it has enhanced the technology to effectively double the maximum distance between Ethernet segments linked by microwave from 4.3 miles to up to 9 miles without having to install a repeater.

Additionally, MBS won the contract to install and service several dozen microwave links to interconnect various universities, businesses, and research facilities on the New England Academic Research Network (Nearnet).

Theodore acknowledged that using microwave signals to transmit Ethernet data "is still a mysterious technology to a lot of users, since they haven't had a lot of experience with it."

Nonetheless, Theodore and IDC's Gold asserted that microwave technology is finding more and more adherents because of its inherent reliability, security, and low cost ($35,000 for a complete system) and maintenance. Theodore also pointed out that microwave is inherently a more secure medium than fiber-optic cable or dial-up modems.

"In order for someone to tap into a high-frequency microwave signal, the would-be data thief would have to physically place an antenna in the transmission path between the two microwave dishes just to intercept the signal, and after that they'd have to find a way to convert the data to Ethernet," he detailed.

Based on these facts, MBS is projecting that its sales will double every year for the next five years. To date, Theodore has eschewed all offers from potential investors in the venture capital (VC) community for funding, although he said he's open to outside financing at the right time.

"VC money would be the easy way to go, but it would have to be the right partnership. For the time being, I'd still prefer to keep fanning the entrepreneurial fires."

Meanwhile, MBS will concentrate on what it does best: putting new networking spins on good old reliable microwave. It recently added support for the Simple Network Management Protocol (SNMP) to its LAN Link 1000 Bridge, which will begin shipping at the end of first quarter 1991. MBS also currently offers 4Mbps token-ring transmissions over microwave via interfaces and LAN gateways. The company has no plans at this time to support 16Mbps token-ring transmissions over microwave, but Theodore said when and if his customers want that capability, Microwave Bypass will provide it.

ENLACES CON FIBRA OPTICA

FDDI Applications and Network Design

Michael Francini
Senior Product Manager

OVERVIEW

- Networking the 90's with FDDI
  - Expanded Enterprise LANs
  - Client/Server Networks
  - Special Applications

- Network Design with FDDI
  - Network Topology
  - Integrating Existing Networks
  - FDDI Host Systems
  - Desktop FDDI

THE CHANGING SHAPE OF INFORMATION

- Increased Graphical Data
  - Graphics, Imaging, Video

- Distributed Computing
  - Relational, Peer-Peer, Transaction Processing

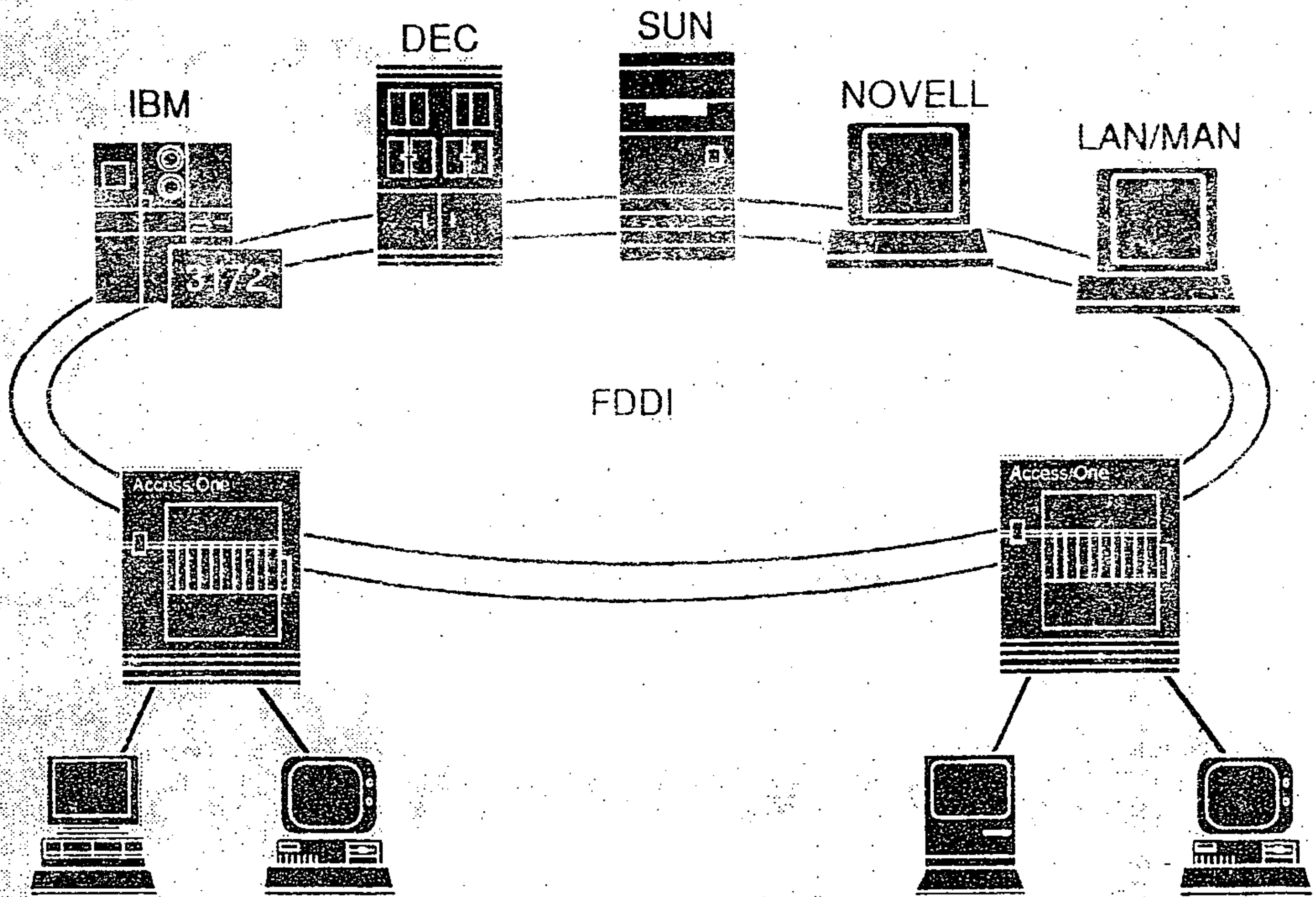
- Mission Critical Applications
  - Manufacturing, Financial, Engineering
  - Individual Productivity → Enterprise Productivity

ENTERPRISE NETWORK CHALLENGE

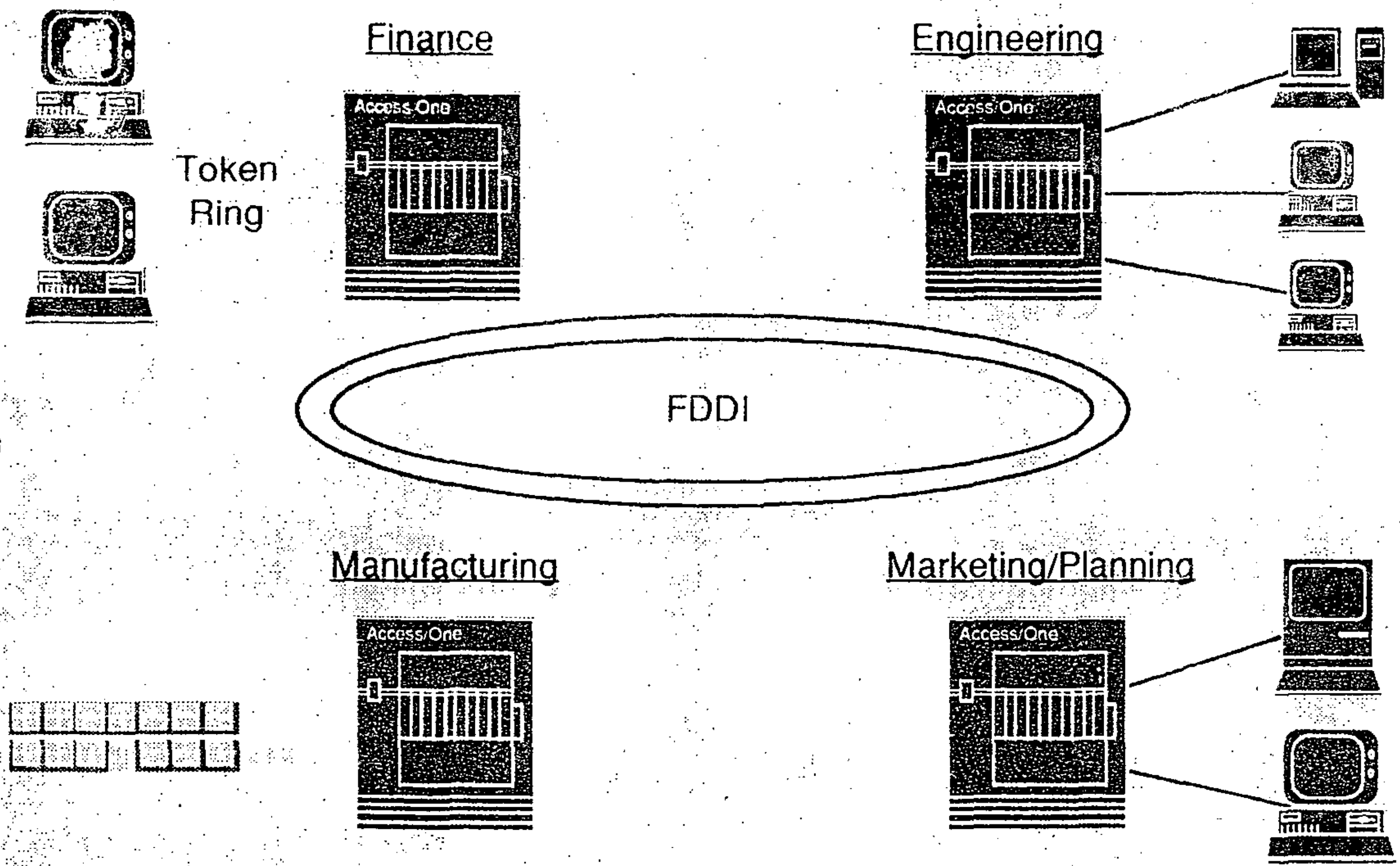
Satisfy businesses insatiable

need for information

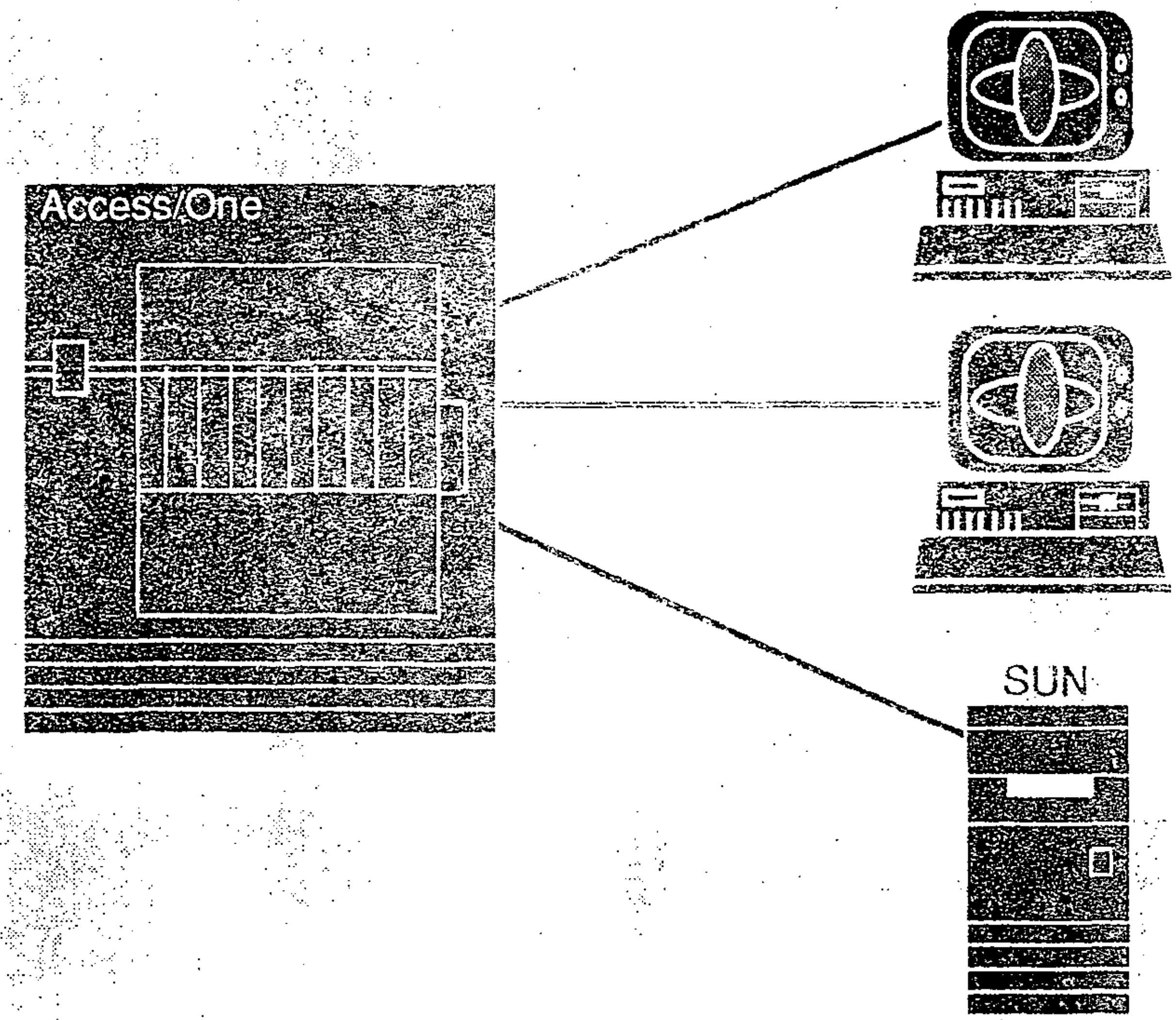
HIGH PERFORMANCE CLIENT/SERVER SYSTEMS



EXPANDING REQUIREMENTS OF ENTERPRISE NETWORKS

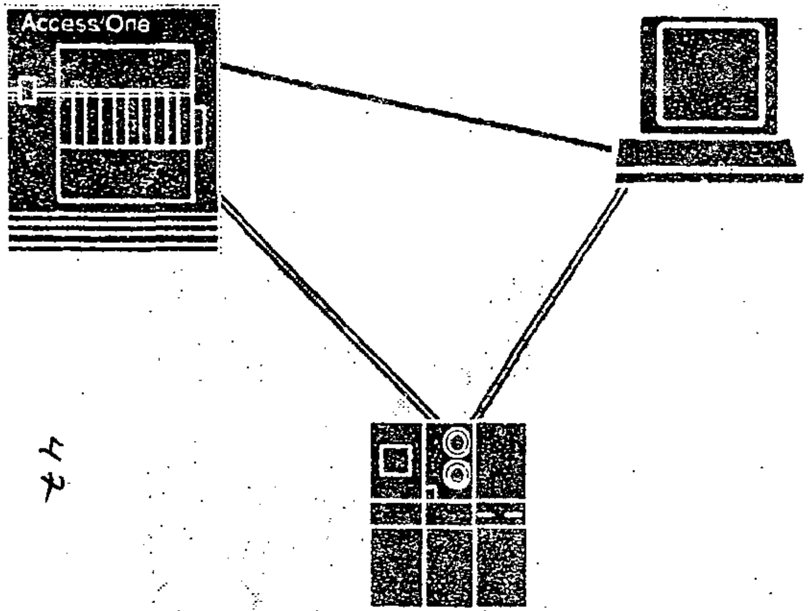


HIGH PERFORMANCE SPECIALIZED APPLICATIONS



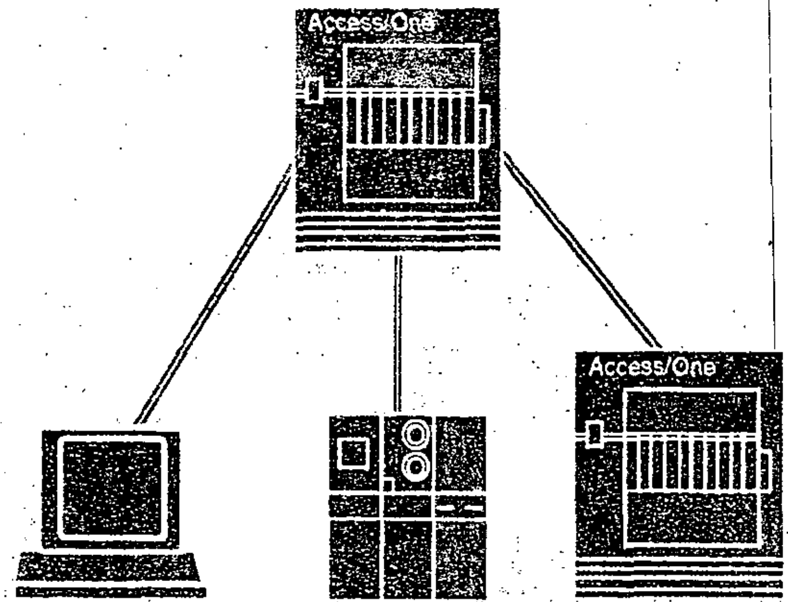
FDDI NETWORK TOPOLOGY

DAS Topology



DAS
- Redundancy
- Distance

SAS Topology



SAS
- Economy
- Control

BASES DE DATOS

DIRECTORIO DE ASISTENTES AL CURSO: TALLER DE REDES (LAN) DE MICROCOMPUTADORAS (PARTE IV)

DEL 15 DE JUNIO AL 26 DE JUNIO DE 1992

1.-HUMBERTO BOJORGES FLORES
JEFE DE DEPARTAMENTO
INSTITUTO MEXICANO DE CINEMATOGRAFIA

ATLETAS No. 2
COUNTRY CLUB COYOACAN
04220 MEXICO, D.F.
TEL. 6 89 57 86

CDA. TEMASCALIXPA No. 5
SAN PABLO.
56270 MUNICIPIO DE CHINCONCUAC

2.-NOE CRUZ MARIN
TECNICO ACADEMICO
U.N.A.M.

CIUDAD UNIVERSITARIA

FELIPE ANGELES No. 25
LA CONCHITA TLAHUAC
13720 MEXICO, D.F.
TEL. 8 41 42 41

3.-FERNANDO CUEVAS PEREZ
PASANTE
INSTITUTO MEXICANO DEL PETROLEO

EJE CTRAL. LAZARO CARDENAS No. 152
SAN BARTOLO ATEPEHUACAN GUSTAVO A. MADER
07730 MEXICO, D.F.
TEL. 3 68 59 11

PEÑON No. 58 DEPTO. 401-A
MORELOS CUAUHTEMOC
06200 MEXICO, D.F.
TEL. 5 29 12 67

4.-JESUS DAMIAN SANCHEZ
PROGRAMADOR DE COMPUTADORAS
INSTITUTO MEXICANO DEL PETROLEO

ATLETAS No. 2
COUNTRY CLUB COYOACAN
04220 MEXICO, D.F.
TEL. 6 89 57 86

CALLE 1509 No. 88 SECC. 6
GUSTAVO A. MADERO.
07920 MEXICO, D.F.
TEL. 7 96 28 67

5.-EFRAIN FLORES PRIEGO
OPERADOR DE RED
TELEVISA, S.A. DE C.V.

EJERCITO NACIONAL No. 579-2o. PISO
GRANADA MIGUEL HIDALGO
11520 MEXICO, D.F.
TEL. 2 03 92 61

6.-GUSTAVO GARCIA GUTIERREZ
SUPERVISOR DE SISTEMAS
SERVICIOS ADMVOS.LOZANO HMNOS.S.A.DE C.V

LORENZO BUTURINI No. 118
OBRERA CUAUHTEMOC
06800 MEXICO, D.F.
TEL. 7 61 01 21

AV. MORELOS No, 595 EDIF. 2 DEPTO 308
VENUSTIANO CARRANZA
MEXICO, D.F.
TEL. 5 52 46 39

7.-MA. DEL CARMEN JUAREZ HUERTA
SUPERVISOR DE PROGRAMAS Y PROYECTOS OBRA
TELECOMUNICACIONES DE MEXICO

PLAZA VILLA MADERO No. 1
ROMA CUAUHTEMOC
06700 MEXICO, D.F.
TEL. 2 07 65 36

SAN ANTONIO No. 120
SAN JOSE DE LOS LEONES
53760 NAUCALPAN EDO. DE MEXICO.

8.-PATRICIA ISABEL MORALES BOBIS
ANALISTA ADMINISTRATIVO
S.C.T.

GUNDI Y ALCOCER ESQ. MISTERIOS S/N

90008 TLAXCALA, TLAX.
TEL. 2 41 16

REFORMA NORTE 419 DEPTO. 2

90500 HUAMANTLA, TLAX.
TEL. 2 08 85

9.-CESAR MOTA GOMEZ

S.C.T.

10.-HERIBERTO OLGUIN ROMO

11.-MARIO PEGUERO PARRA

PERDIZ No. 34
LOMAS VERDES
53120 NAUCALPAN, EDO. MEX.
TEL. 3 43 29 37

12.-ALBERTO ROMERO TREJO
KEFE DE DEPTO.
SRIA. GRAL. DE PLANEACION Y EVALUACION

DR. LAVISTA NO. 144
DOCTORES CUAUHTEMOC
06720 MEXICO, D.F.
TEL. 5 88 10 37

POLEN No. 51
EL RELOJ COYOACAN
04640 MEXICO, D.F.
TEL. 6 84 77 51

13.-FRANCISCO A. RUIZ TALLEDOS
PROFESIONAL ESPECIALIZADO "B"
INSTITUTO MEXICANO DEL PETROLEO

EJE CTRAL. LAZARO CARDENAS No. 152
SAN BARTOLO ATEPEHUACAN GUSTAVO A. MADER
07730 MEXICO, D.F.
TEL. 3 68 93 33 EXT. 20351

VALLE DE PAPANTLA MZ.34 LOTE C DEPTO.303
FUENTES DE ARAGON
55210 ECATEPEC. EDO. DE MEXICO.
TEL. 7 76 29 40

14.-FERNANDO ARTURO SANCHEZ MORGAT LOPEZ
OPERADOR DE RED
TELEVISA, S.A. DE C.V.

EJERCITO NACIONAL No. 579 2o. PISO
GRANADA MIGUEL HIDALGO
11520 MEXICO, D.F.
TEL. 2 03 92 61

15.-FRANCISCO JAVIER SANCHEZ SANCHEZ
ANALISTA DE SISTEMAS
SRIA. DE PLANEACION Y EVALUACION.

DR.LUCIO ESQ. DR. VERTIZ
DOCTORES CUAUHTEMOC
06720 MEXICO, D.F.
TEL. 588 10 37

NORTE 60 A No. 3650
GUSTAVO. A. MADERO
07880 MEXICO, D.F.
TEL. 7 57 17 71

16.-GABRIELA S. VALDEZ MARTINEZ
ANALISTA
SRIA. GRAL. DE PLANEACION Y EVALUACION

DR. LAVISTA No. 144
DOCTORES CUAUHTEMOC
06720 MEXICO, D.F.
TEL. 5 88 10 37

COAHUILA No. 111 C
PROVIDENCIA GUSTAVO A. MADERO
07550 MEXICO, D.F.
TEL. 7 10 76 47

17.-MARIA DEL CARMEN ZARATE RAMIREZ
ANALISTA PROGRAMADOR
ENCAJES MEXICANOS, S.A. DE C.V.

BOULEVARD TOLUCA No. 4
SAN FRANCISCO CUAUTLALPAN.
NAUCALPAN, EDO. DE MEXICO.
TEL. 3 58 38 00

CALLE 8 EJE SATELITE No. 16
VIVEROS DEL VALLE
54060 TLALNEPANTLA, EDO. DE MEXICO.
TEL. 3 97 56 92