Unite Technology Conference

TCP/IP Basics

For The

ClearPath/A Series User

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MGS, Inc.

Session AS4086
1:30pm - 3:45pm
Tuesday October 3, 2000

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Introduction

- MGS, Inc. - consulting and software development firm in the Unisys NX, LX and A Series market space

- Based on our actual experiences since 1993

- We use Networking extensively to solve our internal business problems

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MGS Network - Requirements

- Required services
  - File/Print sharing
  - MCP access
  - Electronic mail
  - Remote Access
  - ***Reliability***
- Standard software products (no programming)
- Limited administration time
- Low-to-Moderate cost
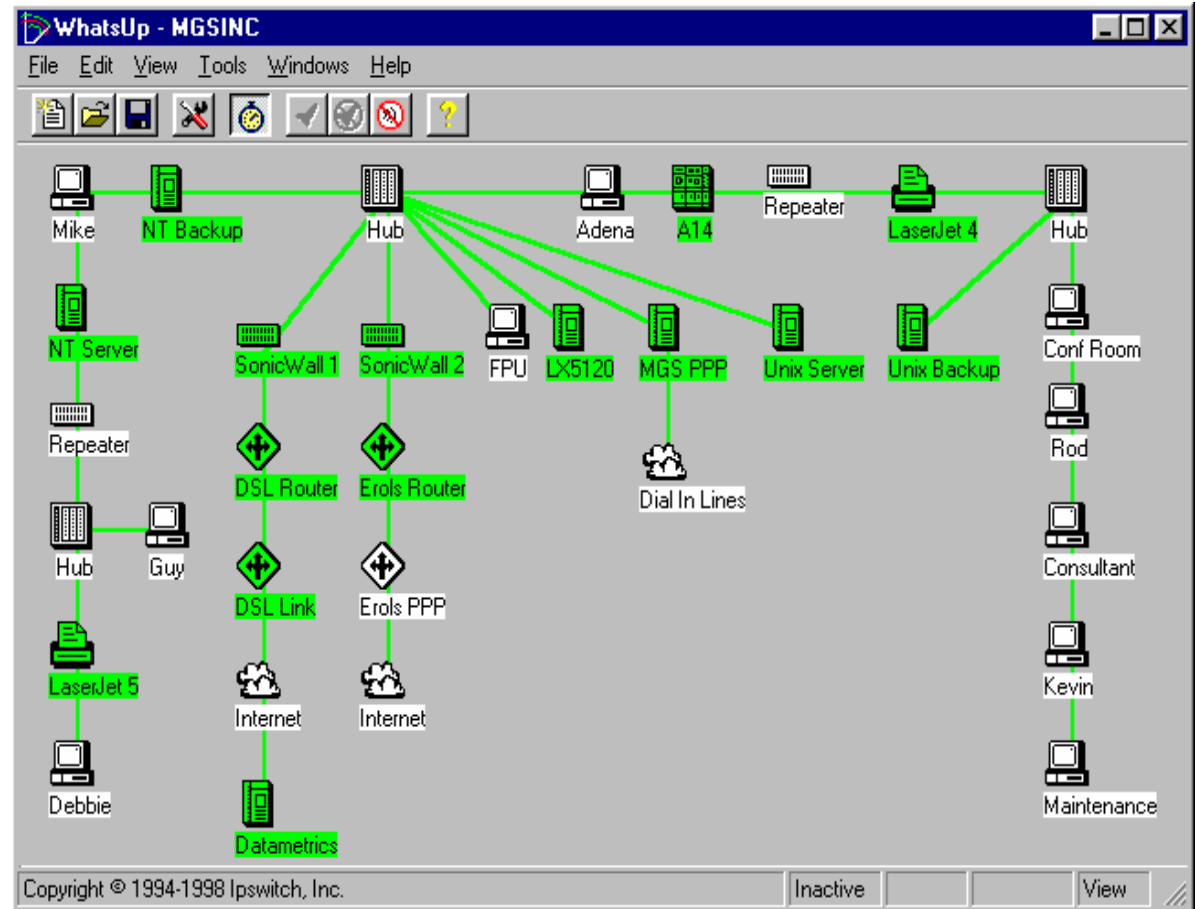
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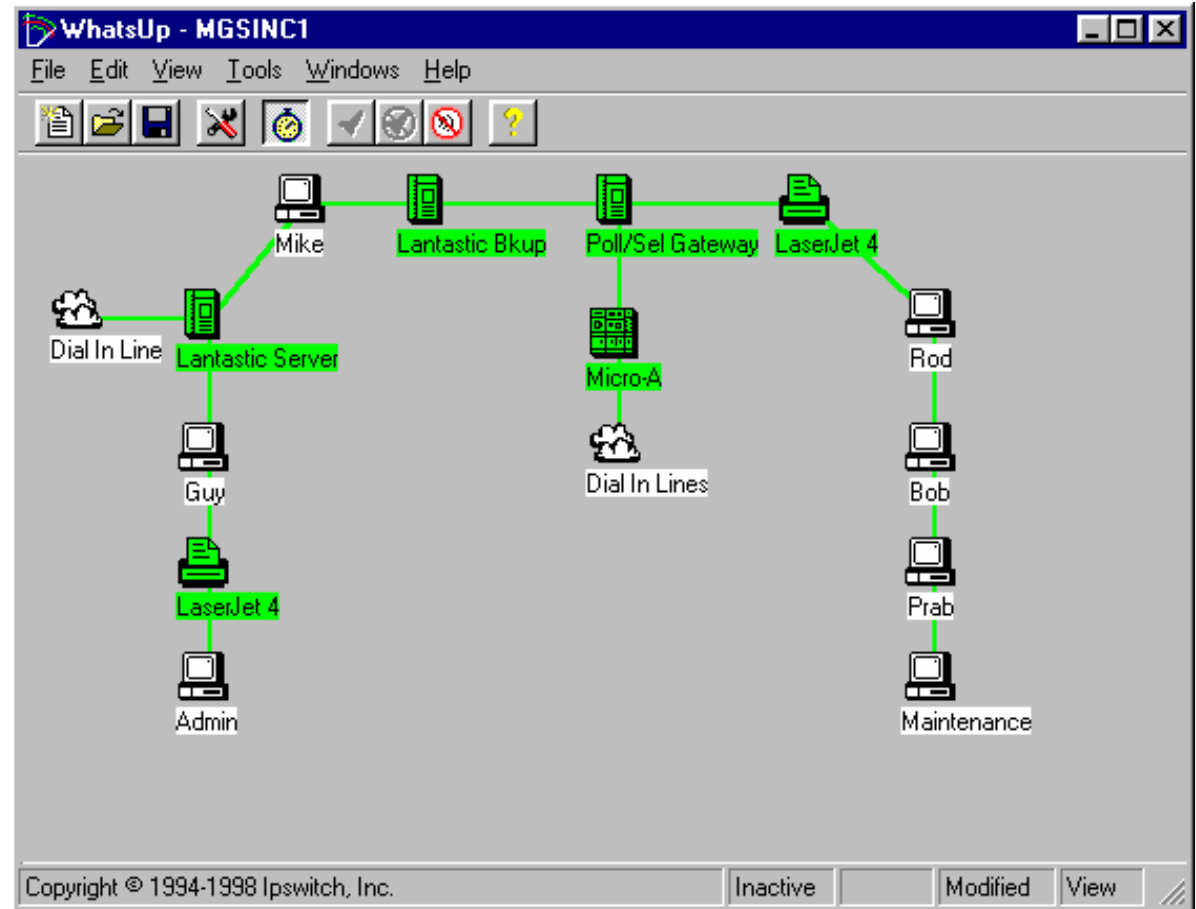
MGS Network - 1993

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- DOS/Win 3.1, DOS/LANtastic
- Services
  - ◆ A Series Access
  - ◆ File/Print Sharing
  - ◆ Dial-in Access
    - ☞ Direct to File Server (slow)
    - ☞ Direct to Micro-A
  - ◆ Email (dial out to CompuServe)
- No Internet
- Minimal redundancy

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- Win9x, Win NT and BSDI Unix
- Services
  - MCP Access
  - File/Print Sharing
  - "Generic" Dial-in Access
  - Internet-in/out Access
  - WEB and FTP
  - Email
  - DNS
- Redundant Capabilities

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What is TCP/IP and Where Did It Come From?

- Designed as part of an effort by the military to develop robust, reliable vendor-independent data communications

- Standards published as Request for Comment (RFCs)

- Download RFCs from:
  http://www.cis.ohio-state.edu/hypertext/information/rfc.html

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What is TCP/IP and Where Did It Come From?

- **TCP/IP and Internet History**
  - ◆ 1969 - ARPANET research started
  - ◆ 1975 - ARPANET made operational
  - ◆ 1983 - TCP/IP added to BSD Unix
  - ◆ 1983 - Term Internet is first used
  - ◆ 1989 - Most major US/Canadian Universities
  - ◆ 1989 - Unisys Releases A Series TCP/IP
  - ◆ 1992 - Most countries inter-networked
  - ◆ 1994 - Commercial use takes over the Internet

- **The Internet is based on the TCP/IP standards**

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Part 1 -
IP Based Communication

- Packet Concept
- Physical transport independent architecture
- Unreliable and connectionless (at this layer)
- Routable
- Superior to older protocols (Novell IPX, Microsoft NetBEUI)

Data Packet Communication - Layered Architecture

- Link (physical)
  - Ethernet, ATM, FDDI
- Network (packet movement)
  - IP, IPX, NetBEUI
- Session (app connection)
  - TCP, UDP, ICMP
- Application (app protocol)
  - Telnet, HTTP,FTP
- Application data (business)

Data Packet Communication - The Link Layer

- Supported by a variety of physical transports

- Most Frequently Used
  - Ethernet (IEEE 802.3)
  - Serial Port (PPP)

- Network Topologies dependant on hardware
  - 10BaseT star
  - ThinNet bus
  - Token Ring ring
  - PPP point-to-point

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Data Packet Communication - The Networking Layer

- Link layer encapsulates the IP packet

- IP packet encapsulates the session protocol (TCP, UDP)

- Session protocol encapsulates the service protocol

- Service protocol encapsulates the data

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Data Packet Communication - Example

- Typical Communications Packet

Link	Network	Session	Protocol	Data
802.3 Header	IP Header	TCP Header	HTTP Header	HTML Data

| Physical | IP | Application |

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IP Addressing - Overview

- Not hardware related

- 32-bit Unique Host Address

- Dotted-decimal Notation: nnn.nnn.nnn.nnn (where nnn is 0 to 255)

- Represents a combined LAN number and HOST number

- HOST 0 refers to the entire LAN

- HOST all-bits-on (example 255) is for broadcast to all hosts

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IP Addressing -
Address Conventions

- **IP Address Class Ranges**
  - Class A -   1.n.n.n to 127.n.n.n
  - Class B - 128.n.n.n to 191.n.n.n
  - Class C - 192.n.n.n to 223.n.n.n

- **IP Address Class Sizes**
  - Class A - 16,777,216
  - Class B - 65,636
  - Class C - 256

- **Special IP Addresses**
  - Loop back - 127.0.0.0 to 127.255.255.255
  - Private
    - 10.0.0.0 to 10.255.255.255
    - 172.16.0.0 to 172.31.255.255
    - 192.168.0.0 to 192.168.255.255

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IP Addressing -
Where do they come from?

- Network IDs are assigned by the Internet Network Information Center (InterNIC)

- Host IDs are are assigned by the local network administrator

IP Addresses - Networks of Addresses

- IP address has two parts:
  - ◆ Network ID
  - ◆ Host ID

- Network ID calculated by:

  (IP Address **AND** Network Mask)

- Example:

  IP Address: 172.31.1.25
  Network Mask: 255.255.255.0
  Network ID: 172.31.1.0
  Host ID: .25

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IP Addresses - Setting The Host IP Address

- Automatically: by Dynamic Host Configuration Protocol (DHCP) which requires a DHCP server

- DHCP not supported on ClearPath/A Series TCP/IP

- Manually: by setting IP Address and Network Mask in the TCP/IP Init File (NW TCPIP INIT)

```
NW TCPIP TCPIPIDENTITY
    IPADDRESS = 172.31.1.46 NP 210 MASK 255.255.255.0 LINEID 1;
```

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IP Addresses - Network Address Translation

- Referred to as NAT

- Maps Internet IP Addresses to Private LAN Addresses

- Many-to-one NAT
  - Maps many private LAN IP Addresses to a single Internet address
  - Limited use for Servers

- One-to-one NAT
  - Maps one private IP Address to one Internet IP Address

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IP Communication - Local-LAN

- Used for communication when destination is on the same LAN

- Address Resolution Protocol (ARP) maps IP Address to hardware address
  - IP Address in ARP table?
  - Broadcast ARP-request
  - Store ARP-reply in ARP table
  - Send packet to respondee

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IP Communication - Off-LAN Routing

- Off-LAN routes are defined in the Host's routing table

- Automatic updates from routers on the LAN

- A default routing entry is needed to send off-LAN packets to unknown routes (Internet)

- Set in TCP/IP Init file along with manually specified routes

NW TCPIP ROUTE ADD DEFAULT 172.31.1.41 1;

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IP Communications - Connecting to the Internet

- Internet Service Provider (ISP)

- Provides Physical Connectivity
  - PPP (56 Kbaud)
  - ISDN / IDSL (128 Kbaud)
  - SDSL (384 to 768 Kbaud)
  - T1 (1 Mbaud)
  - Cable Modem (1-3 Mbaud)

- Provides Logical Connectivity
  - Floating IP Address
  - Fixed IP Address
  - Range of fixed IP Addresses

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IP Communications - Connecting to the Internet

- ISP Additional Services
  - ◆ DNS
  - ◆ Mail
  - ◆ News
  - ◆ WEB
- ClearPath/A Series requires external hardware/software to connect to an ISP
- There are critical security issues to be addressed before putting a server on the Internet

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IP Communication - Additional Capabilities

- **Internet Control Message Protocol (ICMP)**
  - ◆ IP communication service messages like PING, TRACEROUTE and ROUTER

- **Internet Group Message Protocol (IGMP)**
  - ◆ IP communications based on multicasting (sending to groups of hosts)

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The Domain Name System - DNS

- The Domain Name System insulates applications from specific IP Addresses

- Format: host.domainname.domain

- "domainname.domain" assigned by InterNIC

- "host" assigned by network administrator

- "host" can be multi-levels
  aaa.bbb.domainname.domain

The Domain Name System - DNS Servers

- Provides service to convert domain names to IP Addresses

- If necessary, it goes back to the InterNIC "root" server for info

- DNS tables are maintained by the site's network administrator

- Can provide both Forward DNS and Reverse DNS

- ClearPath/A Series does not provide a DNS Server program

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The Domain Name System - DNS Resolver

- Client software which requests a DNS Server to resolve name

- DNS Server(s) IP Address must be specified to the resolver

- ClearPath/A Series has a resolver

- The file SYSTEM/RESOLVER/CONFIG defines resolver configuration

```
CACHE = 100
SERVER + 172.31.1.2
SERVER + 172.31.1.3
MODE = FORWARDING
```

ClearPath/A Series TCP/IP - IP Communications Summary

- TCP/IP requires initialization of:
  - Core Network Services (CNS)
  - TCP/IP
  - Resolver (if DNS needed)

- Initialization commands specify the initialization command files:
  - NW CNS + <prefix>/CNS
    - ☞ Establishes LAN Connection Groups
  - NW TCPIP + <prefix>/TCPIP
    - ☞ Sets TCP/IP properties for connections

- Initiate Resolver
  - NA RES +

- Unisys provides sample Init files

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ClearPath/A Series TCP/IP - IP Communications Summary

- In TCP/IP Init File:
  - Use NW TCPIP TCPIPIDENTITY to set IP Address and Network Mask
  - Use NW TCPIP ROUTE ADD DEFAULT to set the LAN Gateway

- Modify SYSTEM/RESOLVER/CONFIG to set the IP Address of the DNS Server(s)

- External Internet connection required

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Network Diagnostic Tools - Overview

- **Useful Diagnostic Utility Programs**
  - ◆ PING
  - ◆ TraceRoute
  - ◆ IPSwitch WhatsUp
  - ◆ IPSwitch WS_Ping ProPack
  - ◆ Microsoft NetMON

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Network Diagnostic Tools - PING

- **Always use to confirm basic end-to-end communication**

ODT Command:
    NW TCPIP PING IPADDRESS 172.31.1.2

ODT Response:
    TCPIP PING ENABLE TO "NULL"/172.31.1.2 FROM: "NULL"

Response in Messages Display:
    NW 17:44   SENT FROM NODE AT "NULL"
    NW 17:44   % PACKET LOSS 0
    NW 17:44   NUMBER MESSAGES RECEIVED 1
    NW 17:44   NUMBER MESSAGES SENT 1
   NW 17:44 TCPIP PING REPORT FOR NODE AT 172.31.1.2

Network Diagnostic Tools - TraceRoute

```
[C:\] tracert www.unisys.com
Tracing route to www.unisys.com [192.61.11.74]
over a maximum of 30 hops:
 1    138 ms    134 ms    134 ms  loc40.mgsinc.com [172.31.1.40]
 2    143 ms    156 ms    142 ms  gateway.mgsinc.com [64.23.177.1]
 3    164 ms    163 ms    165 ms  207.233.254.1
 4     *         *         *      Request timed out.
 5    165 ms    166 ms    164 ms  gigaethernet5-0.core2.Washington1.Level3.net
                                  [209.244.11.45]
 6    166 ms    163 ms    164 ms  edge2.washington1.level3.net [209.244.2.152]
 7    167 ms    167 ms    166 ms  Serial1-1-0.GW4.TCO1.ALTER.NET [157.130.13.181]
 8    168 ms    162 ms    163 ms  118.ATM4-0.XR2.TCO1.ALTER.NET [146.188.162.142]
 9    166 ms    164 ms    164 ms  192.at-2-0-0.TR2.DCA6.ALTER.NET [152.63.34.34]
10    407 ms    415 ms    412 ms  121.at-5-0-0.TR2.CHI2.ALTER.NET [152.63.1.125]
11    405 ms    395 ms    433 ms  196.ATM6-0.XR2.CHI4.ALTER.NET [152.63.65.65]
12   1373 ms    743 ms    707 ms  190.ATM11-0-0.GW1.MSP1.ALTER.NET
                                  [146.188.209.109]
13   1276 ms   1273 ms   1234 ms  unisys-70-gw.customer.ALTER.NET [157.130.99.246]
14    980 ms   1004 ms    856 ms  192.61.61.34
15    734 ms    762 ms    703 ms  www.unisys.com [192.61.11.74]
Trace complete.
```
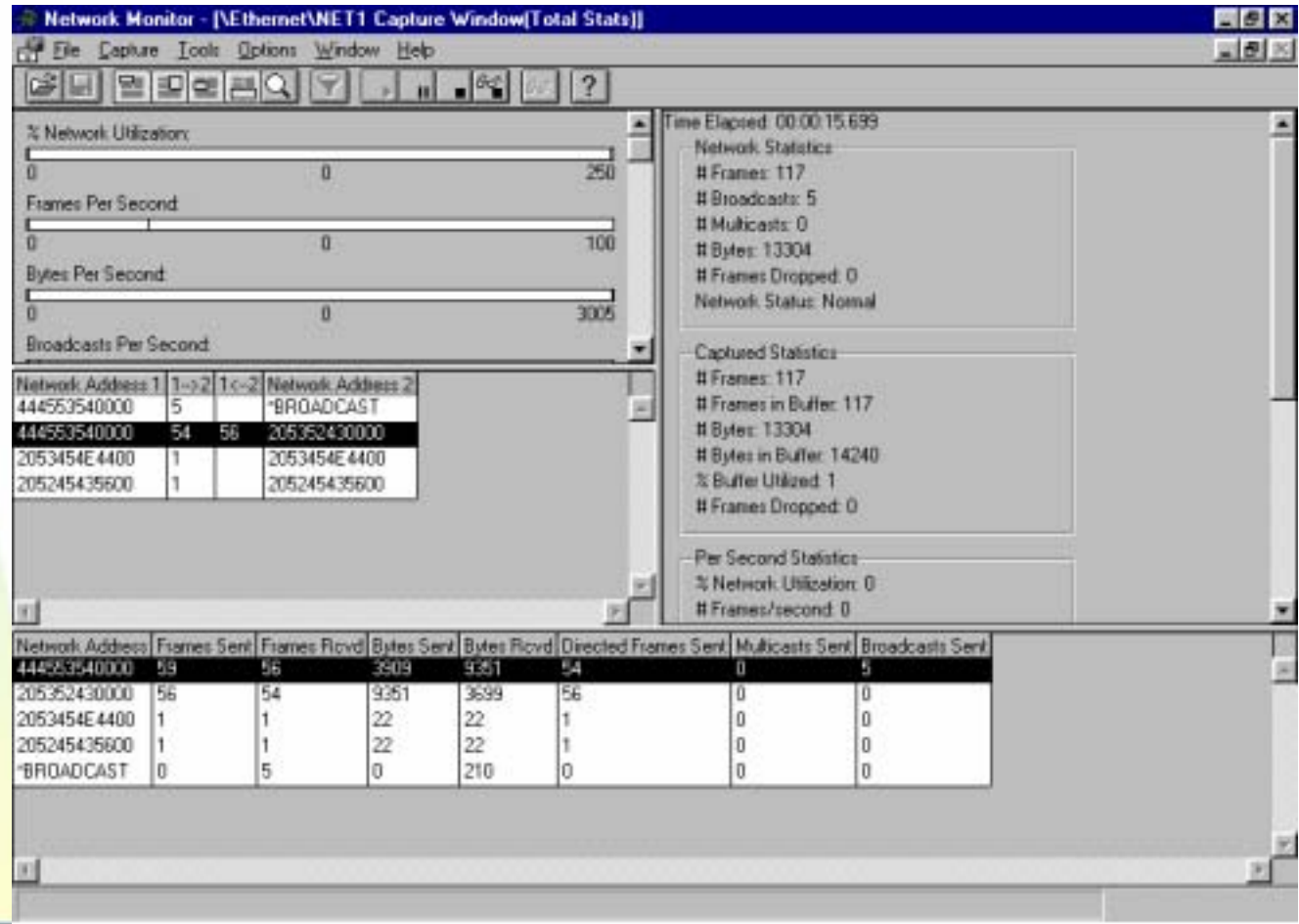
Network Diagnostic Tools - WhatsUp
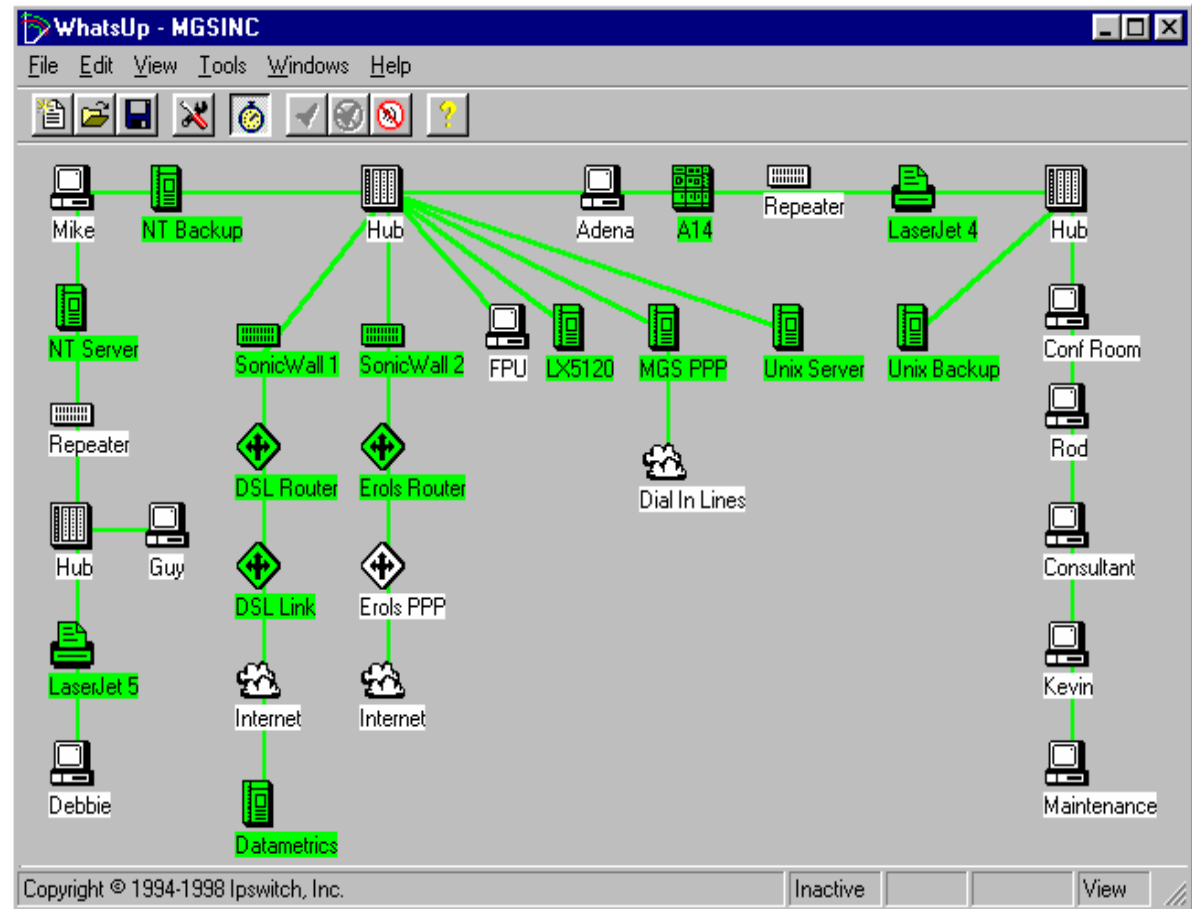
Network Diagnostic Tools - WS_Ping ProPack
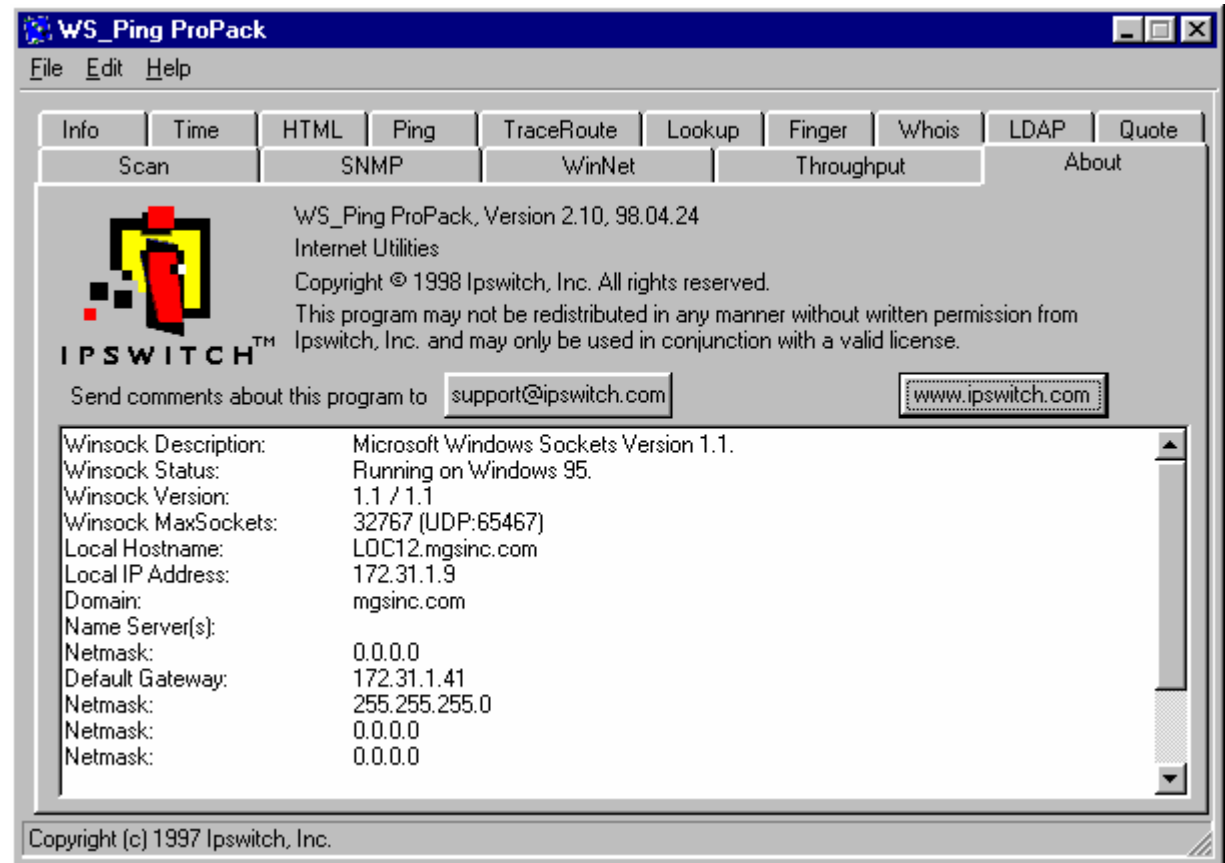
Network Diagnostic Tools - NetMON

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ClearPath/A Series TCP/IP - Diagnostics Summary

- ClearPath/A Series
  - ◆ PING
  - ◆ TraceRoute (future)
- Supplement with non-MCP based tools

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Part 2 - IP Based Services

- Services are built on top of IP
- Services built on top of Session Level protocols
  - TCP
  - UDP
- Services addressed by:
  - Host name or IP Address
  - Port Number
- Services also defined by RFC standards
- Different from NX/Services

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Session Protocols -TCP/UDP

- Application to Application Session

- User Datagram Protocol (UDP)
  - No reliability
  - Connectionless data path
  - application must fragment messages
  - Specify Hostname and Port

- Transmission Control Protocol (TCP)
  - Reliable
  - Automatic message fragmentation
  - Single connection data path
  - Specify Hostname and Port

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Application Protocols

- Each on its own Port
  - ◆ Reserved well known ports 1-1023
    - www.isi.edu/in-notes/iana/assignments/port-numbers
  - ◆ Only authorized applications should use the well known ports
  - ◆ All other ports available
- Terminal - Telnet
- File Transfer - FTP
- Printing - LPD/LPR
- Mail - SMTP/POP3
- Web - HTTP
- Misc. Service Protocols

Telnet - Terminal Interface

- ClearPath/A Series Support
- Negotiated Terminal Characteristics
- Station Control
  - Limit based on station name
  - Options to control the station name
    - NA TELNET CONFIG ...
    - NW TCPIP MAPPING ....
  - COMS Utility controls access based on station name
- Normal MARC logon security
  - *NOTE:* Clear-text password

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FTP - File Transfer

- ClearPath/A Series Support
- Supports both ANONYMOUS and UserID/Password FTP
- *NOTE:* Clear Text Password
- Access controlled through USERDATAFILE RU command
  - ◆ Which UserIDs can access FTP
  - ◆ From which Hostname or IP Address

FTP - File Transfer

- Example USERDATAFILE syntax:

```
USER = MCPFTP
     MAXPW = 1
     PASSWORD = XYZ
     FAMILY DISK = MGS1 OTHERWISE DISK
     CANDEGETMSG
     IDENTITY = "MGS TCPIP FTP ACCESS";
RU *ANONYMOUSFTP OF *ANYHOST LOCALALIAS=MCPFTP;
RU FTP OF *ANYHOST LOCALALIAS=MCPFTP;
RU MCPFTP OF *ANYHOST;
```

- "ANONYMOUS" and "FTP" become reserved "read only" FTP usercodes when anonymous FTP is enabled
  - Enabled by RU *ANONYMOUSFTP definition

LPD/LPR - Remote Printing

- ClearPath/A Series Support
- Both LPD Server (incoming) and LPR Client (outgoing)
- Requires specification of both a Hostname and a printer-name for that host
- Configure:
  - ◆ File SYSTEM/TCPPRTSUPPORT/CONFIG
  - ◆ PS CONFIG + ...

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SMTP/POP3 - Mail Services

- SMTP (send mail) will not be supported after December 2000
- POP (receive mail) is not supported
- Non-Unisys SendMail utility programs are available
- Sending email from WFLs and programs is extremely valuable

HTTP - Web Services

- ClearPath/A Series Support
- Supports HTTP 1.0
- Atlas WEB Server running under MCP control
- Different from products that acquire MCP data for Microsoft IIS Web access under NT
- WEB paradigm does not fit well with traditional T27 paradigm
- *NOTE:* Clear Text Password

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Service Protocols

- SNMP
  - ◆ Support for a Simple Network Management Protocol (SNMP) Agent
  - ◆ Provides standard MIB-II Attributes
  - ◆ Provides standard TCP/IP enterprise MIB
  - ◆ Provides an enterprise MIB for Unisys specific attributes
  - ◆ Supports an API for supplying user defined MIB objects

- Echo
  - ◆ ClearPath/A Series does not provide
  - ◆ Non-Unisys utility programs are available

- Time
  - ◆ ClearPath/A Series does not provide
  - ◆ Non-Unisys utility programs are available

Proxy Servers

- Proxy Servers "front end" servers providing well known services

- Requests are forwarded to the real server for processing

- Benefits
  - Security
  - NAT
  - Data caching
  - Workload distribution

- Problems
  - Slows performance (bottleneck)
  - Client may require knowledge of proxy

Security - General

- Don't just make the Unisys ClearPath/A Series mainframe available on the Internet

- Only allow Internet access to specific services on the system

- Limit to access from fixed locations (not the whole Internet)

- Audit *ALL* Internet access using A Series log scanning software

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Security - Firewalls

- **Firewalls**
  - Restrict access to/from a LAN
  - Limit packets based on packet type, IP Address and port
  - Software like Microsoft Proxy Server
  - Black-box like SonicWALL

- **ClearPath/A Series support**
  - Standard support for packet filter type
  - SYSTEM/TCPIPSECURITY/RULES file built by the RULE/DRIVER program
  - TCPIPSECURITY Library must be correctly SL'd to enable
  - NW TCPIP SECURITY ENABLE
  - See Security Admin Guide for details

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Security - VPN

- Virtual Private Networking
  - ClearPath/A Series requires external hardware/software support
  - Works in a similar fashion to a dial-in PPP connection to your LAN
  - Provides a secure, private path from the workstation to your LAN, through the Internet or an Intranet
  - Requires special workstation software
  - Path through Firewall on a known port
  - Both logon security and data encryption
  - VPN server acts like two routers that use IP for "physical communication"

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Reliability

- **Internet IP Communication**
  - Redundancy must come from your ISP
  - Multiple-ISP redundancy is difficult (IP Addresses change)

- **Workstations**
  - NAT makes switching LANs transparent by insulating the workstation from the Internet IP address

- **Services**
  - TCP/IP Services have limited built-in reliability
  - Only DNS and MAIL have fail-over designed into the protocols

ClearPath/A Series TCP/IP - IP Services Summary

- **Available TCP/IP Services**
  - ◆ Terminal - Telnet
  - ◆ File Transfer - FTP
  - ◆ Printing - LPD/LPR
  - ◆ Web - HTTP
  - ◆ SNMP - System Management

- **Firewall Support**

- A detailed list of the ClearPath/A Series supported services and RFCs is available on Surenet

http//www.support.unisys.com/ASERIES/npo/TCPcap.HTM

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ClearPath/A Series TCP/IP - IP Services Summary

- Detailed TCP/IP Service configuration information is documented in the Unisys manuals (see references)

Additional Questions?

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For The

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