The Growth of IP Usage At Chrysler

Robert G. Moskowitz
rgmoskowitz-0@clis.chrysler.com

In 1988, TCP/IP was just a communications tool for Chrysler's Engineering Computing Center to connect some new CAD workstations together. Today, TCP/IP has experienced phenomenal growth and is the heart of Chrysler's enterprise computing strategy for all of its computing groups. This growth occurred as a technologist's choice, with management backing, to meet the business requirements of making Chrysler Corporation a leader in the Automotive Industry. In looking back over the years, much of the growth was organic, not planned or anticipated, but not unexpected. This growth and how TCP/IP is used in Chrysler can best be seen via a travelog.

In those early days, a few key people at Chrysler's Technical Computing Center worked out a plan to use SGI workstations for CAD work. A few of the systems would be for administration and support and the majority would be for designers. These designers were scattered across Chrysler's Highland Park corporate campus and thus an architecture was needed. The approach used was a collapsed PRONet 80 backbone in the datacenter connected via fiber to the ethernet segments in each design area. TCC's Cray and IBM mainframes were attached to this network as well. One of the engineer's concerns was the perceived ability of an SGI workstation to consume much of the bandwidth of a 10Mb ethernet segment. IP subneting was used to limit the number of workstations on a segment by using a mask of 255.255.255.224, 32 addresses per subnet.

The full integration of American Motors Corporation into Chrysler by 1989 brought an important change to TCC's plan. The CAD focus moved to CATIA on an IBM MVS mainframe. 5080 workstations were connected to it with a proprietary cabling scheme. This did not end the TCP/IP network. The SGI workstations began to be joined by engineering PCs that needed connectivity to the Cray and IBM mainframes. These PCs did not have the same effect on their networks as the SGI workstations had. Traffic was minimal and the engineers wanted to allow a large number of devices per segment. Since the B class network, 129.0, was already subnetted, Engineering started using unassigned C class network numbers up in the 192 range and did not subnet these.

By 1990, Engineering was well along with their TCP/IP network and had begun planning the conversion of all LAT traffic to TCP/IP and the design for the TCP/IP network in the new Tech Center. At the same time, Corporate MIS was reviewing its LAN technologies direction. The corporate LANs were using XNS and 3COM's LAN MANAGER with plans to migrate to Microsoft LAN MANAGER. A series of key technology meetings between the engineering and MIS network staffs resulted in a joint decision to strive for a unified corporate network based on TCP/IP. At that time, Manufacturing's use of Novell's IPX was seen as a small, but hopefully solvable problem.

At this time, planning was completed to facilitate the new networks for the Chrysler Technology Center, Corporate sites, and Manufacturing and Assembly plants. The IP address requirements for these plans were submitted to the NIC, and after much dickering, Chrysler was issued two more B class networks. The first was 151.171, subnetted at 255.255.254.0 for the large plant and corporate networks. The second was 152.116, subnetted at 255.255.255.192 for CTC. This choice of subnetting was pragmatically derived. The plants did not want routers in the way of the cell controllers on the lines and the upstream systems they needed to work with. Corporate wanted easy management of large PC work units. CTC, on the other hand wanted easy facilities management by mapping a subnet to a wiring closet that was designed to support approximately 50 work areas. There was hope at that time that variable subnetting for wide-area links would prevent an exhaustion of the 151.171 network.

This groundwork in 1990 began to bear fruit in 1991 and 1992. Engineering began the wholesale movement of Chrysler personnel from the Highland Park campus and a number of rented locations to the

new Tech Center. In some cases the servers moved with the personnel, in others the servers went first, and still others the servers followed. In all cases, once the equipment was connected in its new location, connectivity was there. The CTC datacenter houses six collapsed FDDI rings, each serving a different population of users. The datacenter also houses a number of different mainframes, Cray, IBM, and VAXs.

Corporate MIS began piloting of LAN MANAGER over TCP/IP. This ended up a failure, as the response time was viewed as unacceptable by the users. A lot of effort was devoted to tuning those early NETBIOS drivers for TCP/IP. Another group in MIS was busy setting up the Bramelea Canada plant for IP and IPX devices for the launch of Chrysler's LH cars. This was to be a non-SNA plant after the SNA/IP/IPX installation in the Jefferson plant for the Grand Cherokee. SNA would be supported via TN3270 and TN3287 to LPR to Novell print queue. Additionally some of the SNA based applications were to be provided on IP based UNIX platforms.

The first attempt at mobile IP was set up at this time. A proposal was floated and tested to have the Chrysler field force access corporate resources via TCP/IP. Although this solution was deemed viable, an alternative direct 3270 proposal was implemented primarily due to resource constraints. The TCP/IP support staff was significantly over-booked.

A number of things were learned from this effort. Asynchronous devices that worked with 3708 protocol converters do not necessarily work with TELNET to an TN3270 gateway server. There is more to converting an SNA/CICS application to client/server than just putting in a based UNIX host and re-writing the applications. IPX tunneling through IP between servers is not efficient and direct wide-area IPX support is needed. The bottom line was that JOB 1 was met and the LH vehicles are a success. The Neon plant was done a little smarter.

The final bell-weather project during this time was the planning for converting Chrysler Finance Corporation from a distributed, multi-user UNIX environment, connected to corporate via SNA, to a client/server TCP/IP network. The new network would replace the terminals with workstations, 2500 in over 100 offices. These workstations would have client/server applications to a local SQL UNIX server and TN3270 to the legacy SNA applications. The UNIX server would use TN3287 for SNA print and support some sort of file transfer for bulk movement of data from IBM mainframe. NeXtStep was chosen for the workstations, Sybase on NCR UNIX platforms was chosen for the local servers, MVS/TCP was selected for the TN3270 server to support the nearly 5,000 concurrent sessions required, OCSII for the TN3287 server, and CICS Sockets for the file transfers. Based on this design, the INTERNIC assigned 162.12 to CFC. It is subnetted to support 128 addresses per subnet, as no branch office is this large; the corporate office would require a number of these subnets.

In 1992, the problems with LAN MANAGER, and the growth of NOVELL in the plants with the need of the corporate staff to access plant data, resulted in a major shift to NOVELL as the MIS Network Operating System standard. Initially IPX bridging was used, but the resultant broadcast SAP traffic led to IPX routing.

This rapid network growth that began in 1992 brought OSPF to Chrysler. This was far from painless, as Chrysler required it to be multi-vendor. It was not until 1993 that the network support staff got OSPF with variable subnetting from the three router vendors used, Proteon, Tymplex, and Wellfleet, working in a six domain network. Even now, issues in managing this are resulting in a move to six autonomous areas with some of the larger ones needing multiple OSPF domains within them. 1994 will see this network migration.

If 1992 and 93 were the foundation years, 1993 and 94 are the rollout years. 4,000 new PCs were deployed in 1993; most have TCP/IP connectivity. Some were replacement units for old XTs and ATs, the majority were new growth. These systems are using TN3270 to access the SNA legacy systems. An ever expanding number of them have SQL front end applications to access Sybase or DB2 databases. We have learned some important lessons on what it really takes to do client/server applications and would like to think that each application rollout is better architected than the pervious one. Client/Server is being used in many of the Chrysler organizations: Finance, Parts, Service, and Sales; but none of them are 'mission critical', just very important to Chrysler's growth.

MVS/TCP and VM/TCP are beginning to carry significant access load. MVS/TCP has been stress tested to its maximum of 5,000 concurrent sessions. Gigabyte file transfers are performed regularly to populate Sybase databases. Chrysler Finance

Corporation is a major part of this usage. The CFC rollout is on target, nine branches per month and a one year rollout. The wide-area network for CFC is based on MCI's Frame Relay service. Thus only a handful of T1 connections are needed at corporate to support over 100 branch offices running 56Kb Frame Relay links.

The Neon plant was set up during this time with many of the SNA printers and some test cell equipment returned to asynchronous connection to the 3708. Not everything is ready for TCP/IP. By this time the growth of the SAP tables in IPX started becoming a real problem. Each printer is broadcasting multiple SAPs, many of them 3 SAPs. The size of the SAP tables, that has to be maintained in each router supporting IPX has consumed a large amount of network support time and router upgrade dollars. With all of these lessons learned, Chrysler went on to establish both SNA and TCP/IP connectivity to the Minivan plant in Austria.

This rapidly growing network is managed by two Openview servers. One for Engineering's half of the network, and one for MIS's which includes the CFC and plant networks. The attached chart shows the growth of this network as viewed by these servers. The network map in the MIS Openview server might be the largest one anywhere; currently at 9,000 managed objects.

Engineering has been actively redefining the Chrysler network during 1993. While MIS has been busy fleshing out the Chrysler internal network to catch up with Engineering, the engineers have been reaching out to their design shops. The southeast Michigan area is becoming laced with T1 circuits connecting this design shops into Chrysler's internal network. IP filters are used, where the design shop has other connectivity to manage access. In the same vein, some suppliers are gaining connectivity to plants and Chrysler's advertising firms have been connected to corporate.

Part of this Engineering drive has been fueled by the shift from mainframe CATIA to RS/6000 CATIA. Thus a proprietary wiring scheme is being supplanted by TCP/IP. RS/6000s can be located in a design shop and tied into the mainframe databases and the VAX based backup system.

MIS had more NOVELL server and UNIX client/server applications scheduled for 1993 than there was any hope of supporting. The NOVELL installs were out-sourced. This freed up some internal staff to begin evaluating Netware 4.0 and Netware/IP. The Netware 4.0 has led to a superserver pilot right in MIS. This is the first time that MIS has tested LAN technology on itself. In other words it is beginning to get ahead of the usage curve. The Netware/IP is going slowly. The Chrysler internal DNS has been slow to happen, and NW/IP requires DNS. New client/server applications have included Hourly Employee Reporting and Customer Care Center. These are being dwarfed by the designs for two warranty applications, each requiring 100s of Gigabytes of data in SQL tables. The larger one may be Chrysler's first major DB2 based client/server application.

The forecasted growth for 1994 was a serious concern for the Telecommunications staff. The MIS building, with almost 500 devices on one segment had already shown the infeasiblity of large subnets, except for slow devices. OSPF variable subnetting has made it possible to divide the MIS building into fourteen subnets of 128 addresses each. Thus reducing traffic on each segment and allowing for an explosive growth of networked workstations in MIS to replace the venerable 3270 terminals. MIS applications staff is now talking Netware, TN3270, FTP, and client/server lingua as if they were in on the ground floor. Fortunately for them they were late-comers. Telecomm has viewed the current T1 and T3 mesh in the Detroit area as inadequate. Plans are coming together for a fiber network that will deliver at least ethernet speeds to all locations.

An interesting by-product of this growth is 'creeping criticality'. Chrysler's field offices, field staff, and dealers are needing access to services only available via IP. This realization came at a time when separate projects in Chrysler were getting ready to replace workstations for these three groups that would offer more local functionality and some better SNA connectivity. The field office replacement has now been enhanced to replace the 9.6 controller based SNA connectivity with a frame relay TCP/IP network. No servers are planed for the offices in 1994, but room is there for them in 1995. The field staff of 1,000 notebook users will have dialup IP access from anywhere in the US or Canada (Mexico soon). By using 14.4Kb modems with compression, these users will have as good a connection as their office cohorts sharing a 56kb line. They will also be able to connect to the office LAN when they are in it.

The Chrysler dealer communications is a satellite X.25 network. Chrysler, along with the rest of the Detroit automotive industry dominated SBS4; today,

Galaxy-7's horizontal polarity side supports the Chrysler VNET. The backup network is terrestrial X.25 VANs. Currently this network has supported a proprietary X.25 protocol. New requirements have Chrysler looking at how to support 6,000 dealerships via TCP/IP over the satellite with PPP over X.25 into the dialup IP routers for backup. This will require a firewall technology that will support over 6,000 TCP connections. TN3270 server requirements are anticipated to start around 3,000 concurrent sessions. Client/Server access is expected in 1995, as is direct engineer to service system interaction for repair support.

The technique to supply dial up access for the Chrysler Field Force via a dial up IP router will used to offer this to any Chrysler employee whose work responsibilities require mobility. Novell access will also be supplied via IPTUNNEL until NW/IP is viable.

Back in 1992 a manager asked the technical team if we really can be successful in the move to TCP/IP. The response was a yes, on the backs of a handful of technical support people. This has indeed happened. Fortunately it is no longer just a few backs supporting this network. Chrysler has gone from only a dozen people knowing how to spell TCP/IP to full support staffs trained in all levels of the TCP/IP protocol suite. It is showing in the quality and quantity of new IP based applications. Chrysler does not expect the pace to slacken. Infrastructure issues will be replaced with higher level issues like distributed security. But the real goal of all of this is to allow the non-technical staffs to do their job to design and build the cars that the public desires with the quality the public demands.

Author Biography

Robert Moskowitz came to Chrysler via the American Motors purchase in 1987. He received a Bachelor of Science in Computer Science from Michigan State University in 1972. Bob has supported standalone and SNA connected PC deployment and LAN attached PCs. In 1990 Bob was assigned to assist in the TCP/IP strategy planning sessions. Since that time he has been a key player on the Chrysler TCP/IP team.

Bob joined up with the IETF in March 1993 to get enhancements to TN3270 for Chrysler. He has been active in a number of IETF activities, including reviewing the various IPng proposals from a corporate viewpoint. Bob has been a regular contributor to Network Computing Magazine since its creation in 1991 and became a Contributing Editor in 1994.

THE GROWTH

OF IP USAGE

AT CHRYSLER

ROBERT MOSKOWITZ
IS TECHNICAL SERVICES
CHRYSLER CORPORATION

THE EARLY YEARS

TCP/IP STARTED IN ENGINEERING FOR CAD

1988 - SGI CAD WORKSTATIONS ON CAMPUS NETWORK

ONE 'B' CLASS NETWORK, 129.9.0.0 MASK OF 255.255.255.224 (32 ADDRESSES PER SUBNET)

COLLAPSED PRONET-80 BACKBONE WITH FIBER RUNS TO WORKGROUPS (200+). SMALL SUBNETS TO ENFORCE FEW WORKSTATIONS PER SEGMENT FOR PERFORMANCE REASONS.

CRAY AND IBM MAINFRAMES CONNECTED TO DATA CENTER SEGMENTS FOR DESIGN REPOSITORIES

1989 - CAD DIRECTION CHANGED TO 5080 TERMINALS

TCP/IP NETWORK BECOMES METHOD FOR PC CONNECTION TO IBM MAINFRAME (TN3270, 500+)

USE OF 'ILLEGAL' C CLASS NETWORKS TO SUPPORT LARGE PC LAN SEGMENTS.

THE CRUCIAL YEAR
1990

DURING THE WINTER OF 1990 A SERIES OF MEETINGS BETWEEN ENGINEERING AND MIS RESULTS IN TCP/IP SELECTED AS THE STRATEGIC NETWORKING PROTOCOL.

ENGINEERING WOULD REPLACE LAT WITH TCP/IP.

MIS WOULD REPLACE XNS/NETBIOS WITH TCP/NETBIOS.

SMALL IPX PRESENCE IN PLANTS WOULD BE IGNORED.

KEY MIS PERSONNEL TRAINED IN TCP/IP, ALONG WITH ADDITIONAL ENGINEERING STAFF.

MIS DESIGNS CHRYSLER TECHNOLOGY CENTER FOR TCP/IP USAGE.

ALL ROUTERS IN DATACENTER WITH FIBER RUNS TO CLOSETS.

MULTIPLE FDDI RINGS; BASED ON PLATFORM TEAMS.

ONE 'B' CLASS NETWORK, 152.116.0.0 MASK OF 255.255.255.192 (64 ADDRESSES PER SUBNET). SIZED TO WORKSTATIONS PER CLOSET.

MIS DESIGNS PLANT FLOOR TCP/IP AND IPX USAGE.

PLANT MANAGEMENT DICTATES NO ROUTING ON PLANT FLOOR. PERCEIVED COST/PERFORMANCE/RELIABILITY ISSUE.

ONE 'B' CLASS NETWORK, 151.171.0.0 MASK OF 255.255.254.0 (512 ADDRESSES PER SUBNET). FOUR SUBNETS FOR AN ASSEMBLY PLANT, TWO FOR A MANUFACTURING PLANT.

ONE FOURTH THE SUBNETS RESERVED FOR CORPORATE PC LANS.

THE CHALLENGING YEARS
1991 AND 1992

MIS BEGINS TESTING TCP/NETBIOS IN LAB AND BEGINS EXPERIMENTS IN DIAL-UP TCP/IP.

MIS ASSUMES RESPONSIBILITY FOR CHRYSLER FINANCIAL'S OSI/NETBIOS NETWORK (STARLAN, 250+ PC) AND SNA ATTACHED BRANCH OFFICES.

ENGINEERING MOVES FROM OLD CORPORATE CAMPUS TO NEW TECHNOLOGIES CENTER. A LAN DROP FOR ANYONE.

HP OPENVIEW TO MANAGE NETWORK. TWO AREAS, ENGINEERING AND MIS.

MIS LAUNCH OF TCP/NETBIOS FAILS. PERFORMANCE ISSUES. LAN MANAGER 2.1 REPLACED BY NETWARE 3.11 TO MATCH CORPORATE USERS WITH PLANT USERS.

MIS LAUNCHES LH PLANT ALL ON IP AND IPX. MVS ACCESS VIA TN3270 AND TN3287 TO LPR (400+ PRINTERS)

IPX TUNNELING OVER IP FAILS. PERFORMANCE. IPX IS BRIDGED WHERE NEEDED.

OSPF IMPLEMENTATION BEGUN. MAJOR SOFTWARE ISSUES.

MIS SELECTS SYBASE ON UNIX 5.4 PLATFORMS FOR THE CLIENT/SERVER ENVIRONMENT. FIRST PILOTS WITH GATEWAYS TO DB2 DATA.

MIS TAKES ON CHRYSLER FINANCIAL BRANCH REDESIGN. TCP/IP WAN TO 100+ BRANCHES.

MVS/TCP WITH TN3270 FOR 'LEGACY' APPLICATIONS; 4,000+ SESSIONS NEEDED.

ONE 'B' CLASS NETWORK, 162.12.0.0 MASK OF 255.255.255.128 (128 ADDRESSES PER SUBNET). SIZED TO BRANCH SIZE AND ONE SUBNET FOR EACH BRANCH CONNECTION.

ROLLOUT YEAR
1993

4,000+ NEW PCs. MAJORITY ON LANS WITH IPX AND IP.

MVS/TCP CAPACITY TESTED TO 5,000 TN3270 SESSIONS ON AN ES9021-900.

CHRYSLER FINANCIAL BRANCH ROLLOUT BEGINS. UNIX 5.4 SERVERS WITH SYBASE AND NEXTSTEP WORKSTATIONS (2500+).

FRAME RELAY USED FOR WAN.

OSPF IMPLEMENTATION IN PLACE. 3 VENDORS, 6 ADMINISTRATIVE AREAS. 300+ ROUTERS. VARIABLE SUBNETS.

DECISION MADE TO IMPLEMENT A BACKBONE. BACKBONE ROUTING PROTOCOL AN OPEN ISSUE.

IPX ROUTING WITH SAP FILTERS IMPLEMENTED.

MIS LAUNCHES NEON PLANT. SAME PLAN AS LH, BUT SOME PRINTERS AND TEST CELL EQUIPMENT DIRECT TO MVS.

MIS CONNECTS WITH AUSTRIA FOR MINIVAN. SNA AND IP CONNECTIVITY.

ENGINEERING BEGINS DIRECT IP CONNECTION TO KEY SUPPLIERS OVER T1 LINKS. FILTER ROUTERS USED TO LIMIT ACCESS.

PLANT HOURLY PAYROLL CONVERTED TO A CLIENT/SERVER SYBASE APPLICATION. TOO MANY OTHER CLIENT/SERVER APPLICATIONS STARTED FOR SUPPORT STAFF TO MANAGE.

NETWORK SECURITY, RELIABILITY, AND BACKUP SEEN AS KEY ISSUES.

SUCCESS BREEDS SUCCESS
1994

CHRYSLER FINANCIAL ROLLOUT COMPLETES.

NETWARE IP MOVES TO PILOT.

NETWORK ARCHITECTURE FOR CHRYSLER FINANCIAL USED AS BASIS FOR CHRYSLER SALES ZONE NETWORK UPGRADE.

35 OFFICES U.S. AND CANADA, FRANKFURT OPEN ISSUE.

CHRYSLER FIELD FORCE (1000+) TO CONVERT FROM ASYNC 3270 TO DIAL UP IP.

'CREEPING CRITICALITY' OF CLIENT/SERVER APPLICATIONS.

TELEBIT NETBLAZERS ON SPECIAL CORPORATE WATS LINE FOR MANAGED ACCESS.

NOVELL LAN WORKPLACE PPP DRIVES FOR WINDOWS NOTEBOOKS.

DIAL UP IP AND IPX TUNNELING A MAJOR HOT ITEM FOR WORK-AT-HOME, ROVING WORKERS, AND FIELD DEMOS.

NOT ALL IPX APPLICATIONS WILL RUN THROUGH THE TUNNEL. PC/ANYWHERE - LAN FOR ACCESS TO A NACS FOR THOSE APPS. NO LINES ON NACS.

6,000 CHRYSLER DEALERS ON SATELLITE X.25 NETWORK TO GET NEW UNIX PLATFORM. IP OVER X.25 FOR TN3270 AND CORPORATE UNIX SERVER ACCESS.

CHRYSLER CONNECTED TO THE INTERNET VIA FIREWALL TECHNOLOGY. PUBLIC AND BUSINESS FUNCTIONS HANDLED BY THE FIREWALL.