

# THE LOCAL AREA NETWORK AT DARNALL

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## Abstract

A Local Area Network (LAN) was installed at Darnall sugar mill during 1988. This LAN extends through the Mill as well as the administration building. Subsystems such as stores inventory and the planned maintenance system are available to all users of the Network. A gateway to the Central Board Cane Testing Data-General computer was installed, making the laboratory system information available throughout the LAN. The Process Control Supervisory System is being linked to the Network, and the real-time factory condition monitoring will become available to authorised users.

## Introduction

During the early part of 1987, the Darnall Engineering Department made inquiries about the feasibility of purchasing a Planned Maintenance system, and installing it on a PC-based Local Area Network. It was specified that this system should also, via a gateway, be able to look at the stores inventory data files on the Administration Department's IBM System/34 mini-computer. Towards the end of 1987 the Planned Maintenance system software, together with an AT compatible PC, was purchased, and a start was made on the capturing of plant history. The first quote for the network software was obtained in February 1988.

The possibility of linking this network to the existing Sugar Industry Central Board laboratory system, as well as the proposed Process Control System, was also investigated.

At about the same time, the Tongaat-Hulett Information Systems Department at the La Lucia Head Office near Durban was looking at phasing out the IBM System/34's which were currently installed at the Mills, and replacing them with PC-based networks. The installed software on the System/34's would be re-written in PC compatible languages.

It was felt by Darnall that, rather than having two smaller, separate networks for Administration and Engineering, a larger common network should be installed. A request was made to the Information Systems Department that Darnall be used as the test centre for their new administration systems. This was agreed.

A common File Server was purchased and installed in April 1988.

## Network Configuration

### Topology

The configuration chosen at Darnall was a mixed star and bus topology. High impedance controller cards (PC210) are used as network interfaces. One of these is installed in the File Server, as well as in each PC on the network.

Data signals are distributed and amplified by active hubs. Each active hub has eight ports, and from each port a data cable acts as a bus from which up to eight PCs can be hung. The active hub serves as the star portion of the topology, with the data cable from which each port serving as the bus portion. Active hubs cannot be more than 650 metres apart, and each bus cannot be more than 325 metres long.

The topology used is presented in Figure 1.

### File Server Hardware

The Darnall File Server consists of a dedicated AT tower type IBM compatible computer. The Random Access Memory (RAM) is 5 mega-byte, and installed secondary memory on three internal hard disks is a usable 380 mega-byte.

### File Server Software

The File Server was originally supplied with the Novell ARCNET version 2.0A operating system, but this has been upgraded to version 2.12 SFT. This software runs under the standard Microsoft DOS version 3.3.

Off-the-shelf applications packages such as Lotus 1-2-3, dBase III+, and Harvard Graphics etc. are installed on the File Server. The SAMNA word processing package was also purchased, and is used by all the administration secretaries. Only the so-called LAN packs are installed on the File Server. These allow a fixed number of users to use the software simultaneously and legally. More users than the permitted limit are not allowed access to the software.

Customised software is also installed on the File Server. This includes both software written by the Mill staff, as well as more sophisticated programmes developed by Information Services, including administration systems such as Stores Inventory, and General Ledger.

### Major Peripherals

Two 60 mega-byte tape streamers were purchased for hard disk back-ups. One of these is installed in the telephone exchange room, and the regular back-ups are carried out on this unit at night. The second streamer is in the computer room and is used for non-routine back-ups and file restoration.

An 800 line-per-minute printer was installed in the computer room for high volume printing. This printing facility is accessible to numerous users on the network.

A gate-way PC is also installed in the computer room. This consists of an XT compatible with a gate-way card which is linked via a modem to the IBM mainframe computer at Information Services. This gate-way allows authorised users on the network to access the Durban mainframe.

A second dedicated gate-way is installed in the Mill to allow access to the Sugar Industry Central Board Data-General mini computer. Up to four authorised users on the network can simultaneously access this computer.

A number of active hubs are located along the cable to distribute and amplify the data signals.

### Node Configurations

Excluding the File Server, the LAN has 44 nodes (PCs).

The PCs in the Administration Department are all monochrome units, but in the Mill area the PCs are fitted with Enhanced Graphic Adaptor (EGA) cards and multi-scan monitors. These units are used to access the Factory Process Control System. Because of the high resolution graphics of this system, EGA screens are required.

Using separate software packages, printers attached to PC's can be configured as network printers. Authorised users on the network can spool to the printer's print queue on the File Server, and the hard-copy will then be produced by the relevant printer.

# Network Topology

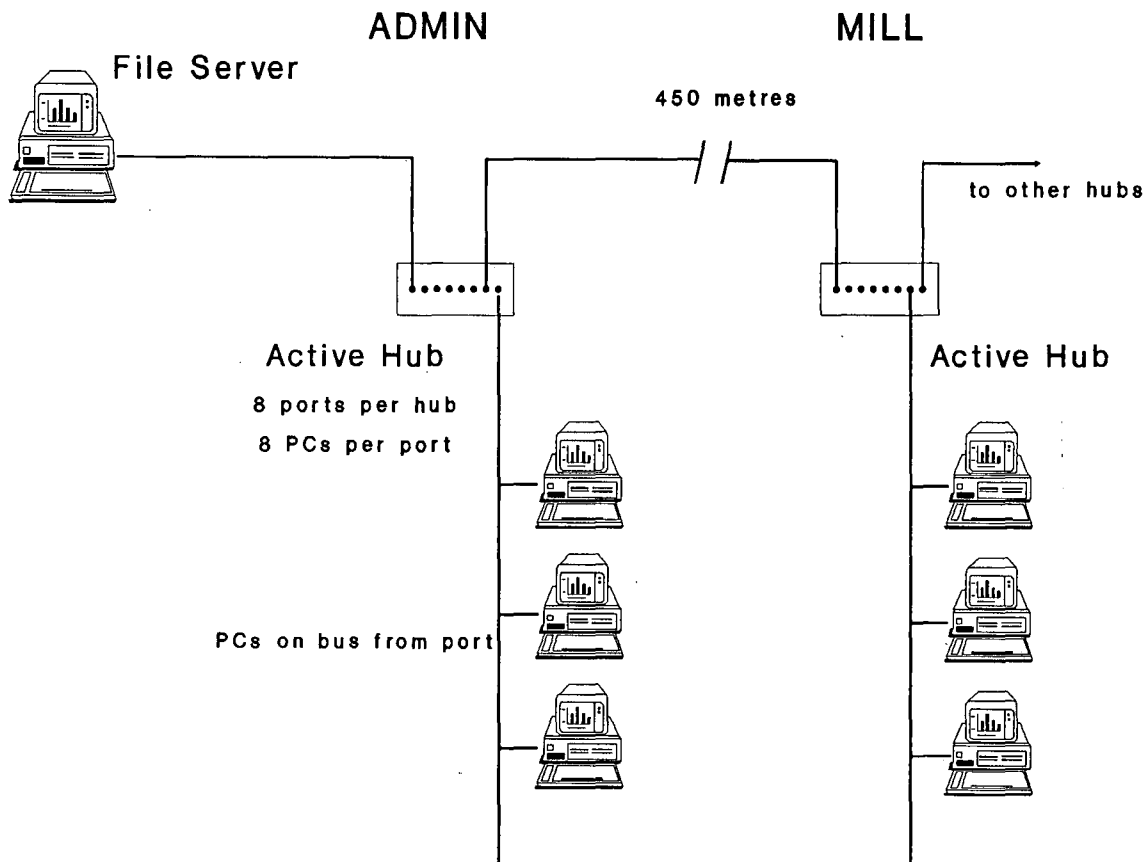


FIGURE 1 Network topology used at Darnall

The network layout is schematically presented in Figure 2.

### Computer Subsystem Access

Excluding the Head Office mainframe computer in Durban, another computer subsystem exists at the Mill, and a second is in the process of being installed. These are the MILL-LAB and the Process Control systems respectively.

### Laboratory System (MILL-LAB)

The Sugar Industry Central Board run their laboratory system on a Data-General (DG) MV2000 mini-computer, and the mill-laboratory section of this system, MILL-LAB, can be accessed by users on the network via a dedicated gateway PC. A single expansion card allowing four users to access the Data-General is installed, although this can be expanded to three cards, allowing 12 users simultaneous access to the DG. Each of the installed cards has four port sockets, each of which is physically connected to a port on the Data-General. Output from the gateway PC to the network is through the network communications cable.

The user accesses the DG in a terminal emulation mode, i.e. the PC acts as a standard DG terminal. Access to the Data-General is restricted by means of password protection.

A number of "screen reports" have been designed for each of the various sections. Pan-boilers, for example, can call up a screen report detailing massecuite and molasses purities for the preceding 24 hours. This enables them to make meaningful decisions concerning future molasses and syrup

feed quantities in the pans. In the same way the mill-shiftsman can see hourly mill crushing rates.

In this manner, laboratory data are available throughout the centre as soon as the analyses are complete.

The Data-General at Darnall is also connected, via a modem, to the Data-General in the Head Office Technical Management Department (TMD).

### Process Control Supervisory System

During 1988, a decision was made to purchase and install a supervisory control system in the Mill/Factory.

The intention was to connect as much of the existing plant instrumentation as possible into this system on a monitoring only basis, as opposed to having full supervisory control facilities. This was due to the large base of Fisher AC<sup>2</sup> controllers installed in the plant. These controllers cannot have their set points remotely adjusted by means of a supervisory system. Any future instrumentation purchased will have to have this remote set-point and auto/manual mode manipulation facility. This is, however, possible with most of the new generation controllers.

The following conditions had to be met by the supervisory system:

- reliability
- common to other plants in S.A.
- real-time monitoring of plant conditions
- supervisory control and decision making available

# Network Layout

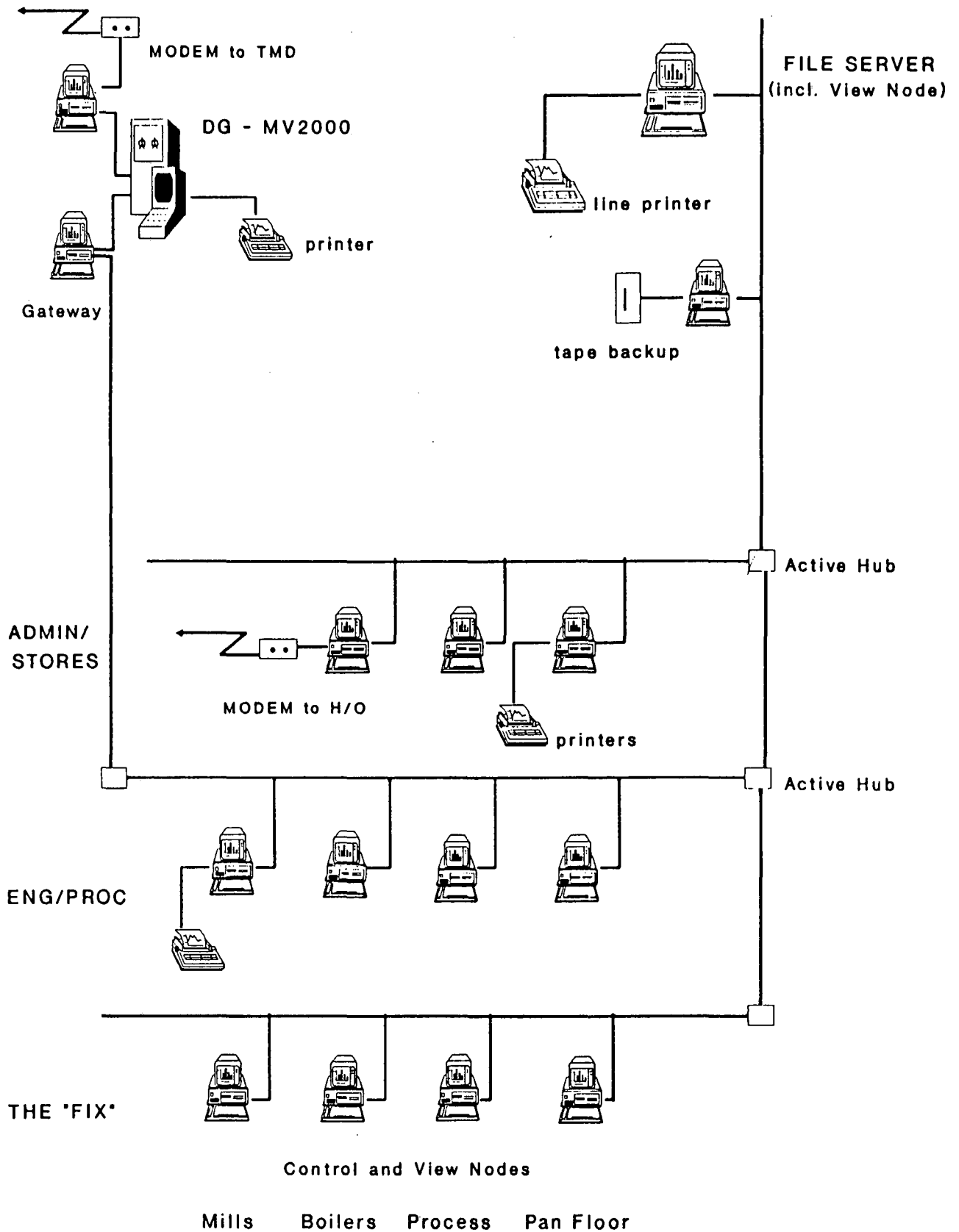


FIGURE 2 Schematic representation of Darnall network

- high resolution graphics
- compatibility with installed instrumentation
- storage of plant data to history files
- facilities for the recall and trending of historical data
- alarm logging
- adjustable scan interval of analog and digital inputs
- viewing of conditions in other parts of the plant
- compatibility with the LAN

Various types of the conventional stand-alone systems such as the Provox and Yokogawa systems installed at other sugar centres were investigated. It was, however, felt that these systems, whilst inarguably excellent, were too inflexible for Darnall's needs, and integrating them with the network would be difficult and expensive. PC-based systems were then investigated.

A software package known as "The FIX" was eventually chosen, and this system was ordered in 1988.

Four control and display nodes of this system were purchased. One of these is installed in each of the control rooms: mills, boilers, factory and pan-floor. These each consist of two AT type machines, one performing data acquisition and data-base storage, and the second performing the presentation of these conditions on a screen. These computers are connected to each other and to the rest of the network by means of the LAN cable.

Instrumentation signals in each of these sections are connected to the local data acquisition computer via interface units. These data can also be viewed by any of the other control room units.

A fifth view node was purchased, and was installed on the File Server. This allows any one other person on the network who has a PC with a graphics adaptor, to view the real-time conditions in the plant, as graphically presented by the supervisory control system. Only one user at a time can take advantage of this. Any other authorised user, however, can access the history data collected in the data-bases in Lotus or dBase format. In this form the data can be manipulated at will, although the data stored in the data-base cannot be altered.

### Problems Experienced

The following problems have been experienced with the installation and running of the network:

- Faulty cable. The double screened co-axial cable supplied by our regular cable supplier had a break in its central core. This was unfortunately only discovered after the installation of the cable.
- System "crash" on Lotus 1-2-3 installation. An attempt was made to install a single-user Lotus pack onto the File Server, but the copy protection system used by Lotus does not allow this. After a few attempts at installation the system "crashed", and numerous data files and application programs were lost. Our dBase III+ disks had to be refreshed as their locking system allows only a single installation procedure to be carried out. The Lotus 1-2-3 LAN pack, however, installs without any problems!
- Faulty RAM chip on memory cards. A RAM chip on the File Server's memory expansion card failed. This resulted in parity errors occurring, with the system failing. This was rectified by the supplier.

### Discussion

The network as installed at Darnall allows the following:

- Shared use of expensive resources such as printers (whether laser, dot-matrix or line).
- Shared use of software. The use of LAN packs also ensures that the simultaneous use of software packages by numerous users is legal.
- Shared use of files. Files can be accessed by various users (provided they have access rights to the file's area). Single versions of documents exist on the File Server which are the most up-to-date versions. These files can be updated and manipulated by various users as the need arises.
- Enhanced communications capabilities. Documents, messages, or files can be sent to other users on the network either by means of the network mailing system or by means of other mailing packages. The mailing facility which is supplied as part of the Novell system is somewhat clumsy and is not user friendly, but other software packages can be obtained which are more friendly and effective.
- Large secondary storage space available. Hard disks need no longer be purchased for PC's, as the File Server has relatively large disk space available for users. Boot PROMS can be installed on the communication cards in the PCs, which allow for booting up directly off the File Server. Users need not have any form of secondary storage capabilities on their PCs (no hard disks or floppy diskettes). The boot PROM option is used at Darnall on the PC's which are used as replacements for the IBM System/34 terminals, i.e. they are used purely as data-punching terminals.
- MILE-LAB access. The mill and Central Board laboratory information is available to users on the LAN. This information is the latest data available by the laboratory. By means of screen reports, individual analytical results as well as daily/weekly/monthly/season-to-date summaries are available to all users of the network.
- Plant condition monitoring. Provided the user has an EGA PC, real-time conditions in the plant can be monitored from anywhere on the LAN. An engineer can also, for example, analyse a past incident by trending relevant plant conditions at the time of the incident on a PC in his office. Causes of mill stops can be in this way be determined and prevented. Historical data can also be imported into Lotus type spread-sheets and manipulated in this form.
- Head Office mainframe access. Authorised users on the LAN can access the Tongaat-Hulett Head Office IBM mainframe in Durban.
- Administration system access. Administration programmes such as the Stores Inventory system can be accessed. Stock levels of store items can be viewed. Purchase, requisition and budget control information is available.
- Planned maintenance system access. Once the history is captured and the system is on-line, this information will again be available to interested users on the LAN.

### Conclusion

The network at Darnall has served, and will continue to serve, the invaluable function of the timeous dissemination of information from a vastly expanded data base throughout the centre. Information is, after all, the most important tool of the manager.