NETWORKING AND MANAGEMENT INFORMATION SYSTEMS

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ABSTRACT: The current generation of highly productive electronic color scanners created a severe 'bottleneck' in the stripping area of trade shops and commercial printers as they attempted to meet the ever-decreasing deadline times in the production of high-quality, fully-imposed pages.

This bottleneck led to the development of the computerized page composition and image processing system, such as the Crosfield Studio 800 System. With the introduction of the image processing system, trade shops and commercial printers then had the ability and facilities to produce fully-imposed pages quickly, accurately, and with high quality.

However, as the systems continued to develop to be expanded to handle more and more production requirements, another bottleneck was discovered that needed to be addressed.

This bottleneck was in the area of production control and product flow. In order to maximize the effectiveness and utilization of these highly-productive image processing systems, it would be necessary to automatically control the production flow of the material, in order to ensure that all elements of the page were being produced and 'readied' to be handled by the image processing system.

To this end, Crosfield has recently developed a Networking and Management Information System to 'tie' the input and output devices to the image processing system, under a networking configuration and, likewise, to interface and coordinate the management information data and more effectively manage and utilize the image processing system.

The paper to be presented will describe the study, development, and implementation of this networking and Management Information System.

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INTRODUCTION: (1) In discussing the application of Networking and Management Information Systems to electronic pre-press, I would first like to consider why they are needed, and what we can expect successful systems to provide.

When electronics was first applied to pre-press processing of images, the object was to speed up the production of separations, then a time-consuming process requiring skilled craftsmen. (2) The result was the electronic color scanner. The first models used analogue technology, but this was soon superseded by digital techniques, allowing improved color correction and new facilities such as image enlargement.

With the widespread introduction of digital color scanners, separations could now be produced rapidly. This led to an apparent bottleneck in stripping, which then became the slowest process.

(3) Page composition systems, made possible by using digital scanners as their I/O devices, addressed this problem. The next function to come under scrutiny was retouching: more sophisticated page composition systems have electronic retouching and airbrushing facilities.

Thus, as each electronic product was introduced, the 'bottleneck' was shifted, as a different process then became the slowest. (4) The sequence was completed with the introduction of electronic plate-making and laser engraving systems, and direct inter-connection between page composition and typesetting systems.

But with all processes now being carried out at electronic speeds, a different type of 'bottleneck' appeared. This was in the areas of production control and product flow. On the one hand, to achieve the deadlines which are now possible, the resources, both machines and media, must be available and ready to process the jobs that require them in their passage through the studio. On the other hand, to secure an adequate return on the investment in this highly productive equipment, and associated manpower, it must not be left idle for significant periods between jobs.

(5) Thus the various items of origination must be made ready:

- layout
- text
- transparencies
- graphics
- and in this case, color swatches and fabric samples

(It is interesting to note that one of our customers successfully scans in mounted fabric samples as reflection copy)

(6) appropriate media must be available:

- scanner cylinders
- disk space
- archive tapes
- gravure cylinder

(7) and the machines must be available:

- input scanning station
- composition station
- file management system
- appropriate output unit (scanning station, platemaker or engraver)

Up until now, the pre-press system has been made up of a collection of these independent machines.(8) Job coordination and control in the studio has relied upon observation and scheduling by operators and supervisors, using charts to plan out activities, and 'message boards' to hold details of disk usage and resource allocation. It is to provide assistance in this area that the Management Information System, or MIS, has been developed.(9)

MANAGEMENT INFORMATION SYSTEM: This is a small computer system which receives and coordinates Management Information from each element of the pre-press system (Fig. 1). It will also be supplied with details of the jobs to be processed in the studio, which it then tracks through the system. Various types of scheduled and on-demand reports, including real-time interrogation of job and machine status, may be obtained from the MIS, enabling more effective management and utilisation of the studio equipment. In particular, the production controller or planner can assign and distribute jobs to work stations, can display the current activity and work backlog of each station, and can specify and alter the priorities of items in these queues.

PRE-PRESS SYSTEM WITH MIS

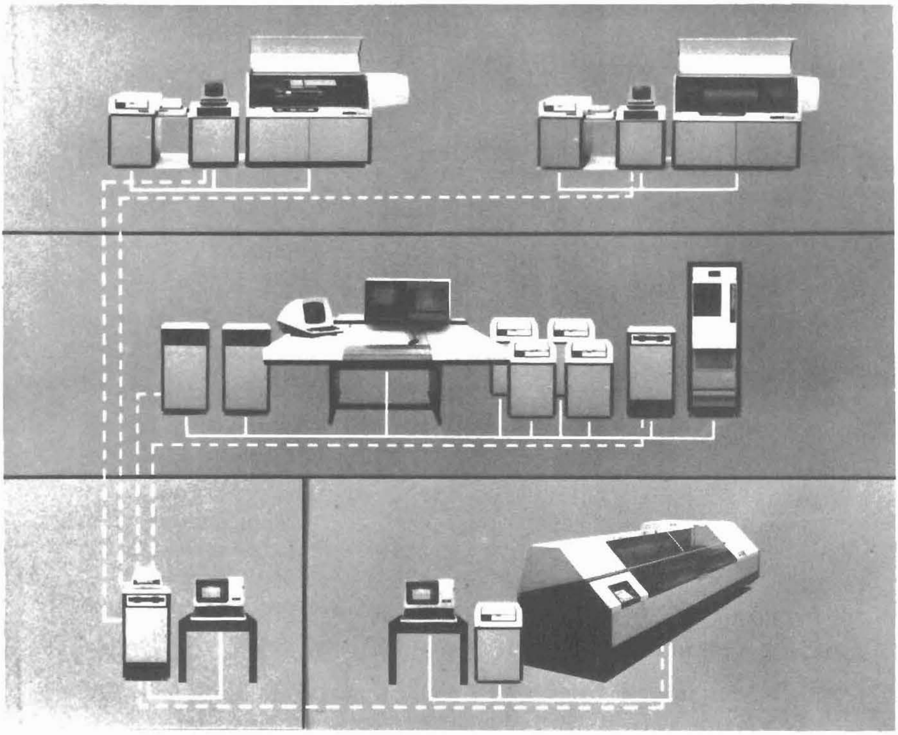


FIGURE 1

From the hardware point of view, a number of possibilities are open to the designer of the MIS. At its simplest, there need be no physical link to the other studio equipment: a number of VDUs could be placed by the work stations, and the operators could key in details of their activities. However, a directly coupled system brings a number of advantages:

- the operators have less typing in, as data is transmitted automatically from the studio equipment to the MIS

- it is less easy either accidentally or deliberately to mislead the system, and

- the MIS can control certain operations of the equipment to which it is connected: for example, access to shared databases or image stores. We shall return to this topic shortly.

I shall now turn to the software. (10) Conceptually, there are three major data structures associated with the basic functions of the MIS, as shown in this slide (Fig.2):

a) First, the job files. When a job enters the department, its details will be entered from the client's job bag. Production planning and job processing will cause this data to be updated, so that the past, present and (anticipated) future status of the job may be determined. The job may pass through the system a number of times for revision: when it is finally OK'ed by the client, its data can be transferred to a history file.

b) Second, the work queues. One of these is maintained for each element of the pre-press sytem (each scanning station, composition station, etc), indicating the job currently in progress, and the sequence of jobs to follow it. Work items may be entered, deleted or rearranged by production planning, and the 'current activity' status will be modified by data from the station itself. For example, it will be possible to suspend work on one job to rush another one through. Normally each station would interrogate the MIS to find its next job to be done.

c) Third, the journal files. These simply receive activity reports from the various stations, and so build up a record of the operations of the whole

MIS Data Structures and Flows

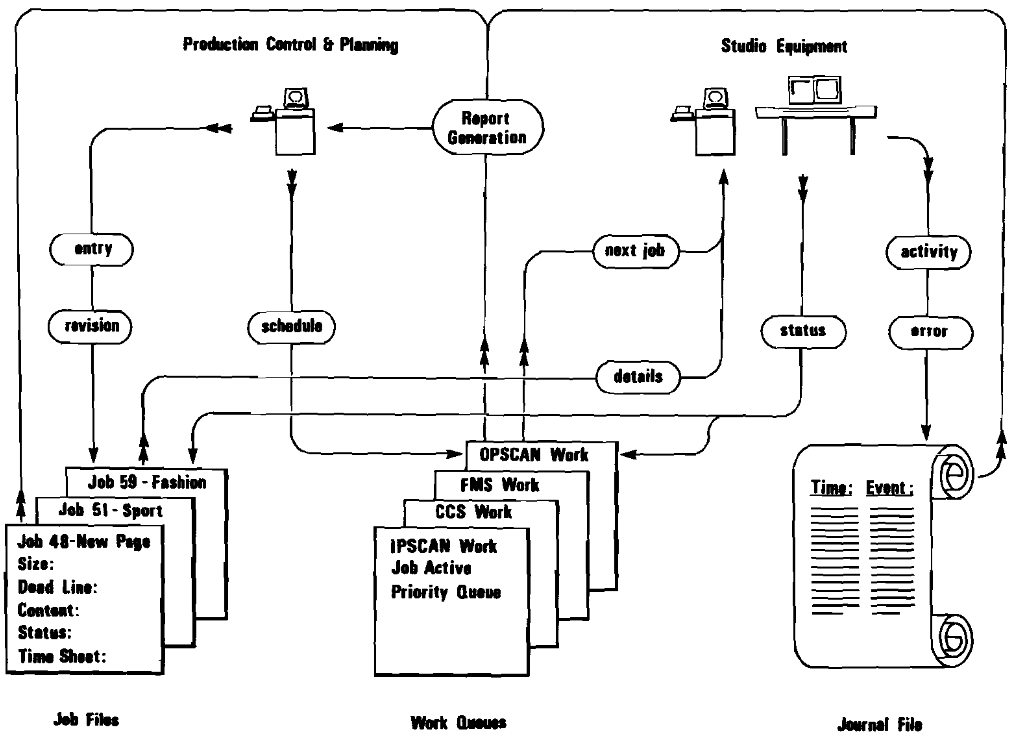


FIGURE 2

pre-press system. Activity reports are normally sent to signal the start and finish of each function at a work station, but other types may be used; for example, for error reporting.

(11) Thus information is received by the MIS in the form of job data and scheduling data, from production control and planning, and activity and error reports, from studio equipment; and information is stored with reference to jobs, to check their current status and chart their progress through the studio, and with reference to machines, to check their utilisation, current activity and availability (Fig. 3).

(12) The stored data may be used by the Management Information System to provide further reports:

- with a pricing file, job costings can be generated from the data on the usage of the equipment:

- utilisation of the system elements can be charted, to highlight overloaded resources:

- reports on system malfunctions, to aid maintenance, are possible: as is

- information on personnel performance, if required.

In connection with some of these items, it should be noted that a security mechanism is provided, with different access levels for data entry and report generation by

- operators

- production planner/controllers

- managers

- system maintenance engineers

A number of enhancements could be considered to this basic system:

- some scanning and planning data (such as page sizes, scanning enlargements and resolutions) could be entered at the MIS with the job data, and then transmitted to the work stations as they start that job.

FIGURE 3

MIS Data Processing

Information Received:

- job data	}	from production control/planning
- scheduling data	}	
- activity reports	}	from studio equipment
- error reports	}	

Information Stored:

- about jobs:	current status track progress through studio
- about machines:	current activity availability utilisation

- some aspects of the scheduling and distribution of jobs to work stations could be handled by the MIS, with speedy recalculation for machine breakdowns, delayed originals etc.

- bar codes and wands could be used to keep track of the location of job bags and stock transparencies

- costings could be extended to cover processes not directly connected to the MIS: or other types of equipment could be interfaced into the MIS.

- it would be very convenient to have an on-line directory of all disk packs and archive tapes on the MIS, which could then allocate the media for each job.

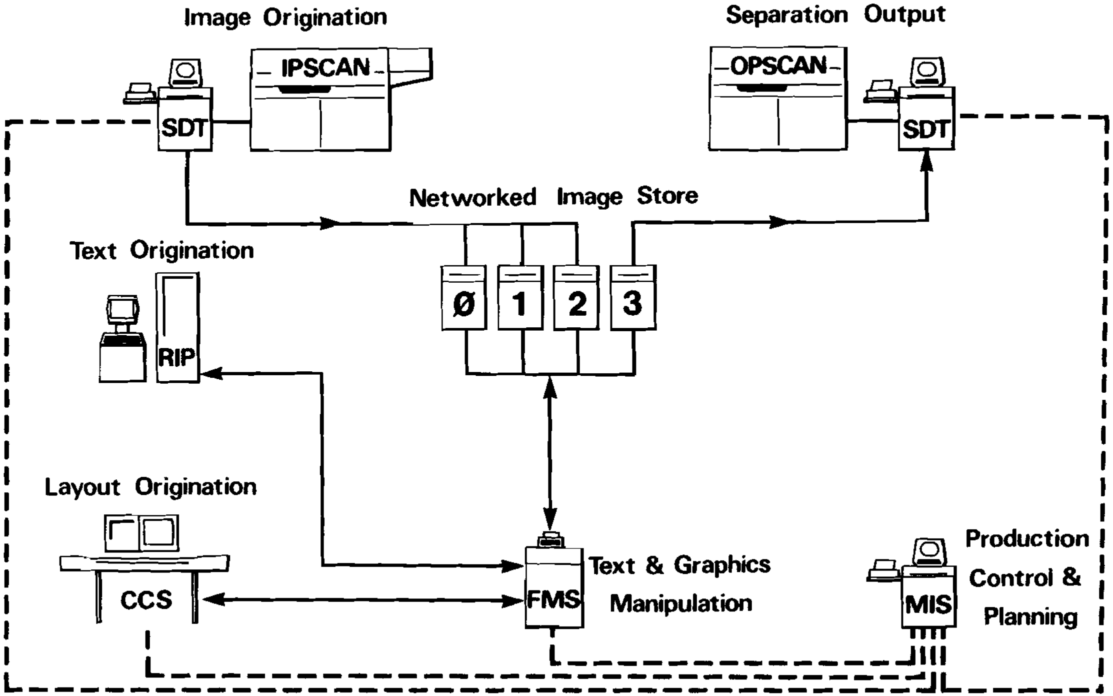
IMAGE NETWORKING: (13) This brings us to the second topic of this paper. It is not convenient to heft weighty disk packs between the various elements of a pre-press system. Could an image-data network not be provided?

The problems of both disk usage and image networking are caused primarily by the volume of image data to be handled: an A4 or American Quarto image contains about ten million pixels, or forty MBytes of data, at standard levels of resolution and quantisation. A normal trade house requires so many images 'in the system' at any time that it is uneconomic to provide enough disk drives to have all of these on line, and so the removable so-called three-hundred MB disk packs (actually containing about two hundred and fifty MB of image data) have been ideal for electronic pre-press. A typical trade house may have twenty disk packs, giving a 'buffer' of five gigabytes of digitised images, between the scanning stations, which can access 1/4 GB of this, and the planning station, which has access to 1/2 GB. We must compare the capacity of the total number of disk packs on a conventional site with that of the drives in a networked system, when considering its viability.

The other pitfall to avoid is having to transfer data electronically between disk drives in a network. A typical bandwidth for such a transfer is 1MB per second, or just over six minutes for a full pack. Within the studio, a data rate more than three times higher can be obtained by spinning down, unloading and physically carrying the pack across from the one disk drive to the other!

FIGURE 4

Integrated Studio System For Weekly News Magazine



There are certain applications where different considerations apply. For a weekly news magazine, the display advertising is made up well in advance: and for the editorial pages, where speed is of the essence, both the individual image sizes and the total image volume are usually quite small.

(14) This has enabled Crosfield to supply a system essentially as illustrated here (Fig. 4). You will see that the disk drives are dual-ported, and can connect either to the File Management System or one of the scanners. To start with, images are scanned onto drive zero, which is then switched to the FMS, and planning can start while scanning takes place onto drive one. Assembly can take place from drives zero and one onto drive three, while the scanner fills drive two. Drive three is then switched to the output scanner while the next page is planned, and so forth.

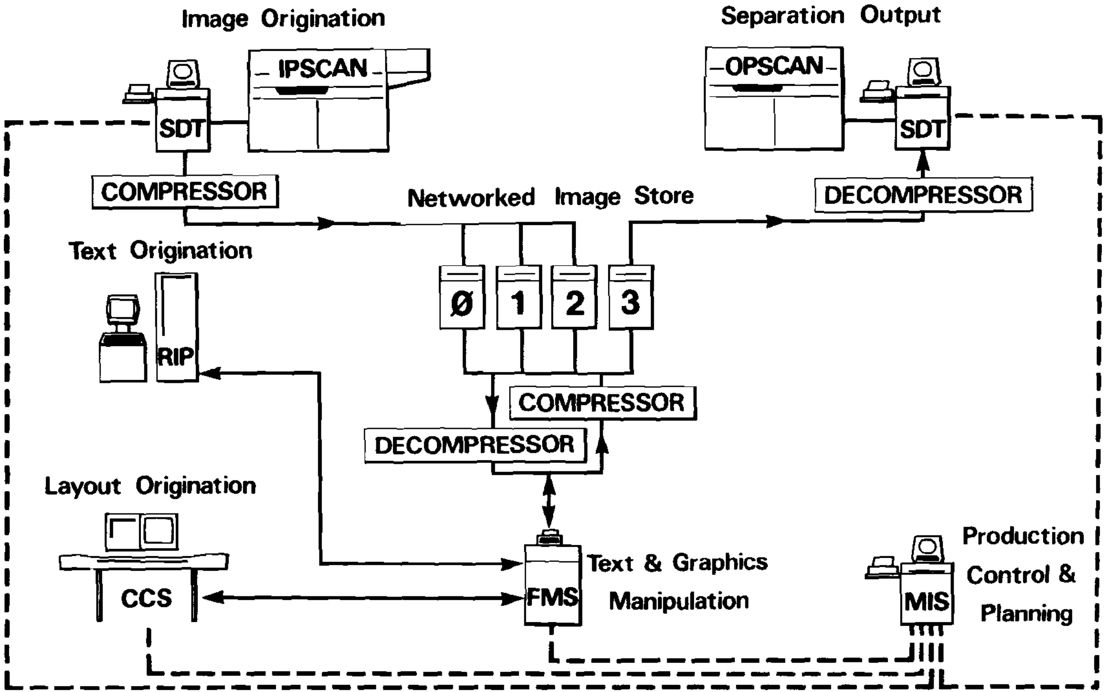
The timing requirements of the scanners do not allow disk head seeks, which would be necessary if the systems had shared access to the drives, so exclusive access must be assured. This is where the control capabilities of the Management Information System, mentioned earlier, are exercised.

(15) Despite what I have said, all is not lost for the normal trade house. The key is data compression. The techniques described in our paper to the 1983 TAGA Conference (Ref.1) provide on average an 8:1 'compression ratio' on halftone image data, and hardware has been implemented which can compress and decompress 'on the fly' at the data rates required by our scanners. This reduces the storage space required for an A4 or American Quarto image from forty MB to five MB. It also reduces the data rate at the disk drive to such a degree that shared access is possible.

(16) With the addition of data compression, the system previously described becomes viable for most organisations. In effect, there are now six GB (twenty-four packs) shared between input scanning and page composition, with a further two GB (eight pack) buffer between page composition and output scanning (Fig. 5).Page composition requires decompression of the input files and recompression of the output files, but the reducing cost of memory makes possible the buffers necessary for this purpose.

FIGURE 5

Integrated Studio System For Trade House



Thus with compression, local image networking is possible. An image store is shared between processing systems (image processing, page composition and sheet imposition) and I/O devices (scanners, engravers and plate makers). This allows image transfers within a site, without carrying disk packs. The Management Information System is required to coordinate access to the shared devices.

The greatly reduced volume of compressed image data also makes image transmission between sites viable, using either landlines or satellite, instead of sending originals or tapes. In this connection, we have also instituted a technique for simultaneously transmitting to multiple receive stations. This allows later deadlines, and reduces the amount of satellite time required, for magazines which transmit made-up pages to multiple remote printing locations.

SUMMARY: To summarize, there are two distinct levels of networking in the integrated pre-press system we have been considering:

i) The MIS network, requiring only a relatively low transmission rate, carries information and control messages regulating the workflow of the whole site.

ii) The image network provides very fast data access to a store of compressed images shared between input, processing and output devices under the control of the MIS.

(17) The combination of Networking and Management Information Systems will lead to the elimination of control and operation bottlenecks in electronic pre-press installations.

Thank you for your attention.

LIST OF SLIDES:

(1) Title
(2) Digital Color Scanner
(3) Scanning Station and Page Composition System
(4) Complete Pre-Press System
(5) Job bag displayed with contents
(6) Disk packs and archive tapes

(7) Electronic pre-press Studio
(8) Chart board for scheduling
(9) Pre-Press System with MIS (Fig. 1)
(10) MIS Data Structures and Flows (Fig. 2)
(11) MIS Data Processing (Fig. 3)
(12) Electronic pre-press studio
(13) Operator changing disk pack
(14) Integrated Studio system for weekly news magazine (Fig. 4)
(15) Conventional trade house disk room
(16) Integrated Studio system for trade house (Fig. 5)
(17) Endpiece.

SYMBOLS USED:

MIS Management Information System

I/O Input/Output

CCS Color Composition Station

FMS File Management System

IPSCAN Input Scan (Analyse)

OPSCAN Output Scan (Expose)

RIP Raster Image Processor

A4 210 x 297 mm (8 - 1/4 x 11 - 2/3 inches)

American Quarto 8 - 1/2 x 11 inches

B byte (b = bit)

M mega = 10^6 or 2^{20}

G giga = 10^9 or 2^{30}

REFERENCE:

Jordan, Brian: "Data Compression Techniques", TAGA Proceedings 1983, pp 689 - 700.