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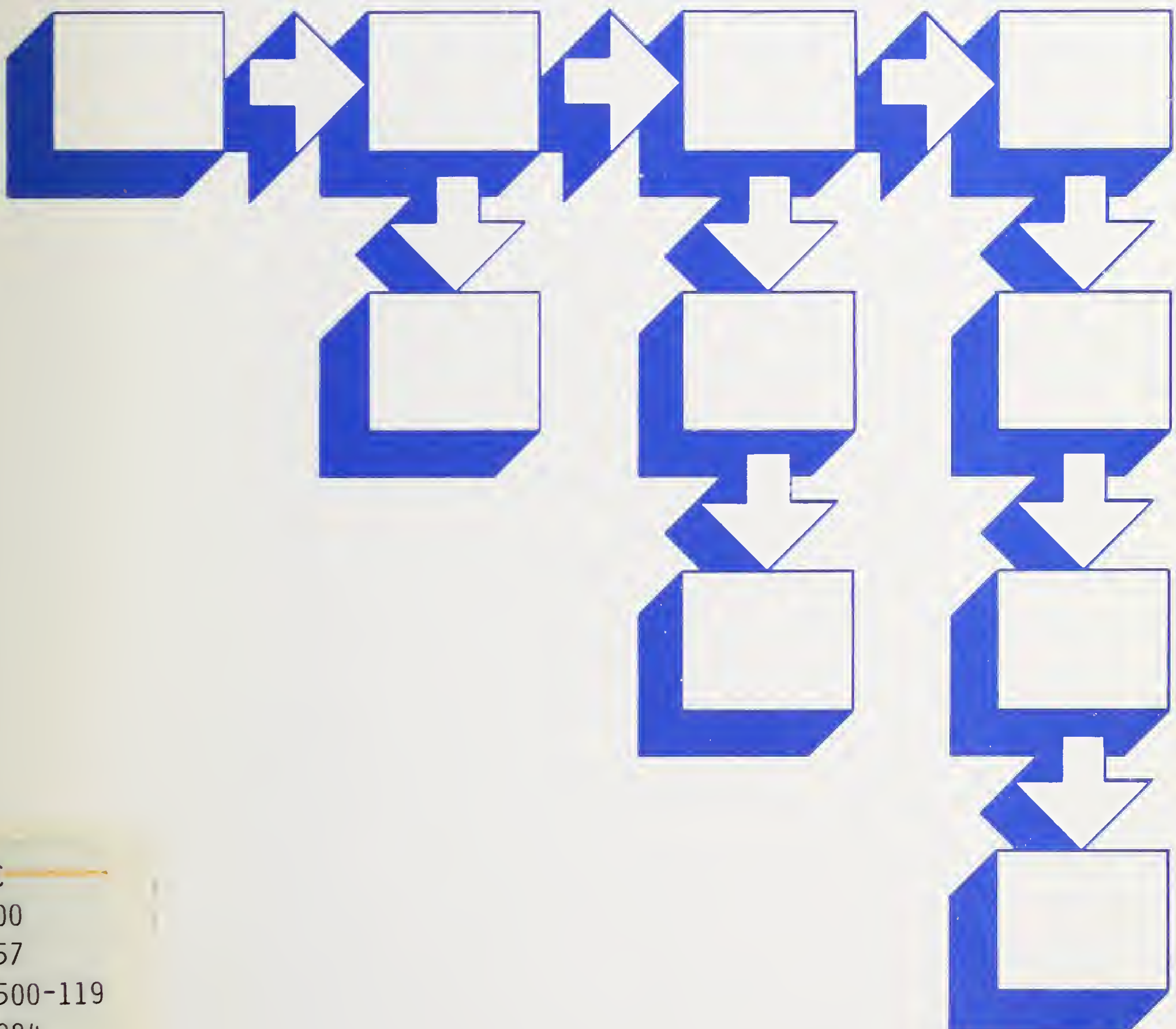

4.2.7 New Systems

Over the next ten years we will probably see a movement away from today's very large, centralized document batch processing operations and toward a more decentralized approach. The following systems are likely to appear on the market over the next ten years:

- A small document transaction processor with limited font capability and slow reading speed, to be used as a decentralized terminal in counter-type operations in banks and post offices.

- Low-cost multifont page readers with medium speed, to be connected to word processors and text-oriented telecommunications terminals as part of the trend in office automation.

- Compact and truly portable readers with slow reading speeds and exchangeable fonts, to be used as stand-alone units or as attachments to mobile data entry terminals.

- Omnifont readers that can be trained to read most typed and printed fonts and hand-print at medium to high speeds to capture general text for input into information banks.

In addition, in the 1990s recognition systems may become available which can be trained to read individualized, connected handwriting. Even though current technology is far from achieving this, there is little doubt that it can be done, if a supplier is willing to engage in a major software development program. The key question is whether there would be sufficient demand for this capability.

4.3 FACSIMILE

4.3.1 Background and Present Approaches

Although facsimile was patented by Alexander Bain of Scotland in 1843, it has only recently emerged from a long development stage and is now rapidly expanding. The primary reason for its slow early growth was the lack of several relevant technologies, such as photocells, amplifiers, transmission lines, modulation technology, and miniature circuitry. In addition, facsimile required computer arts such as software and microprocessing before its price/performance and utility could stimulate and supply a significant office market.

The technical feasibility of using the telephone to deliver a facsimile signal (telephone coupling) was demonstrated in 1935. However, except for news pictures and the transmission of fingerprints by the FBI (deemed to be in the public interest), regulatory authorities in the United States strictly forbade coupling of facsimile and other "foreign" signals into the switched telephone network.

A series of court decisions permitted the use of acoustic coupling, which enabled the Xerox/Magnavox Telecopier to circumvent the prohibition against interconnection in 1966, and other restrictions were removed by the Carterfone decision of 1968. The rules for the certification of interconnected equipment had been established by 1977 when the FCC permitted facsimile and other equipment to be connected directly to the telephone network without either acoustic coupling or telephone-company-supplied connecting arrangements. [STAFF COMMENT 23]

Leading-edge facsimile technology is now designed to meet the following goals:

- To place the burden of processing on software, while minimizing the use of hardware;
- To optimize the cost, reliability, and produceability of essential optical and printing transducers;
- To improve human factors (ergonomics);
- To keep pace with evolution of the International Standards Organization (ISO) Open Systems Interconnect reference model;
- To optimize compatibility with the developing integrated services digital network (ISDN); and
- To establish facsimile printers as the universal non-impact printers of choice to replace or enhance typewriters, office copiers, computer output printers, microfilm blowback copiers, and daisywheel printers.

To achieve these goals, development efforts are concentrating on compression codes, modems, scanners, printers, circuitry, electronic filing and optical storage, mail delivery techniques, image terminals, distributed office communications protocols, and ergonomics.

Mail delivers an original, and communicating word processors can deliver documents with the quality of the original. In contrast, most facsimile equipment cannot deliver a copy that even approximates the quality of the original.

Facsimile equipment is classified according to four "groups," numbered 1-4. Table 4-2 shows some of the more important characteristics of each group.

Group 1 and Group 2 facsimile copies, at 96 lines per inch (3.85 lines/mm), are barely of borderline quality for 10-point type and are legible only in context for 8-point type. An alternative mode at 64 lines per inch (2.5 lines/mm) is barely legible for 10-point type. It is an effort to read such "fuzzy" copy; eye and mental strain cause the reader to tire and even to develop

Table 4-2

COMPARISON OF GROUPS 1-4 FACSIMILE

Group	Speed sec/page	Speed bus	Terminal	Transmission	Resolution	Error Correction	Quality
1	360		Rotating drum scanner	Regular telephone line	96 lines/in. (3.85 lines/mm)	None	Low
2	180		Same	Same	Same	None	Low
3	24	2400 4800 7200 9600	Various	Regular telephone line	200 lines/in. (7.7 lines/mm)	High	Good CCITT
4			General purpose and non-impact printer	Data line		Low*	High CCITT Comparable to office copier

*Error correction done in data link

subconscious hostility toward the sender. Poor copy quality is the primary obstacle to general use of facsimile as a preferred document delivery method.

Groups 3 and 4 offer much higher resolution and speed, and also some form of "punch-through" error correction techniques that lower the transmission rate when repeating a block containing an error.

Various manufacturers offer equipment for groups 1-3; these devices usually operate together satisfactorily, because of standards issued by the International Consultative Committee on Telephone and Telegraph (CCITT), which have been adopted worldwide. Standards for Group 4 are expected before the end of 1984.

4.3.1.1 Compression Codes

Compression codes are sophisticated algorithms that act upon the digitized facsimile signal to reduce redundancy in the bit stream created by scanning the image. As employed in Group 3 devices, an analog facsimile scan is digitally encoded in terms of run lengths, or distances between horizontal changes in the picture. A second set of codes of ascending length describe run lengths of descending probability, so that the set of run lengths is described in a minimum of bits. This process is called "compression," because it compresses the description of a page into fewer bits of information. Since adjacent lines in facsimile are often very similar, a line can be encoded, not with new data, but by comparison with the preceding line. In 1969 Dacom developed such a run length code, plus a line comparison code every other line. These codes were incorporated into equipment supplied to compress newspaper facsimile transmissions of the *Wall Street Journal* between San Francisco and a publishing site in Riverside, California.

A year later, CBS and Savin Business Machines Company acquired Dacom and enlisted Ricoh as a partner in a venture to develop an office facsimile terminal based on data compression using the Dacom code. Although the product was developed and tested in the United States, it was made in Ricoh's Atsugi plant in Japan. In 1974 the CBS/Savin/Ricoh product, called the Rapifax 100, was introduced. Subsequently, Ricoh bought the CBS, Savin, and Dacom interests, obtaining 100 percent ownership of the Rapifax program.

Rapifax production helped to stimulate a major national effort to advance facsimile technology among Japanese manufacturers. Kokusai Denshin Denwa (KDD), the Japanese government-owned international telephone carrier, developed an improvement over the Dacom code called the Relative Address Code and offered it as an international standard. Six other codes were offered by AT&T, 3M, IBM, Xerox, the British Post Office, and the West German Bundespost. The CCITT selected a British modification of the