

Special Issue on Printers: UDC 681.327.54'22 : 621.397.12

Multi-function Technology for FAX / MFP Devices

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Abstract

We released DOC • IT in 1992 as an MFP (Multi-Function Peripheral) which integrates PC peripherals such as printers and scanners. We have been consecutively developing FAX / MFP as PC peripherals integrating the accumulated printer technology and FAX technology while reexamining DOC • IT. This paper describes the technology on each functional element of MFP, and the combining technology that allows these multiple functions to coexist on one equipment. An example of a PC application for utilizing FAX / MFP is also introduced.

1. Introduction

MFP (Multi-function Peripheral) is peripheral equipment of a PC that has multiple functions in one unit, and is also called "composite equipment". From a PC a user can access a printer, scanner, and such communication functions as a FAX transmission (hereafter PC FAX), and a combination of these functions. Using one MFP rather than installing multiple single function equipment has the following merits.

1. Space: Less installation space is required with a simple installation. MFP is especially suitable for SOHO (Small Office Home Office).
2. Cost at purchasing: Cost is lower than the purchase of single function devices that are used in combination.
3. Running cost: Low power consumption and low maintenance cost.
4. Integration: Operation efficiency improves by linking each function.

Okidata commercialized DOC • IT in 1992 as a printer based MFP. We have been developing FAX / MFP, which is a FAX integrated with printer functions. The multi-function technology of FAX / MFP is described below.

2. System configuration

2.1 Configuration

Figure 1 shows an example of a configuration of an MFP system.

This MFP system consists of a mechanism section, control section and interface section.

1. Mechanism section

The mechanism section consists of a scanner engine and printer engine. The scanner engine has an image sensor to read originals and an automatic paper feed mechanism to feed multiple pages of an original continuously. For the printer engine, an electrophotographic LED printer has been used for the FAX / MFP.

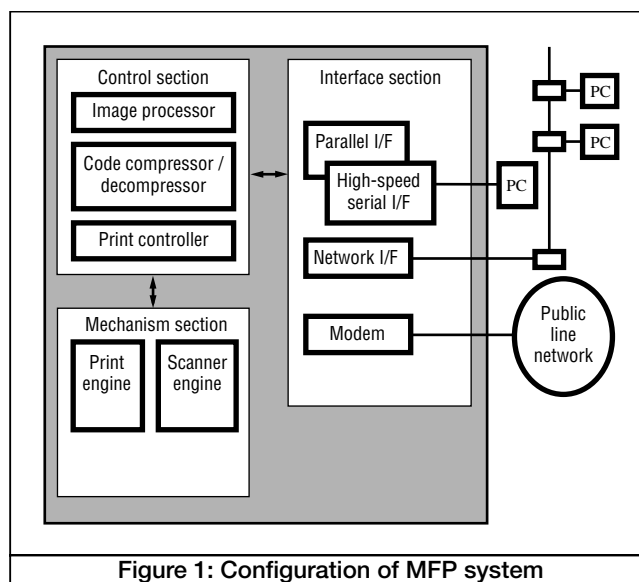


Figure 1: Configuration of MFP system

2. Control section

The image processing section converts optically read data from the scanner engine to electrical data, and compensates the data to obtain optimum images. This image processing section performs gamma control, binarization and error diffusion processing.

The print control section sends print data to the printer engine. Print control primarily controls such print processes as latent image, development and fixing of the LED engine. The code compression / decompression section compresses data by encoding and decompresses data received from the external interface when image data is sent via an external interface. Optimum compression / decompression control is performed for the printer, FAX and image scanner.

3. Interface section

The interface between the host PC and MFP (hereafter HOST - MFP I/F) has various systems that include IEEE 1284 (parallel interface)¹, LAN (Local Area Network) and a high-speed serial interface.

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3. MFP functions

Figure 2 shows the MFP functions.

3.1 Basic functions of FAX / MFP devices

The major functions of FAX / MFP devices are input (scan), communication and output (print).

1. FAX function

When the FAX / MFP operates as a FAX, for example, data is processed as:

- FAX transmission: input (scan) → communication
- FAX receiving: communication → output (print)
- Copy: input (scan) → output (print)

2. MFP function

As the FAX / MFP operates the peripheral functions of a PC, data is processed as:

- Printing from PC: PC → output (print)
- Image scan: input (scan) → PC
- PC FAX transmission:
PC → communication (FAX transmission → communication line)
- PC FAX receiving: communication (communication line → FAX receiving) → PC

4. Individual technology

Figure 3 shows the configuration of logical functions of an MFP system.

4.1 Printer technology

The MFP system can print data at a 600 dpi equivalent resolution using ACC (Arithmetic Copying Coding)², which is a high compression system developed by Okidata.

4.2 Scanner technology

The MFP system conforms to TWAIN³, which is the de facto standard for scanner interfaces. Multi-value reading and high-speed reading were implemented by developing a dedicated LSI for reading.

4.3 PC FAX communication technology

For PC FAX, the MFP system conforms to the AT command-based standard interface Class 1 standard recommended by TIA / EIA⁴. Communication at 14.4 kbps is possible.

4.4 FAX communication technology

The MFP system supports FAX communication without depending on a PC. The supported FAX communication functions are ordinary feeder transmission and receiving data to recording paper, as well as such high level functions as memory transmission/receiving, polling communication and personal and confidential communication. High-speed communication protocols such as V.34 are also supported.

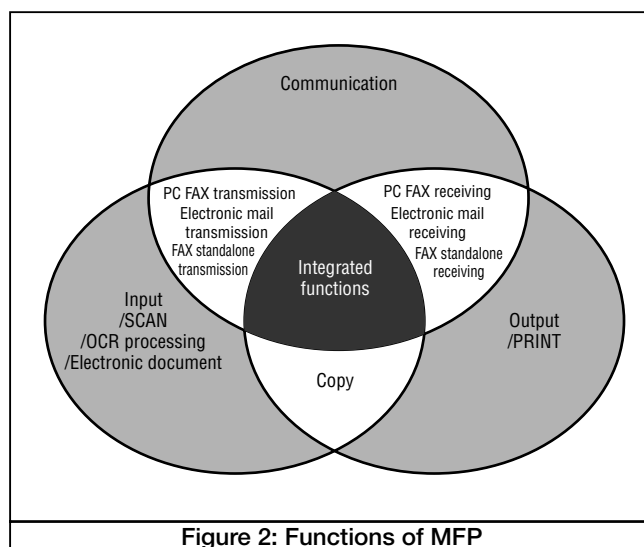


Figure 2: Functions of MFP

4.5 File transfer

The file transfer function by HOST-MFP I/F allows being notified of terminal status and update registration contents.

5. Integration technology

5.1 Oki MFP interface protocol

To implement multiple functions between HOST and MFP, we developed the Oki-MFP interface protocol. Each function, such as scanner and printer, is packeted and is identified by a packet header. Because of this structure, multiple functions are shared and operated in parallel, even if only one physical interface is available between HOST and MFP. This structure also insures the independence of each function, therefore, an abnormality in printer operation, for example, has no affect on scanner operation.

5.2 Multiplex processing technology

To make parallel operation of each function possible, high processing capability that includes CPU processing, data transfer and circuit processing, is necessary. For this we adopted a high-speed RISC (Reduced Instruction Set Computer) CPU, and developed an ASIC dedicated to MFP. As a result, parallel operation of high-speed FAX communication processing, such as V.34 and 8 ppm print processing at 600 dpi equivalent image quality from a PC, became possible.

5.3 High-speed switching technology

This technology is explained using PC FAX modem control as an example. If half-duplex communication, such as IEEE 1284, is used as the HOST-MFP I/F for the PC FAX modem, which is supposed to use a full duplex serial interface, a full duplex connection must be implemented virtually. So we developed the MCE (Mode Change Express) interface communication system, and implemented high-speed switching.

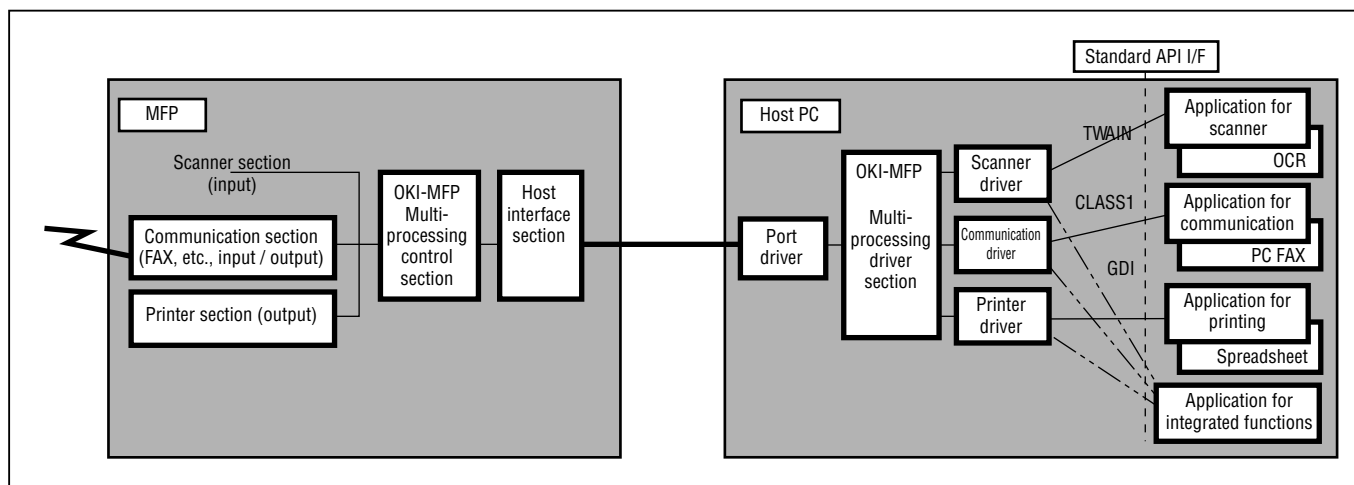


Figure 3: Functional block diagram

5.4 Resource management technology

The printer engine and scanner engine are resources commonly used for multiple processing. In the case of MFP, which includes multiple functions in a device, for example, a request to print a FAX received image and a request for printing from the PC may be generated simultaneously to one printer engine. These requests are controlled by priority, so that each resource of the printer engine and scanner engine can be controlled efficiently and effectively.

5.5 Driver

The driver for multiple processings of MFP is arranged at the higher layer of the port driver, which implements interface control and resource control of MFP, including packet control.

6. Usability

This section describes critical points to enhance the usability of products.

1. Adoption of standard I/F

As the I/F with an application, the scanner adopts the TWAIN protocol, and the PC FAX adopts Class 1 protocol. This makes it possible to freely use general applications.

2. Providing integrated applications

An integrated application environment is necessary so that the user can use the purchased MFP immediately without purchasing separate applications. Examples of such integrated functions are listed below.

1. Electronic documents

A document is computerized (hereafter an electronic document) to make handling and information exchange on the PC easier (Figure 4).

- a. <Scan —> compression —> electronic document (image)>
Data (paper) is read by the scanner to create an electronic document, which can be displayed and scrolled through on the PC screen by the attached

viewer. This also promotes paperless operation.

- b. <Scan —> character recognition —> electronic document (text)>

An original document is read and optically processed by OCR (Optical Character Reader). This converts character information into a text file, which can be processed and edited. This function is convenient to compress and reuse information.

- c. <Print capture —> compression —> electronic document (image)>

An image format electronic document is output by an ordinary printing operation. Since output from various applications is created into electronic document files, it is unnecessary to startup multiple applications, and the screen can be read by only one viewer operation.

- d. <Electronic document —> electronic mail>

An electronic document can be sent as data via electronic mail. The receive side can display and print the received document using a viewer application.

2. High function copy

- a. <Scan —> image processing —> printing>

The images of a read document can be processed on the PC. Such copy processings as enlargement / reduction and printing multiple pages on one page become possible.

3. PC FAX

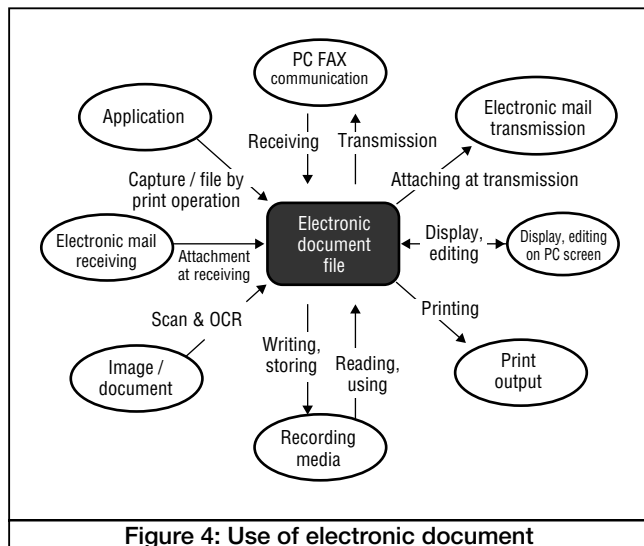
- a. <Arbitrary application —> PC FAX transmission>
Direct PC FAX transmission is possible from any application using a similar operation procedure as printing. This allows the transmission of clear images without any deterioration via FAX.

- b. <Scan —> electronic document —> PC FAX transmission>

After creating an electronic document by scanning of an original document, the electronic document is edited on the PC and transmitted via PC FAX.

- c. <PC FAX receiving —> compression conversion —> electronic document>

The file received by PC FAX is converted to an electronic document and is stored. Data can be reused, such as by sending the electronic document to another destination via PC FAX.



7. Conclusion

This paper presented an overview of MFP and its integration technology. We will improve the individual functions for MFP devices, and at the same time will promote user oriented technological development pursuing the seamless integration of these functions and expanding applications.

8. References

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