Print Controller Design Guide for Information Security:

Model AP-P2
Model Katana-C2
Model Katana-P1
Model MT-C4
Model SI-P2

Ricoh Company, Ltd.
March 29, 2010

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Overview

This document describes the structural layout and functional operations of the hardware and software for the multi-functional products and laser printers listed below (herein referred to as the “MFP” and “LP”, respectively), which were designed and developed by Ricoh Co. Ltd. (herein referred to as Ricoh), as well as the information security of image data and other information handled internally by Ricoh MFP/LPs.

The explanations will primarily focus on the following, with particular attention to demonstrating how unauthorized access is not possible to local network environments via FAX telecommunications lines, nor to any of the data stored in the MFP/LP.

- Operational summaries
- Data flow
- Data security considerations

Products to Which This Document Applies

This document applies to the following MFPs/LPs designed and developed by Ricoh:

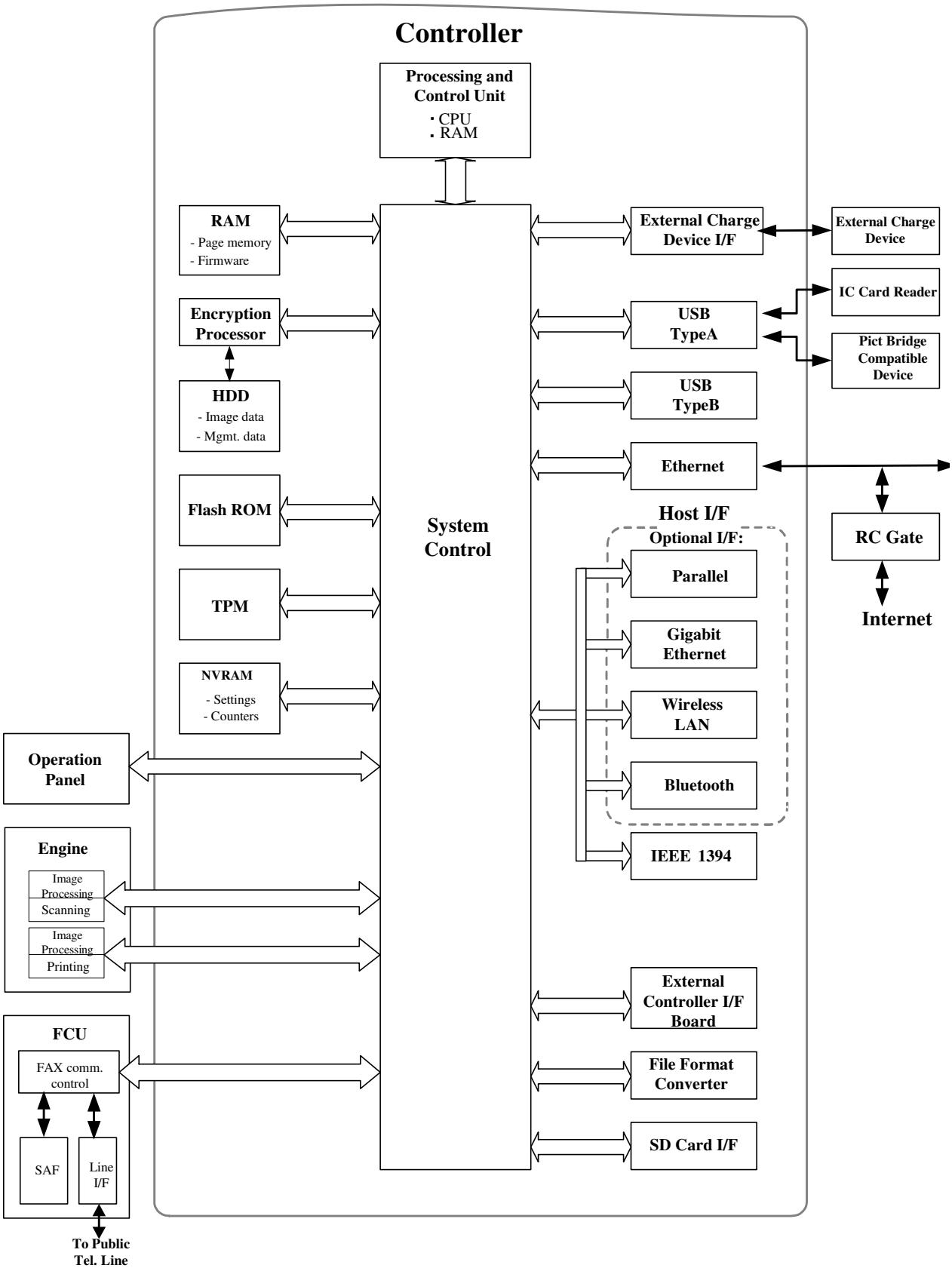
- AP-P2
- Katana-C2
- Katana-P1
- MT-C4
- SI-P2

Note: Some of the hardware (e.g. external I/F) and functions described in this document may not be supported by the end user’s machine. For these details, please refer to the Operating Instructions for the specific machine in question.

1 Internal System Configuration

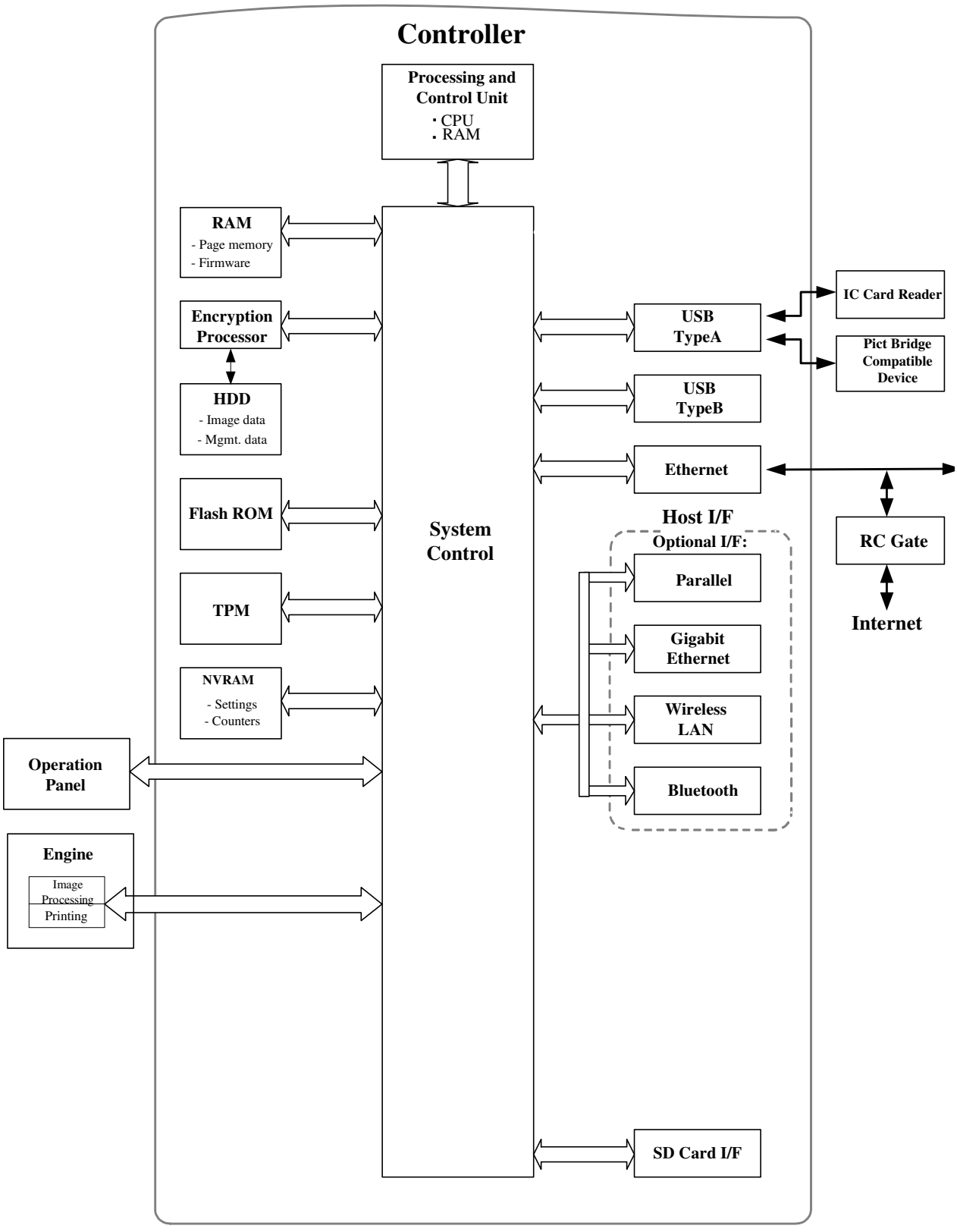
1.1 Hardware Configuration

1.1.1 MFP



- Serial communication between the external charge device I/F and external coin/card-operated devices.
- External controller I/F board: Acts as the interface between the MFP and external controller.
- File Format Converter: Converts the file format of image files.
- RC Gate: Intermediary device connected to the MFP/LP via an Ethernet connection for performing remote diagnostic operations including firmware updates and settings changes.
- SD card I/F: Used for performing service maintenance and as an interface for firmware storage media.
- RAM, HDD: Image data stored in the RAM and HDD memory undergoes compression, decompression and other image processing.
- HDD storage: Data stored on the HDD is encrypted.
- TPM (Trusted Platform Module): When the MFP/LP main power is turned on, this security module (chip) performs a verification on the validity of the software installed on the hardware platform, which includes checking for any illegal alterations.

1.1.2 LP


Controller
Processing and Control Unit
・CPU
・RAM
RAM
- Page memory
- Firmware
Encryption Processor
HDD
- Image data
- Mgmt. data
Flash ROM
TPM
NVRAM
- Settings
- Counters
Operation Panel
Engine
Image Processing
Printing
System Control
USB TypeA
USB TypeB
Ethernet
Host I/F
Optional I/F:
Parallel
Gigabit Ethernet
Wireless LAN
Bluetooth
SD Card I/F
IC Card Reader
Pict Bridge Compatible Device
RC Gate
Internet

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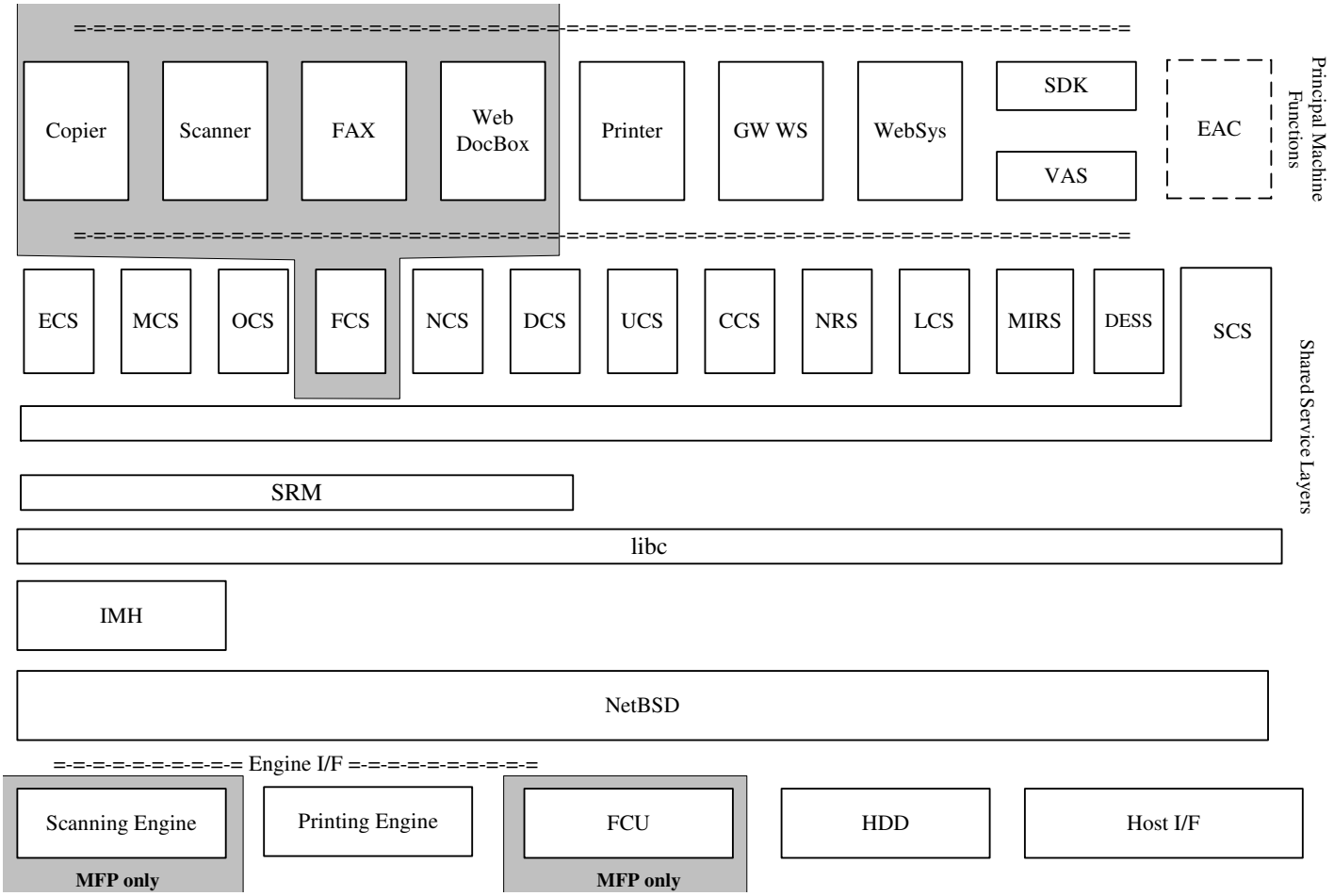
1.2 Software Configuration



Software Configuration

1.2.1 Shared Service Layers

ECS (Engine Control Service)	Controls engine operations for scanning and printing.
MCS (Memory Control Service)	Manages the memory in the Image Memory area (incl. the HDD), as well as compression/decompression.
IMH (Image Memory Handler)	Transfers data between the controller and engine.
OCS (Operation Panel Control Service)	Controls the panel LEDs, monitors panel keys and manages panel objects and display messages.
NCS (Network Control Service)	Controls host I/F and protocol control (transport, session).
FCS (FAX Control Service)	Exchanges data and commands with the FCU (FAX Control Unit), which manages and controls FAX communication and telecommunications lines.

SCS (System Control Service)	Manages the status of all internal operations performed on or by the system as a whole, and controls the switching of the LCD screen as well as the operational link between SP settings and machine operations.
SRM (System Resource Manager)	In addition to managing hardware resources, this module mediates control of the printer engine, scanner engine and memory resources during the image creation process.
DCS (Delivery Control Service)	Controls all non-FAX transmission/reception of e-mail as well ass the forwarding of image data to servers and folders.
MIRS (Machine Information Report Service)	Controls the sending of machine configuration settings by e-mail
UCS (User Control Service)	Manages the Address Book data.
CCS (Certification Control Service)	Mediates communication between the principal machine function and external charge device during the authentication process, as well as the charge-related processing (e.g. counters).
NRS (New Remote Service)	Controls remote correspondence with RC Gate (e.g. diagnostics, firmware update, settings changes).
LCS (Log Control Service)	Controls the MFP/LP's access logs (e.g. Address Book, Document Server, MFP/LP functions).
DESS (Data Encryption Security Service)	Controls the encryption and decryption functions.

1.2.2 Principal Machine Functions

Copier	Activates the scanning engine, which reads the original and then sends the data on to the controller to be printed out from the printing engine. Secondary data, such as that used for access control, is handled from the operation panel.
Printer	Receives image data through the host interface, which then sends the data to the controller. Also contains a printer language processing subsystem (e.g. RPCS) that converts the printer language into image data, which is then printed out from the printing engine. Secondary data is handled via the connection protocols between the driver UI and the host I/F.
Scanner	Activates the scanning engine, which reads the original and then sends the data to a PC via the host I/F. Scanning can be initiated from both the operation panel and from a PC via a TWAIN driver.
FAX	Activates the scanning engine, which reads the original and then sends the data to the FCU to be sent as a FAX via a telecommunications line. Also receives FAX data and prints it out from the printing engine.

Netfile (GWWS)	As a server, GWWS provides some MFP/LP functionality to specific network-connected PC utilities. This includes the ability to view and make changes to user information and machine configuration settings, as well as to print out or perform other operations on documents stored on the MFP/LP. GWWS also acts as a client to external Web services, including transferring the machine log data to specific log data collection utilities
WebSys	A Web application that allows machine configuration settings to be viewed and changed via a Web interface.
WebDocBox	Allows operations to be peformed on Document Server documents stored in the MFP (viewing, downloading, printing, deleting) via a Web interface.
SDK/VAS	SDK: Applications provided by third-party vendors designed to function with MFP/LP pricipal machine functions developed by Ricoh. VAS: An MFP/LP API that standardizes the meanings of simplified commands used by SDK applications when communicating with the MFP/LP.
EAC	This module controls the TCP/IP command flow between the GW-API and external controller connected to the MFP via the Gigabit Ethernet-compatible network I/F. The EAC allows the external controller to initiate MFP operations such as print jobs and scan jobs, as well as store Printer documents to the MFP HDD. In addition, this module also makes it possible to change some of the internal settings of the external controller from the MFP operation panel. **Note:** This is only available on models capable of supporting an external controller.

1.3 Data Security

1.3.1 External I/F

The MFP/LP is equipped with the following external interfaces:

- Serial I/F for connection of external coin/card-operated devices.
- Serial I/F for connection of peripheral devices (e.g. DF, Finisher, LCT).
- Analog G3 FAX I/F (public telecommunications line), G4 FAX I/F (ISDN).
- Standard IEEE 1284 parallel I/F (Host I/F), which can function as a two-way parallel interface when using a USB cable.
- Standard IEEE 1394 I/F
- 100BASE-TX and 10BASE-T compatible network I/F (Host I/F)
- Gigabit Ethernet-compatible network I/F (Host I/F options, external controller I/F board)
- Standard IEEE802.11b wireless LAN network I/F (Host I/F option)
- Bluetooth I/F (Host I/F option)
- USB2.0 Type B I/F (Host I/F)
- USB2.0 Type A I/F (IC card, Pictbridge)

1.3.2 Protection of Program Data from Illegal Access via an External Device

1. All of the above principal machine functions, as well as software for all shared service layers, run on the UNIX operating system as independent processes (data/program modules). Memory space is allocated specifically for each module, which makes it impossible for one module to directly access the memory space of any other.
2. Data transfer between modules is Unix socket-based, whereby communication is performed along ID-protected communication paths. This ensures exclusive connections among the modules present in the MFP/LP, thereby preventing access by any module outside this pre-determined set. For example, incoming FAX data will only be sent to those modules designated to perform FAX data operations. This arrangement prevents illegal access to networks and internal programs from an outside line.
3. All image data stored on the HDD or stored temporarily in the Image Memory is managed by a memory control module called the MCS (Memory Control Service), which ensures that the data can only be accessed by specified machine function(s). In addition, this arrangement prevents illegal access to this data from an outside line.

   User data, such as the Address Book data stored in the HDD/flash ROM and User Code data stored in the NV-RAM, is managed by the UCS module. Access to this data is not possible by any module except those pre-determined modules in the MFP/LP itself. This arrangement ensures that the data stored in the MFP/LP cannot be accessed illegally via an external I/F.
4. Communication between the MFP/LP and its peripherals is conducted via the peripheral I/F using Ricoh-unique protocols. These exchanges are limited to pre-determined commands and data, and only take place after the MFP/LP has recognized the peripheral device. If the MFP/LP receives illegal data from the peripheral, it will judge that a perhiperal device failure has occurred or that the device is not connected. This prevents any illegal access to internal programs or data.

5. The MFP communicates with external coin/card-operated devices through the External Charge Device I/F in accordance with the same protocols used for its peripherals described in #4 above. It is possible to utilize such devices in tandem with the access control settings for each user, in which case the device and MFP exchange the relevant information (e.g. User Code data).
6. With the @Remote function, the MFP/LP is connected via the network to a Ricoh-developed device known as RC Gate, which is then connected to the @Remote Center, or to the @Remote Center directly. When connecting to the center directly, the MFP/LP communicates via a LAN connection over the Internet. Before transferring any data, mutual authentication is performed using digital certificates between the MFP/LP and RC Gate or MFP/LP and @Remote Center, which ensures that the MFP/LP cannot connect to any device other than RC Gate or to its single, pre-assigned @Remote Center. Communication between RC Gate/@Remote Center and the MFP/LP modules responsible for @Remote operations is performed over exclusive socket-based connections, as described in #2 above. In addition, it is also possible to change the MFP/LP settings to prohibit @Remote communication.
7. External controllers are connected to the MFP via the Gigabit Ethernet-compatible network I/F, and are then routed internally through the external controller interface board. The internal arrangement is designed such that the external controller cannot gain access to the MFP internal modules until after it has successfully cleared the device registration process.

   In addition to sending data for printing to the MFP, the external controller is also capable of storing image data received from the PC inside its own memory as well as obtaining scanned data just following an MFP scanning job. It is not able to access any of the image data stored in the MFP.
8. The standard IEEE1284 parallel I/F, USB I/F (Type B), and Bluetooth I/F treat all incoming data as print data. This print data can only be sent to pre-specified modules responsible for executing printing operations. In addition, using MFP/LP settings, it is possible to disable each interface individually.
9. The USB I/F (Type A) only allows connection with devices that support either IC card-based authentication or PictBridge printing functions. Each function can be enabled/disabled individually.

   PictBridge printing functions (color MFP/LPs only):
   After the identity of the connected PictBridge device is verified, the interface and device exchange only pre-defined commands and/or data. Access to data stored inside the MFP/LP is not possible. In addition, if User Authentication has been enabled, the machine will not accept commands or data from any PictBridge functions that do not require authentication.

   IC card-based authentication functions:
   Authentication is mutual and encrypted, which prevents impersonation and ensures that data is properly protected.

1.4 Protection of MFP/LP Firmware

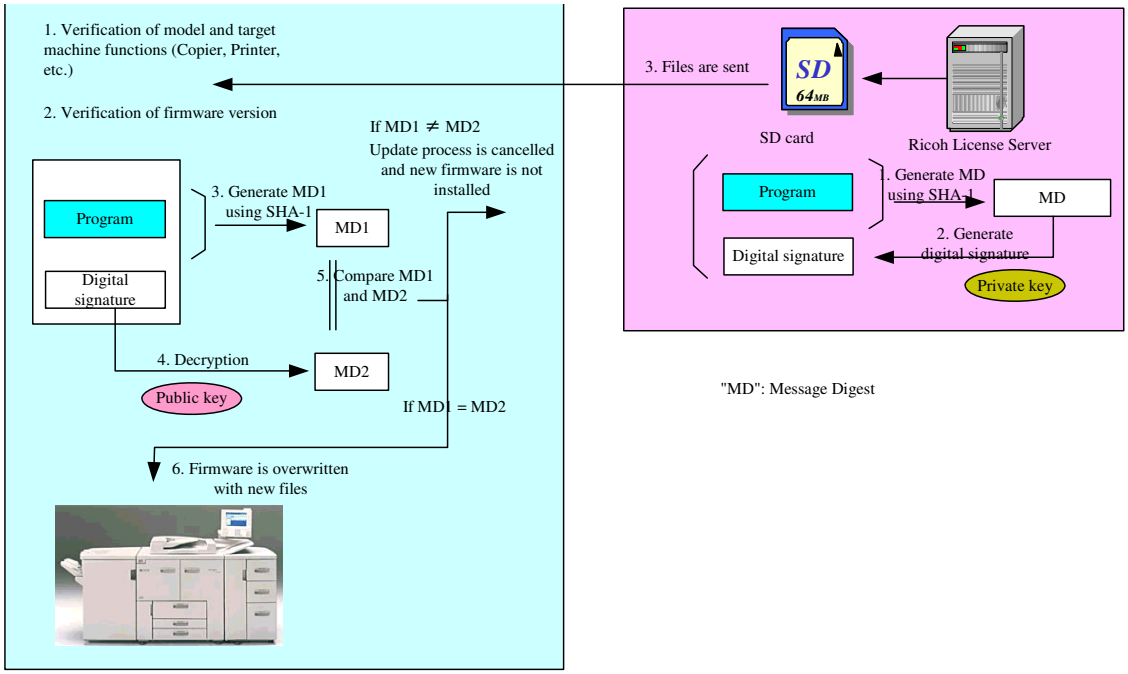
1.4.1 Firmware Installation/Update

It is possible to update the firmware stored on the MFP/LP using an SD card or via a remote connection. The following process is used to verify the validity of all firmware introduced into the MFP/LP in the field. This applies to firmware updates as well as to new installations of MFP/LP options.

Firmware Installation/Update Using an SD Card

- Since SD cards themselves are generic items that are widely available for purchase in the field, the following process is used to prevent the illegal introduction of firmware into the MFP/LP via this storage media. Briefly stated, a license server assigns a digital signature to the firmware, which the MFP/LP then uses to authenticate the firmware when it is introduced in the field.
  1. The Ricoh license server applies the SHA-1 algorithm (Secure Hash Algorithm 1) to the program to generate the value MD1. A private key is used to encrypt this value, which is then used as the firmware's digital signature.
  2. The firmware in the SD card is introduced into the MFP/LP via the SD card slot.
  3. The MFP/LP checks the firmware to identify the type (e.g. System, Printer, FAX, LCD). It then verifies that the model name is the same as its own, and in the case of a firmware update, that the firmware version is newer that the one already installed.
  4. The MFP/LP then applies SHA-1 to the program to generate MD1, after which it uses a public key to decrypt the digital signature to generate MD2.
  5. If MD1 = MD2, the firmware update process begins.

- Using a public key to decrypt the digital signature allows the MFP/LP to verify that the firmware has not been altered since it was assigned the digital signature by the license server.
- The basic identifying information of the firmware (version, type, etc.) is stored in the MFP/LP as the update is being performed. Therefore, the update can be reinitiated using the same SD card in the event that it is interrupted by a sudden loss of power or other cause. After recovery is initiated, the MFP/LP checks to see that the data in the SD card has not been altered, and then resumes the update.

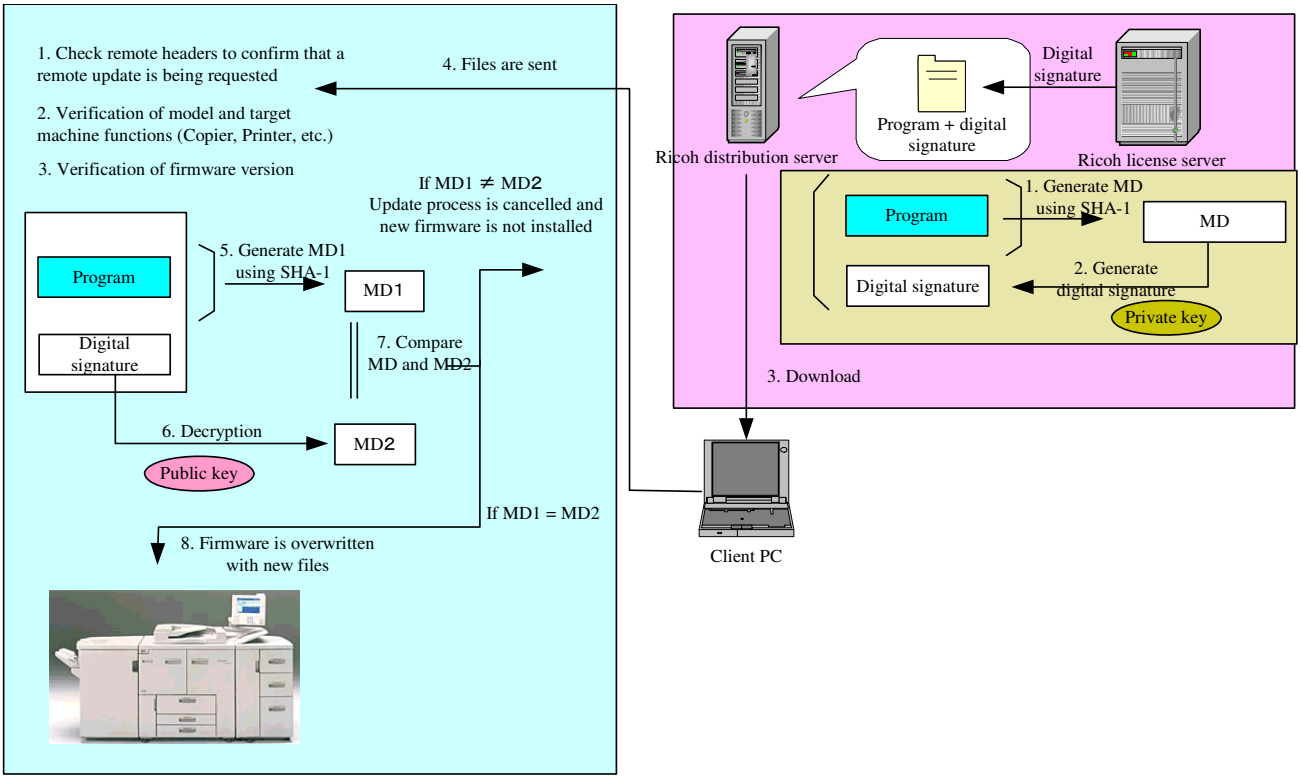


Firmware Update Using an SD Card

Remote Firmware Update

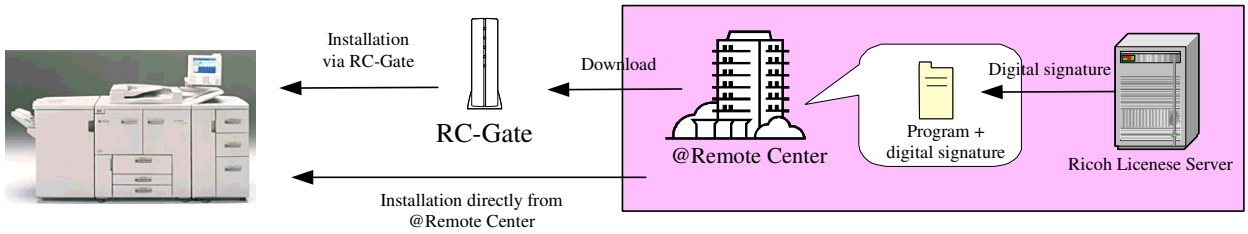
- In addition to using an SD card, it is also possible to update the firmware by transmitting the firmware files to the MFP/LP via a remote connection. Since these files are transmitted over public Internet communication paths in some cases, routed through multiple servers before reaching their destination, it is necessary to use the authentication process described above for remote updates as well. The process for remote updates is virtually the same as that for the SD card-based update described above, with the following differences:
  - Remote headers are attached to the digital signature before the files are sent to the MFP/LP.
  - If the update is interrupted for some reason, it is possible to retry the update by resending the file.

- There are three main scenarios in which a remote firmware update is performed, the process for which is the same as described above (see illustrations below). In each scenario, all of the security features described above are employed.
  - The update is performed by a field engineer in the field via a PC
  - The update is performed using the @Remote function, normally by an individual with access rights to the @Remote Center GUI
  - The update is performed via Web SmartDeviceMonitor Professional IS, usually by the end user

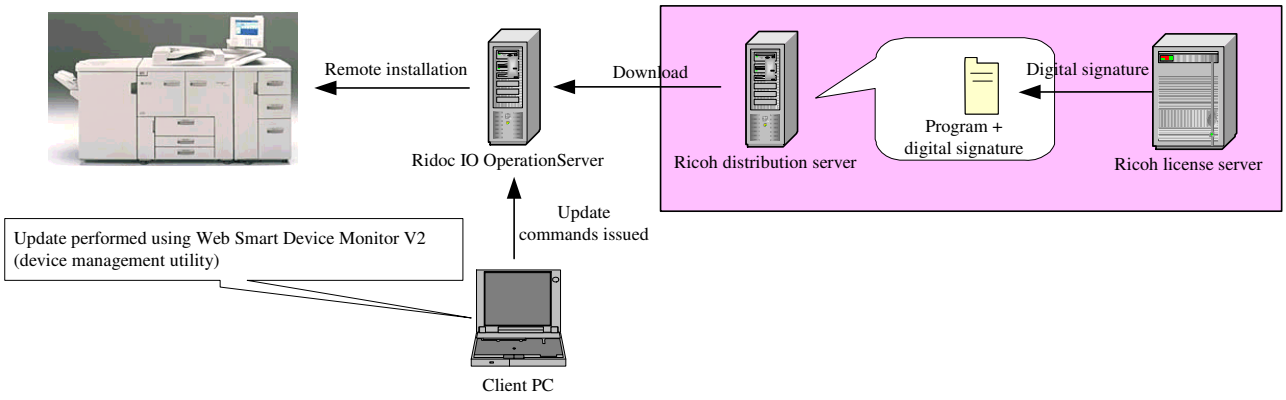


Remote Firmware Installation Performed by a Field Technician

(from a client PC)



Remote Firmware Installation using @Remote



Remote Firmware Installation via Web SmartDeviceMonitor Professional IS

(performed by the end user)

1.4.2 Verification of Firmware/Program Validity

Overview

- In order to continually ensure the validity of all controller core programs and application firmware installed on the MFP/LP at the time of product shipment, as well as those that are newly installed as updates through the process explained in section 1.4.1 above, the MFP/LP performs a validation process known as Trusted Boot every time the main system is booted up. Covering the range of software from boot programs to end-point functions and applications, the Trusted Boot validation process provides comprehensive, TPM-based security.

- The MFP/LP uses the unique digital signature assigned to each program/firmware in order to judge its validity. The public key used for this verification is stored in an overwrite-protected, non-volatile region of the TPM, which makes it extremely difficult for the key itself to be altered in any way, providing additional protection of the programs/firmware.

- Trusted Boot employs two methods to verify the validity of the programs/firmware mentioned above:
  - RTM (Root Trust of Measurement) is used to validate the controller core programs, which include the MFP/LP operating system, BIOS, and boot loader. Using the TPM, this method is capable of detecting any alterations made to these programs.
  - The same digital signature-based verification process explained in section 1.4.1 is used to validate the application firmware

- Trusted Boot is integrated with the protection of the user's encryption keys (see section 1.8 for details), ensuring that only valid programs are given access to these keys.

Note: Produced by STMicroelectronics, TPM is a product of the ST19WP18 family, which has earned Common Criteria certification (EAL5+).

1.5 Authentication, Access Control

1.5.1 Authentication

- When enabled, User Authentication requires all users to go through a username and password-based authentication process before MFP/LP operations can be performed. This is true in cases where the user attempts to access MFP/LP functions via the operation panel as well as via a network connection.

- There are five types of User Authentication:
  - Basic Authentication
  - User Code Authentication
  - Windows Authentication
  - LDAP Authentication
  - Integration Server Authentication

- As the authentication server, the MFP/LP can be used for Basic Authentication, a Windows NT4.0 server, Windows 2000 server or Server2003 can be used for Windows Authentication, and an LDAP server can be used for LDAP Authentication. In addition, when “Integration Server Auth” is selected from the User Authentication menu, the MFP/LP connects to the actual authentication server via an Integration Server. In this case, the authentication is performed using the User Authentication functions of ScanRouter, ScanRouter Document Server, Web SmartDeviceMonitor Professional IS or ScanRouter Web Navigator.
  Note: See “Windows Authentication, LDAP Authentication” and “Integration Server Authentication” diagrams below.

- Usernames:
  - Format: US-ASCII, WinLatin1, WinLatin2, WinCyrillic
  - Length: Maximum 32 characters
    Note:
    - Although it is possible to input the 2-byte characters used in display languages such as Chinese, Japanese, Taiwanese, and Korean, they are not supported.
    - Although usernames longer than 32 characters are invalid, the input field will accept up to 128 characters in order to make the 32-character limit more difficult to surmise.

- Passwords:
  - Format: US-ASCII, WinLatin1, WinLatin2, WinCyrillic
  - Length: Maximum 128 characters (general users), 32 characters (Administrators).
    Note: Although it is possible to input the 2-byte characters used in display languages such as Chinese, Japanese, Taiwanese, and Korean, they are not supported.

- Before authentication at the MFP/LP operation panel can be performed, uses must be pre-registered in the MFP/LP. The communication path can be encrypted using SSL, however for environments that do not support SSL protocol, the password itself is encrypted using an encryption key specified by the Administrator. To do this, however, the Printer/Scanner option must be installed.

To protect against brute force password cracks and DoS attacks via repeated login, the MFP/LP is capable of detecting a high frequency of illegal login requests. Administrators can view the detection results by accessing the job log, or by checking the notification e-mail sent to them. Also, for any consecutive failed authentication attempts, the MFP/LP will delay its response.

- It is possible to set the MFP/LP to automatically lock out any user if the number of failed login attempts by that user exceeds the predetermined limit (access is denied and further usage of that account is prohibited). Additionally, when the operator registers their authentication password, the MFP/LP checks the format against the password policy. This policy is set by the Administrator using the following parameters:
  - Minimum length: Can be set to a value from 1– 32 characters
  - Complexity: Can be set to “Level 1”, “Level 2”, or “Off”
    Level 1 requires that the password contain two or more of the following types of characters, while Level 2 requires that the password contain three or more types: English capital letters, English lower-case letters, numbers, symbols.

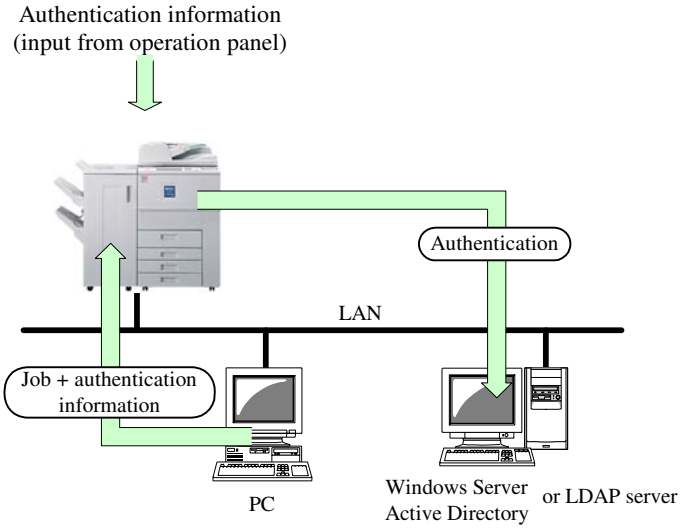
  Note: These two features apply to general user accounts authenticated through Basic Authentication (performed by the MFP/LP), and to Administrator accounts authenticated through all authentication modes. When users log in via an external server, instead of performing the password policy check described above, the MFP/LP follows the authentication results received from the server.

- The information for performing the authentication of administrators is encrypted and then stored in the MFP/LP in non-volatile memory. Therefore, it is always possible to perform authentication on administrators even when a failure occurs with the MFP/LP HDD or one or more of the external authentication servers is down.

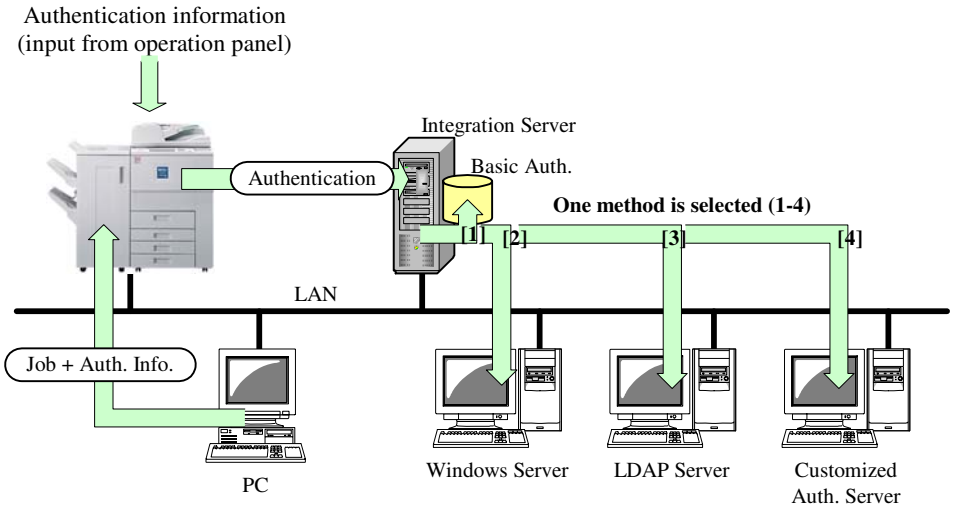
- In the case of Windows Authentication, NTLMv1 Authentication or Kerberos Authentication is performed with the specified domain controller, after which an attempt is made to establish an LDAP connection with the active directory. The e-mail address, FAX number and GUID are then obtained for users who successfully clear the authentication. The same NTLM Authentication process is performed for LDAP Authentication as well, after which an LDAP search is performed to obtain the user’s e-mail address, FAX number and GUID.

- Kerberos Authentication can be used for LDAP Authentication and LDAP searches. Kerberos Authentication tickets are not stored in non-volatile memory, and are destroyed as soon as the authentication process is successful.

- Active sessions will expire under the following conditions:
  - When the “Logout” button is pressed in User Tools
  - When the “Logout” hard key is pressed (on MFPs/LPs that have this key)
  - When the MFP/LP enters Low-power Mode or Energy Saver Mode
  - After a pre-determined amount of time has passed (automatic logout)



Windows Authentication, LDAP Authentication



Integration Server Authentication

1.5.2 IC Card Authentication

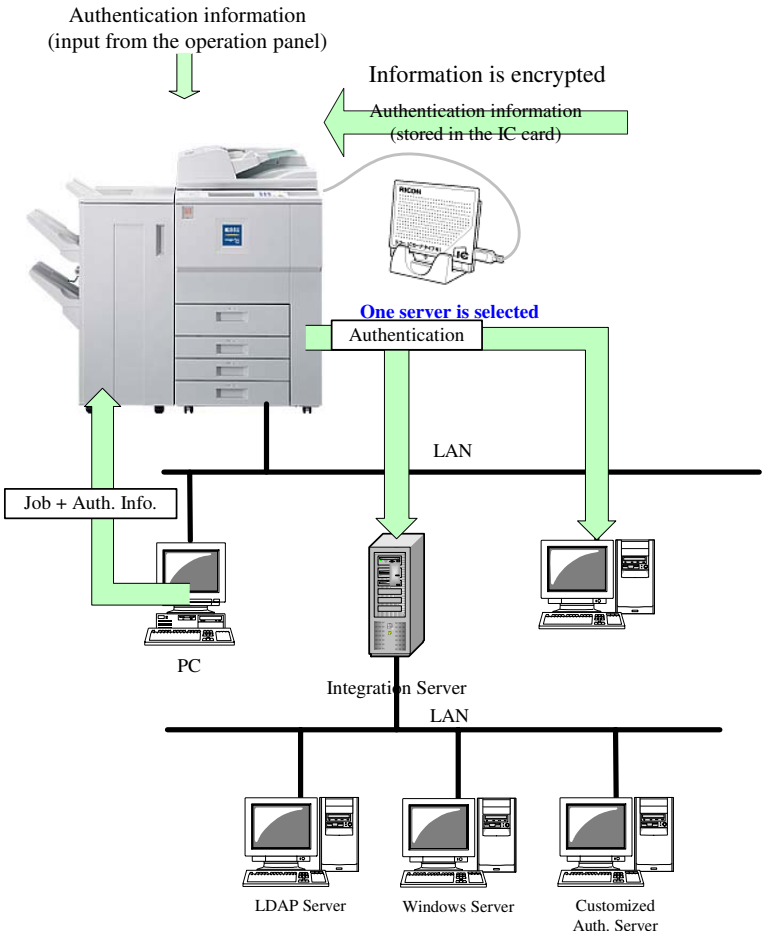
Overview

- IC Card Authentication is provided to the field in the form of an optional IC card. The information necessary to perform the authentication functions described in section 1.4.1 above (username and password) can be stored to this IC card and then used to authenticate MFP/LP users. This feature supports IC cards built to Ricoh specifications.

- To use this option, it is necessary to install the “ADK” (Authentication Development Kit), a local customization solution.

Data Flow

When the IC card is placed in the reader, if it contains a function release code, the user will be prompted to enter this code in order to proceed with the authentication. The CSC compares the code entered with the one stored in the IC card, and if these two match, it then obtains the username and password stored in the card and begins the authentication process. If the IC card does not contain a function release code, the CSC simply reads the username and password stored in the IC card and begins the authentication process automatically.



IC Card Authentication

1.5.3 Access Control

Users logged-in as administrators are able to make changes to the following security-related settings:

- Access restrictions for individual users: Access to each principal MFP/LP function can be controlled for each individual user. In the case of Windows Authentication and Integration Server Authentication, it is also possible to set such restrictions for global groups as well as individual users.
- On MFP/LPs with e-mail transmission applications, to prevent the impersonation of the user by a third party, it is possible to set the MFP/LP so that the e-mail address of the logged-in user is set as the “From” field whenever an e-mail is sent. Users who do not have a registered e-mail address would not be able to send e-mail.
- It is possible to prohibit the sending of e-mail to any address except those that have been approved. This is true for addresses that are entered manually as well as those registered in the Address Book.
- It is possible to prohibit unauthenticated users as well as general users from viewing or making any changes to the User Tools settings.
- An 8-digit protection code can be assigned to each individual Address Book entry to protect its contents, so that users cannot freely select addresses to send e-mail and/or impersonate other users as the sender. If the code entered by the operator does not match the one in the MFP/LP, no operations can be performed on the address. In addition, it is possible to create an access control list (ACL) for each individual Address Book entry and Document Server document at both the individual user and group levels.

1.6 Administrator Settings

In order to disperse the risk of malicious operations by a single individual with administrator-level access rights, the MFP/LP allows the following five types of administrators to be registered.

1. **Machine Administrator:** Manages the User Tools settings and ensures that the MFP/LP is always in good working order.

2. **Network Administrator:** Manages the network-related User Tools settings and ensures that protections against illegal remote access are properly maintained.

3. **Document Administrator:** Manages the document storage-related User Tools settings, access privileges for stored documents, and the stored documents themselves.

4. **User Administrator:** Manages the user information stored in the Address Book, as well as the access rights to this information.

5. **Supervisor:** Manages the passwords of the four administrators listed above, in case any passwords are forgotten.

- Each individual administrator is able to change their own username and password, however they are not able to change the usernames and passwords of other administrators.

- It is possible to assign two or more (or all) of the above titles to the same individual user.

- In the event a Supervisor forgets the passwords, the only way to resolve the condition is to initialize the MFP/LP back to its factory shipment condition. (Even field technicians cannot access this information). If the MLP/LP is initialized in this way, all of the user information, document data, and settings stored in the MLP/LP since installation will be initialized (erased).

1.7 Data Protection

1.7.1 Data Erase/Overwrite

Overview

- A wide variety of data is stored in MFP/LP memory both permanently and temporarily. The HDD stores data such as image data, e-mail destinations, and Address Book data containing various types of user information. In addition, the NVRAM stores data such as User Tools settings, while the FCU stores FAX reception image data. Data stored on the magnetic media of the MFP/LP is normally "erased" by overwriting it with a fixed value (normally, this is performed once).

- However, in the case of a print/copy job, for example, although the MFP/LP completely erases the page location data (the storage location information necessary to access image data on the HDD), the image data itself remains in the temporary storage stored area of the HDD. The Data Erase/Overwrite feature, provided to the field as optional software stored on an SD card, renders this image data indecipherable. Even in the unlikely event that the HDD were removed from the MFP/LP, a third party would not be able to reconstruct the original data.

- In rare cases, performing the overwrite just once may not be enough to completely alter the magnetic pattern of the data to an indecipherable level, leaving the possibility of partial reconstruction of the original data. Because of this, the optional Data Erase/Overwrite feature employs the following methods, which ensure that data reconstruction is not possible.
  - The DoD method, developed and required by the U.S. Department of Defense
  - The NSA method, developed by the U.S. National Security Agency
  - The Ricoh randomized value method, a Ricoh-original method which overwrites data using randomly-generated values

  Note: The DoD and NSA methods automatically perform three passes, using a different pattern each time (the number of passes is unchangeable). The Ricoh randomized value method performs three passes by default, using a different set of randomly-generated numbers each time, however the number of passes can be set from 1-9. In a comparison of the DoD method, NSA method, and Ricoh randomized value method (set at three or more passes), no single method is any safer than the other two. Under these conditions, all three methods render the data equally indiscernible. Regardless of which method is selected, the more passes are made, the more indiscernible the original data becomes (although performing more passes requires more time).

- Before the Data Erase/Overwrite option can be activated on the MFP/LP, a service or sales engineer must perform the setup procedure. If the SD card is removed from the slot at any time after installation, the option will cease to function and an error message will be displayed on the operation panel, however the machine will continue functioning normally. Also, it is not possible to remotely verify whether or not the option is installed or actually running.

- To execute the overwrite, the operator can choose from two options: "Auto Erase Memory" and "Erase All

Memory” (detailed descriptions below).

Auto Erase Memory

- The main purpose of this feature is to automatically overwrite data stored to the processing region of the HDD, i.e. data that is saved to the HDD for purposes of MFP/LP internal processing only, of which users are normally unaware. Auto Erase Memory prevents this unnecessary data from remaining in the HDD by overwriting it as soon as it is no longer used by the MFP/LP.

- In addition, it is also possible to manually erase data that was intentionally saved to the HDD, such as Document Server documents.

Note: If the MFP/LP receives a request to perform a print job or other operation that requires writing data to the HDD in between the time the operator initiates the overwrite and the time the machine actually begins the overwrite, the area of the HDD in question may be used to store the incoming image data.

Erase All Memory

- This function overwrites the contents of every region of the HDD and initializes the contents of the NV-RAM and FCU. Since this operation makes it impossible to retrieve or reconstruct the contents of the HDD in addition to initializing the FCU data, Erase All Memory is primarily used at machine disposal or at the conclusion of a machine lease or rental contract. It is therefore necessary to back up the information mentioned above or send it to a PC for storage before executing Erase All Memory.

- By initializing the contents of the NVRAM to their default values, this feature prevents information that is unique to a particular installation environment from being released to third parties (e.g. IP address, control lists and other administrative information).

- The execution of this feature does not clear engine-related information such as the value of the total counter, or engine-related adjustment settings contained in SP mode and UP mode.

1.7.2 Encryption of Stored Data

Overview

- By encrypting the data stored in the HDD, NVRAM, and flash ROM memories, it is possible to prevent the leakage of the contents of the data, even in the event the encrypted data were stolen. The encryption applies to active data (data still in use), as well as data which remains in memory but for which the page location data has been erased (as described in 1.7.1 above).

- There are three data storage keys, one for each of the storage media mentioned above. These keys are protected using a mother encryption key, which is stored on the TPM. Access to these storage keys is granted only if the controller core passes the Trusted Boot validation process explained in section 1.4.2 above. This eliminates the possibility of illegal system programs accessing any of the customer's personal data stored on these media.

Storage Media

- As mentioned above, the encryption of stored data applies to three MFP/LP storage media: HDD, NVRAM, and flash ROM memory. This function is provided to the field as an option for HDD and NVRAM memory, and requires a license installation before it can be used. For MFP models, a field engineer must perform the installation of the license and option.

- If an HDD containing encrypted data is removed from one MFP/LP and then installed on another, it will not be possible to decrypt any of the data on the HDD, including the format management data. This is because the encryption keys used to encrypt the data would be different. In such a case, the MFP/LP will recognize the drive as "unformatted".

- The function can be enabled/disabled in UP mode. As the function is always enabled for flash ROM data, this Enable/Disable setting applies only to the HDD and NVRAM. When the function is enabled, the following data are encrypted:
  - NVRAM: All data, except the engine adjustment parameters and some Copier screen display parameters (i.e. personal information, network configuration parameters, and other confidential information)
  - HDD: All data, including the format management data
  - Flash ROM: As mentioned above, the following data is always encrypted, regardless of whether the function is enabled or disabled.
    - The machine identification certificate for HTTPS communication
    - The machine identification certificate for the Wireless LAN (WPA)
    - The machine identification certificate for the S/MIME signature
    - The machine identification certificate and site identification certificate for IPSec
    - The server authentication key for SSH
    - The machine identification certificate and site identification certificate for @Remote

- The encryption described above will be applied even in cases where the target data has already been encrypted once using a separate MFP/LP function. For example, when storing Address Book data that has already been encrypted using the Address Book encryption key, this data will be encrypted a second time using the HDD data storage key.

Overview of Operations

- The full range of settings related to this function are as follows:
  - Enable/Disable
  - Encryption Key Update
  - Encryption Key Back-up
  - Encryption Key Restore

  Note:
  - ✧ The first four operations listed above can only be performed by a Machine Administrator. If these operations were not restricted in this way, any user would be able to decrypt the data and/or take possession of the encryption keys.
  - ✧ When this function is disabled or an Encryption Key Update is performed, the old data storage keys for the HDD and NVRAM are used during the data conversion process, and then deleted once the conversion is completed (regardless of whether the process was completed successfully or terminated due to a power cut or other error).

- Whenever the main setting is changed from “Disabled” to “Enabled”, new data storage keys are created for the HDD and NVRAM, and the MFP/LP prompts the operator to create a back-up of the new NVRAM storage key (the Start key must be pressed to execute the back-up. See “Encryption Key Back-up” below). The NVRAM storage key and copy of the HDD storage key (see illustration below) are then used to decrypt the NVRAM/HDD data.

  Note: When the main setting is changed to “Disabled”, the encrypted data is converted into an unencrypted state (plain text format), and the encryption key is deleted.

- Whenever the encryption key is updated, or the main setting is changed from “Disabled” to “Enabled”, data saved up to that point will not be in the same format/state than data to be saved from that point onward. This can occur when, for example, the main setting is changed from “Disabled” to “Enabled”, or the encryption key is changed to a new one. The function is designed so that data saved up to that point is not lost. With the NVRAM, all previous data is automatically read out of memory, encrypted with the current key, and then re-saved back into memory along with all other NVRAM data. With the HDD, the operator is prompted to choose which data they wish to keep (it is possible to choose all of the data). Data that is not selected at this point will not be encrypted with the current key, and will therefore become indecipherable to the MFP/LP (the operator will not longer be able to access it).

  Note: Although the HDD data that is not selected for preservation at this time will become unreadable to the HDD, it still exists inside de-allocated HDD memory, where it will remain until it is overwritten. If the operator wishes to manually overwrite this data, it is necessary to use the Data Erase/Overwrite option explained in

1.7.1 above.

- Encryption Key Update:
  This operation allows the operator to replace the existing encryption key with a new one (the main setting must already be enabled). When Encryption Key Update is executed, a new encryption key is generated. The MFP/LP prompts the operator to create a back-up of the new NVRAM storage key, and the target data is encrypted. Finally, the old key (if the data had already been encrypted) is then deleted. In this sense, the operations performed are identical to those performed when the main setting is changed to “Enabled”.

- Encryption Key Back-up:
  This operation prints out the NVRAM storage key onto a sheet of paper, for the purpose of ensuring that the encrypted data can be recovered and decrypted in the event that the controller board breaks or otherwise needs to be replaced (in which case, the original key cannot be accessed). This back-up key is an extremely important piece of property, as it protects the personal information of the MFP/LP user. Therefore, it must be handled with the utmost confidentiality and care, and must be stored in a safe location, to ensure that it is not lost or leaked out to a third party.

  This key is used to decrypt the NVRAM back-up data. Specifically, if the NVRAM data is backed up while encryption is enabled, the encryption back-up key is needed in order to decrypt the NVRAM back-up data. It is therefore necessary to store the NVRAM back-up key and NVRAM back-up data together as a set.

- Encryption Key Restore:
  This operation must be performed by a field engineer. The encryption key that was backed-up using the method described above is input into a file, which is then stored on a formatted SD card. Finally, the key is restored to the MFP/LP. The Encryption Key Back-up and Encryption Key Restore functions only apply to the NVRAM storage key, however a copy of the HDD storage key (which is encrypted by the NVRAM storage key) is kept in the NVRAM. Through this arrangement, the copy of the HDD storage key is automatically decrypted once the Encryption Key Restore has been completed.

1.7.3 Protection of Address Book Data

- The tables below show the various types of data stored inside Address Book entries, as well as the various operations that can be performed on this data by general users, groups, owners, and User Administrators. It is possible to assign general user access privileges to individual users as well as to groups. Users who have not been assigned any access privileges are not able to view the contents of Address Book entries.
- There are four levels of access privileges: View, Edit, Edit/Delete, and Full-Access. These settings can be changed by Group and User Administrators, users with Full-Access privileges, and the user who registered the entry. User Administrators are also able to change user passwords.
- Using the Extended Security settings, which are separate from the Address Book ACL, it is possible to prohibit all users registered in the ACL from programming new destinations in the Address Book, as well as viewing, editing, or deleting existing entries. This setting effectively overrides the Address Book ACL.
- The data in the Address Book is stored in the HDD or SD card. This data can be encrypted before it is stored if the Printer/Scanner option is installed.

			General Users Groups	Owner of the Entry (User)	User Administrator
General Info.	Reg. No.	00001	R	RW	RW
	Name	Taroh Ricoh			
	E-mail address*1	taroh@ricoh.co.jp	Use ACL		
	FAX No. *1	1234-5678			
	…	…			
Detailed User Info.	Login password*2	**********	—		R
	Authent. Username*1	Taroh			
	Authent. Password*1, *2	**********			
	Protection Code	****			
Admin. Data	Login Username	Taroh	—	R	RW
	Authorized Usage	Copier			
	…	…			
ACL Information		00002=R--- 00003=RW-- 00004=RW-O 00005=RWDO …	Use ACL	RW	RW

Note:

***1**: This item does not appear in the Address Book on LP models.

***2**: This password can only be changed by users with Write privileges. As the password is input, it is displayed as asterisks.

		View	Make Changes	Delete Entries	Change ACL Settings
R	View	Yes			
RW	Edit	Yes	Yes		
RWD	Edit/Delete	Yes	Yes	Yes	
RWDO	Full-Access	Yes	Yes	Yes	Yes

Access Privileges and Operations for the Address Book

1.7.4 Document Server Documents (MFP models only)

- The tables below show the various types of data stored inside Document Server management files, as well as the various operations that can be performed on this data by general users, groups, owners, and User Administrators. It is possible to assign general user access privileges to individual users as well as to groups. Users who have not been assigned any access privileges are not able to view the contents of these files.
- There are four levels of access privileges: View, Edit, Edit/Delete and Full-Access. These settings can be changed by Group and User Administrators, users with Full-Access privileges and the user who registered the entry.
- A password can be assigned to each document (4–8 numeric characters long), ensuring that the document cannot be printed unless the correct password is entered first. In addition, if an incorrect password is entered with the Document Lock feature enabled, the MFP will prohibit all further access to the document in question. This setting can be enabled and disabled in System Settings by the Document Administrator.
- Every time a user logs in using Integration Server Authentication, the document protection setting in that user's Address Book stored in the MFP is automatically changed to "View (only)". Therefore if the user stores a file to the Document Server without changing the document protection setting for that document, or stores the file from an application that does not allow the setting to be changed, the user will not be able to edit or delete the document later. This automatic overwriting of the document protection setting in the MFP Address Book can be disabled for all users in Service Program mode (SP5-401-103).
- The Document Administrator can also change the passwords for individual documents without having to clear a password-based authentication process.

			General Users	Document Owner (User)	Document Administrator
General Info.	Document No.	00001	Use ACL	RW	RW
	Document Name	Meeting files			
	Thumbnails				
	Bibliographic Info.				
	Pg. 1 Image Data				
	Pg. 2 Image Data				
	. . .	. . .			
Detailed User Info	Document Password	********	—	W	W
ACL Information		00002=R--- 00003=RW-- 00004=RW-O 00005=RWDO . . .	Use ACL	RW	RW

Access Privilege Management Structure for Stored Documents

		View Bibliog. Information	View Thumbnails	Printing, Sending	Edit Image	Delete Pages	Delete Doc.	ACL Settings
R	View	Yes	Yes	Yes				
RW	Edit	Yes	Yes	Yes	Yes			
D	Edit/Delete	Yes	Yes	Yes	Yes	Yes	Yes	
RWOD	Full-Access	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Deleting pages can only be performed on certain models.

Access Privileges and Operations for Stored Documents

1.8 Job/Access Logs

- Job logs and access logs for the principal machine functions in sections 2.1-2.7 contain entries for job status-related events (initiation, completion, any changes during the job), while the access log contains entries for MFP/LP operational events (authentication, operations performed on documents, administrator operations). Therefore, not every single operational or status-related event is recorded in the log.

- Each log entry is saved together with the date and time that the event occurred or operation was performed. By saving the data in this way, it is possible to then retrace the sequence of operations performed leading up to a machine failure. In addition, making it known that the time and date are recorded together with the operations can serve as a deterrent to unauthorized use.

- The specific events/data for which log entries are created vary slightly with each principal machine function. The events/data common to all principal machine functions are: SMC printout, log-in, log-out, storage or deletion of a file in the Document Server (MFP HDD), deletion of all Document Server documents in a single operation, HDD format, deletion of all log entries in a single operation, and changes to log settings. For the events/data that are unique to each principal machine function, please refer to sections 2.1-2.6 below.

- It is then possible to have the MFP/LP send the log data to Web SmartDeviceMonitor Professional IS (a log data server utility) whenever any of the events described above occurs, after which the data is stored in an MSDE or SQL Server database. Only users who are registered with an Administrator-level user account in Web SmartDeviceMonitor Professional IS can access the contents from a Web SmartDeviceMonitor Professional IS client station. In addition, these administrators are the only persons who can perform any changes to the log data transfer settings.

  The log data is encrypted before being saved to the HDD, which prevents any illegal acquisition or alteration of the data through unauthorized access to the HDD. In addition, the encrypted data is sent to Web SmartDeviceMonitor Professional IS over an SSL connection.

- Before log data can be transferred from the MFP/LP to Web SmartDeviceMonitor Professional IS, it is necessary to assign MFP/LP administrator types 1-4 described in section 1.5 Administrator Settings to a single account, and then create an Administrator-level access account in Web SmartDeviceMonitor Professional IS with the same name and password. It is also necessary to enable the settings for log data sending in the MFP/LP and in Web SmartDeviceMonitor Professional IS.
  Note: For more information on the transfer of this data, please refer to 2.5 Netfile.

- The MFP/LP does not allow any changes to be made to the log data itself, i.e. the data can only be transferred to Web SmartDeviceMonitor Professional IS in an unaltered, encrypted state. Therefore, the data cannot be overwritten or modified in any way, even by those with administrator-level access rights.

- When the log reaches its capacity, the oldest entries are then overwritten one by one by each new entry. To ensure that this data is not lost, it must be sent to Web SmartDeviceMonitor Professional IS before it is overwritten. As mentioned above, the MFP/LP sends the data to Web SmartDeviceMonitor Professional IS only when an operational or access event has occurred.

  Note: With MFP/LPs that do not have an HDD installed, the log data is stored in volatile RAM. The data is therefore erased when the MFP/LP main power is turned off. In addition, since the RAM capacity is not as large as that of the log area in the HDD, the oldest log entries will be overwritten sooner.

- With the exception of print jobs, it is possible to enable or disable the creation of a log entry for each event shown in the table below. There is also an enable/disable setting that applies to all of these events at once.

  Note: For details on which specific log items are accessible by Machine Administrators, see the Operator's Manual for Web SmartDeviceMonitor Professional IS.

	Event/Data Logged	**Level 1**	**Level 2**
		Only create log entries for events or data critical to log operations, such as changes in the log settings or deletion of log entries.	Create log entries for all events and data that can be logged. **Note:** This can provide valuable information for the purpose of data security management, as well as for the analysis of any machine failures that may occur.
Job Log	Print jobs	Logged	Logged
	Jobs involving transmission/storage other than print jobs	Not logged	Logged

Access Log	Login	Not logged	Logged
	Logout	Not logged	Logged
	Creation of stored document	Not logged	Logged
	Deletion of stored document	Not logged	Logged
	Batch deletion of all stored documents	Not logged	Logged
	HDD format	Not logged	Logged
	Detection of marked document by Copy Data Security Unit	Not logged	Logged
	Batch deletion of log	Logged	Logged
	Log settings changed	Logged	Logged
	Log data transfer results	Not logged	Logged
	Changes to Log Type setting made	Logged	Logged
	Communication	Not logged	Logged
	Access attack detected	Not logged	Logged
	Authentication lock-out (actual lock-out occurs or settings are changed)	Not logged	Logged
	Firmware update performed	Not logged	Logged
	Change in firmware configuration detected	Not logged	Logged
	Firmware configuration	Not logged	Logged
	Encryption key operation performed	Not logged	Logged
	Invalid firmware detected	Not logged	Logged
	Change made to Time/Date settings	Not logged	Logged
	Authentication password changed (password policy check)	Not logged	Logged
	Administrator assignments changed (allocation of administrator access rights changed)	Not logged	Logged
	Change made to Address Book contents	Not logged	Logged
	Document ACL access rights changed	Not logged	Logged
	Capture results	Not logged	Logged

- Storage capacity of job and access logs

For cases in which the log data cannot be transferred to Web SmartDeviceMonitor Professional IS, entries will continue to accumulate in the job and access logs. When capacity is reached, the oldest entries are then overwritten one by one by each new entry.

Log capacity:

- **Job log**
  - With HDD: 2000 entries
  - Without HDD: 500 entries

- **Access log**
  - With HDD: 6000 entries
  - Without HDD: 500 entries

1.9 Capture (MFP Models Only)

1.9.1 Overview of Capture Operations

- When a user makes a copy or performs any of the operations listed below, the Capture function sends a copy of the image over the network to ScanRouter, after which it is forwarded to its final destination, ScanRouter Document Server.
- This function can be used to back-up images, or as a means of maintaining records of MFP usage for each individual user.
- It is possible to enable/disable the function. The type of capture can be set to Auto, Manual, Compulsory (Name Fixed), Compulsory (Name Available), or Do Not Capture. Other settings are described in detail below.
- When sending to ScanRouter, the MFP attaches a copy of the captured image's meta-data (i.e. owner data, usage data, and job log ID).

1.9.2 Operations that Generate Captured Images

- Images are captured and sent to ScanRouter whenever any of the following operations are successfully completed. Once the main setting is enabled, the capture will occur automatically if Auto or Compulsory is selected, and only when the user specifies if Manual is selected.

  Note: The MFP itself is able to capture incoming FAXes as well, but ScanRouter currently does not support this.

Function	Operation
Copier	Copy job
	Copy job + storage to HDD
Document Server	Storage to Document Server
	Printing out of Document Server document
FAX Transmission	Regular FAX transmission
	Regular FAX transmission + storage to HDD
	Storage of regular FAX file to HDD for later transmission
	Transmission of FAX transmission file stored in HDD
	Printing out of FAX transmission file stored in HDD or SAF memory
	LAN FAX transmission
	Storage of LAN FAX file to HDD for later transmission
	Transmission of LAN FAX file stored in HDD
	Printing out of LAN FAX transmission file stored in HDD or SAF memory
Printer	Print job (incl. Normal Print, Locked Print, Sample Print)
	Storage of Printer file to HDD
	Printing out of Printer file stored in HDD
	File printed out with Remote Print
Scanner	Forwarding
	Forwarding + storage to HDD
	Storage of scanned image
	Forwarding of stored file
Desk Top Editor For Production	Restoring a previously downloaded file from Desk Top Editor For Production to the MFP HDD.

1.9.3 Capture Settings

- ScanRouter is used to program all settings for the Capture function.

- The following are the principal settings for this feature. Except for Compulsory, these settings do not require Administrator-level access rights to be changed.

1. Principal settings:
   - The Capture function can be enabled or disabled.
   - It is possible to select Auto, Manual, Compulsory (Name Fixed), Compulsory (Name Available) or Do Not Capture.

     Note: If “Compulsory (Name Fixed)” is selected, the MFP will not display the owner name settings screen.

ScanRouter setting:	Display owner name screen on MFP panel:	Automatically capture the image:	Programmable by non-Administrator users:
Compulsory (Name Fixed)	No	Yes	No
Compulsory (Name Available)	Yes	Yes	No
Auto	Yes	Yes	Yes
Manual	Yes	No	Yes
(Do Not Capture)	No	No	No

2. Other settings
   - Owner name selection

     The Owner Name is used by ScanRouter and ScanRouter Document Server to keep records of which operator performed which operation for each incoming captured image. This setting controls whether or not to permit multiple owners to be assigned to the same document.

   - Default owner name

     This is the default name that will be used as the Owner Name for cases in which the user did not set one.

   - Control of “Public” status setting

     This setting controls whether or not to permit the user to assign the captured document a “Public” status, which would make the document viewable to all authenticated users after being delivered to ScanRouter Document Server.

1.9.4 Security Considerations

- Three transfer protocols are available for sending captured documents to ScanRouter: FTP, HTTP and HTTPS. Protocol selection is based on the settings programmed in ScanRouter.
- In order to use HTTPS, it is necessary to install ScanRouter EX or later and then enable the appropriate settings for encrypted communication. In addition, the operator can also set the machine to authenticate the target ScanRouter server. To do this, it is necessary to pre-register the digital certificate of the trusted ScanRouter server in the MFP.

1.9.5 Captured Documents and Log Data

- A job log ID is embedded in every captured document. If the job log function was enabled at the time the document was captured, it is then possible to use this ID to view the contents of the corresponding log entry.
  Note: This is not possible for FAX documents.

1.10 Additional Methods for Increased Security

In addition to the above, administrators can also perform the following settings as needed to provide additional security.

- Prohibit access to SP Mode without authorization from the user.
- Restrict the performing of operations on jobs in progress to the following (MFP models only):
  - Only the user who initiated the job
  - Any user with access privileges to the MFP
  - (Authentication not required)

2 Principal Machine Functions

2.1 Copier (MFP Models Only)

2.1.1 Overview of Copier Operations

- When a copy job is initiated, the scanning engine scans the original and forwards this data to the controller to be printed out from the printing engine. If “Store File” is selected at this time, the image data is also stored in the HDD.

- The Document Server function can also be used to scan images and store them directly to the HDD without printing them out, as well as to print out documents already stored in the HDD. In addition, a password can also be assigned when scanning a document for storage to the HDD, requiring the operator to input the correct password to print out the document.

- User Codes can be enabled to restrict access to the Copier function.

2.1.2 Data Security Considerations

- Since the page location data is erased at the conclusion of every copy job, it is not possible to perform a job re-print on the same data. In addition, since the Copier function itself does not have any external I/F and does not perform any data exchanges or communication with external devices, it is not possible for any illegal external data to be introduced through the Copier function.

2.1.3 Protection of Copy Jobs in Progress

- When User Authentication is enabled, if one user attempts to cancel a copy job in progress that was initiated by a different user who had logged out before the end of the job, the MFP will prompt the operator for the username and password of the user who originally initiated the job. The only individuals who can successfully cancel the job are the Machine Administrator and the user who initiated the job. Also, the Machine Administrator always has the ability to perform operations on copy jobs in progress (e.g. job cancel).

2.1.4 Protection of Document Server Documents

- When User Authentication is enabled, it is possible to assign specific access privileges to individual documents when storing them to the HDD, which limits what operations can be performed on them (e.g. View, Edit, Delete, Full-Access).

- Users with View privileges can view, duplicate and print out documents but cannot delete or make any changes to the document (incl. filename). Users who have Full Access privileges can perform all operations on the document including viewing, printing, duplicating, editing and deleting, as well as making changes to the document’s access privileges settings. Users who have not been assigned any of these access privileges cannot perform any of these operations, and are also prohibited from selecting documents in the document list screen.

- Refer to 1.7.2 Document Server Documents (MFP models only) for details on the Document Lock feature.

2.1.5 Protection of Copier/Document Server Features

- When Machine Administrator Authentication is enabled and the Menu Protect setting in Copy/Document Server Features is set to “Level 2”, changes to the Copy/Document Server Features can only be performed by the Machine Administrator. With a setting of “Level 1”, users are able to change a select number of items, while a setting of “None” allows users to change all items.

2.1.6 Restricting the Available Functions for Each Individual User

- When User Authentication is enabled, it is possible to then allow or prohibit the use of specific Copier functions for each individual user. For example, with color products, it is possible to allow or prohibit the use of B/W, full-color, two-color and single-color modes for each user. Therefore, if a user were assigned restrictions that limited him or her to B/W copies, even after having successfully logged in, they would not be able to make color copies.

- In addition, it is possible to prohibit Full Color printing and instead enable Auto Color Detection, which ensures that the MFP only uses black toner to print out black and white originals. As this minimizes the amount of color toner consumed, this has the added benefit of reducing costs.

- It is also possible to increase the level of security by using the above features in tandem with an external charge device or key counter. This is because operators would not only be prompted to enter a user name and password, but would also be required to clear the usage restrictions imposed by the external charge device or key counter itself (card, currency, etc.).

2.1.7 Job/Access Log Data Collection

- A job log entry is created and stored in the HDD for each individual job performed, which contains information on the job settings (e.g. simplex or duplex, paper size), completion status (whether completed successfully or not) and user identification (in cases where User Authentication was enabled).

- An access log entry is created and stored in the HDD whenever the optional Copy Data Security Unit detects one of the embedded patterns selected with the Copy Data Security feature (section 3.3).

- In addition, it is possible to set the MFP to send the job log data stored in the HDD to Web SmartDeviceMonitor Professional IS whenever a job has been performed.

2.1.8 Print Backup

- After a job is performed, it is possible to store a copy of the image data in the HDD (via the MCS), and then use the Netfile function to retrieve this data to Desk Top Editor For Production. For more on this data flow, see 2.5.2 Data Flow.
- The supported file formats for this operation are: JPEG2000, JPEG, TIFF, PDF (single-page) and PDF (multi-page). The file format must be selected from the MFP operation panel before the Copy job is started.
- When sending the file in PDF format, it is possible to pre-set the password necessary to open the encrypted PDF

data at the PC side, the password necessary for changing the document's access level, and other security settings associated with the document (e.g. printing out, editing, copying).

2.2 Printer

2.2.1 Overview of Printer Operations

- The Printer function can be divided in to main processes: 1) Converting the printer language data received by the MFP/LP into image data, and 2) Printing out this image data onto the paper in accordance with the specified job settings. The former is performed by the printer language processing subsystem, while the latter is performed by the printing subsystem.

- Once the data sent from the host computer is accepted, and the processing subsystem begins processing the new print job, a print job log entry is created (temporary entry). The entry is registered as soon as the job is completed.

> **Note:** The Document Server and all related Printer functions described below are supported by **MFP models only.**

2.2.2 Data Flow

Printing Unencrypted Image Data

- As stated above, the printer language-encoded data sent from the host computer is interpreted by the language processing subsystem, after which it is converted into image data and then stored temporarily in the Page Memory in binary bitmap format. Once this is done, the data is compressed in Ricoh original compression format, and stored in the HDD page by page. If the MFP/LP does not have an HDD, the compressed data remains in the Page Memory and is treated the same as data written to the HDD.

- When Spooling is enabled, the incoming data is stored directly to the spooling area of the HDD. Following this, the data is sent to the language processing subsystem, where it is interpreted and converted to image data page by page. Before it is printed out, the spooled data can be deleted from the “Spool Printing” list in WebImageMonitor, or “Spooling Job” list on the MFP/LP operation panel. The data is developed page by page in the order in which it was converted (beginning from page 1), however the actual printing order of the pages may differ depending on the job settings received from the printer driver (e.g. duplex vs. simplex, usage of Booklet or Stapling features, etc.).

- When Image Spooling in enabled, all pages of the incoming data are converted to image data and then stored to the HDD. Once this is completed for all pages, the data is then sent to the printing engine for printing out.
  Note: The order in which jobs are printed out is same whether Image Spooling is enabled or disabled.

- From the printer driver, it is possible to select the following printing methods: Normal Print, Sample Print, Locked Print, Hold Print, Stored Print, Store and Print, and Save to Document Server. The data processing flow varies depending on the method used, since some operations are not supported with some printer languages (see below).

- With Normal Print, the page location data for the image data stored in the HDD is erased at the conclusion of the print job or when the main power is turned off. When Sample Print is selected as the job type, the document will remain in the HDD as a Sample Print document even after the sample set is printed out. Additional sets of this document can then be printed out from WebImageMonitor or the MFP/LP operation panel, after which the page location data is deleted at the conclusion of the job.

- When Locked Print or Hold Print is selected as the job type, the image data is saved directly to the HDD as a Locked Print or Hold Print document, without being printed out. Locked Print and Hold Print documents stored in the HDD can then be printed out from WebImageMonitor or the MFP/LP operation panel, after which the page location data is deleted at the conclusion of the job.

- When Stored Print is selected as the job type, the image data is saved directly to the HDD as a Stored Print document, without being printed out. When Store and Print is selected as the job type, the image is saved to the HDD and is also printed out. Just as with the above, the documents stored in the HDD can also be printed out from WebImageMonitor or the MFP/LP operation panel, however these documents remain in HDD memory even after the conclusion of the print job.

- When Save to Document Server is selected as the job type, the image data is stored directly to the HDD as a Document Server document, without being printed out. The necessary bibliographic information for the image data is stored in the HDD along with the image data itself. The bibliographic information is part of the print management data, and includes information such as the page size, paper type and number of sets.

  Document Server documents can be printed out from the MFP operation panel or from WebImageMonitor, after which they remain stored in the HDD. In addition, the documents remain stored in the HDD even if the main power is turned off.

- When Normal Print is selected as the print job, the print management data[*1] for the image data stored in the HDD is stored in volatile RAM memory in Ricoh original format. It is erased at the conclusion of the job, together with the page location data.

- When Sample Print, Locked Print, Hold Print, Stored Print, Store and Print, or Save to Document Server is selected as the print job, the necessary bibliographic information for the document is stored in the HDD along with the image data itself. This information and data is preserved even when the machine main power is turned off.

- The user ID can be registered in the printer driver UI, which machine operators can then use as a unique marker for documents to differentiate them from one another. Once a user ID is registered, it is used for the Sample Print, Locked Print, Hold Print, and Stored Print printing methods, and also appears in the printing history. In addition, it is also possible to set the passwords for Locked Print and Stored Print documents as well as the username and password for Document Server documents.

- Once the necessary username and password have been set in the printer driver, it is possible to perform User Authentication when sending data to the MFP/LP. The username and password are sent along with the printing data as authentication data. If authentication fails, the printing data sent to the MFP/LP is destroyed and the job is cancelled.

- The print job history is stored in volatile memory and is therefore deleted when the MFP/LP main power is turned off. The information stored includes the username, number of pages, the time the print job was performed, and job status/results. The print job history can be accessed from SmartDeviceMonitor for Client, which retrieves the information via a Ricoh-original MIB over an SNMP connection.

  *1: The “print management data” is managed and maintained by the Printer function itself, and contains information such as the size of the paper for printing, job settings (simplex or duplex, etc.) and general job data (time, username, etc.). This is not the same as the “page location data” for the image data stored in the HDD.

Printing Encrypted Image Data

- With PDF Direct Print, it is possible to print out an encrypted PDF file. The password is registered in the Printer function via WebImageMonitor or the MFP/LP operation panel, or is set inside DeskTopBinder (incl. the Function Pallet). When the printer receives the file, the printer language processing subsystem (PDF interpreter) temporarily stores the file directly to the HDD. Once the file is recognized as an encrypted PDF file, the password registered in the MFP/LP is compared to the password sent along with the file. If they do not match, the data itself will not be decrypted correctly, causing an error to occur and the job and data to be erased. If they do match, the data will be decrypted correctly. After this, the decrypted data is converted to image data, stored to the HDD and then follows the normal process described above.

- When Spooling is enabled, the incoming encrypted data is stored directly to the spooling area of the HDD. Following this, the first page of the data is then sent to the PDF interpreter to be interpreted.

- It is also possible to set the MFP/LP to prohibit the printing of PDF files. PDF files for which this setting is used cannot be printed out when received by the MFP/LP, as the MFP/LP resets the job and deletes the data.

2.2.3 Data Security Considerations

Printing Unencrypted Image Data

- The language processing subsystem only allows data in legal format to be processed. In the event that illegal data is received, the subsystem will declare an error and cancel the processing session.

- When User Authentication is enabled, the MFP/LP will only accept printing data that contains a username and password that matches those of a pre-registered user (or a User Code in the case of User Code Authentication). Any data received that does not contain this information is destroyed, preventing the introduction of illegal data. When the Printer's authentication mode is set to Simple Authentication, the MFP/LP does not perform authentication on data sent from users that have been given "Guest" status.

- Authentication passwords:
  Before the printer driver sends the print data and authentication information to the MFP/LP, the authentication password is encrypted using one of two methods: Simple Encryption or driver key encryption (which uses a key common to both the driver and MFP/LP), depending on setting selected in the driver.

  When the "Restrict Use of Simple Encryption" setting in the MFP/LP is ON, the MFP/LP will only accept jobs that carry authentication passwords that have been encrypted using the driver encryption key. Any job carrying an authentication password encrypted by Simple Encryption will be subsequently reset. This has the effect of requiring operators to use the driver encryption key, the stronger of the two methods, and avoids any possibility of sender impersonation by preventing the password from being surmised in the first place.

- Document passwords:
  When Locked Print, Stored Print, Store and Print, or Save to Document Server is specified as the job type, the document password sent along with the print data is always encrypted using Simple Encryption (not with a driver key). However, even when the "Restrict Use of Simple Encryption" setting explained above is ON, the MFP/LP will accept jobs with document passwords that have only been encrypted with Simple Encryption. This is because "Restrict Use of Simple Encryption" only applies to authentication passwords, and not to document passwords.

  In addition, if a job containing a document password is sent from an older driver or using PJL commands, the document password itself will be sent in an unencrypted state. The MFP/LP does not require that the document password be encrypted (the job will be accepted). In such cases, it is possible to protect the password from being stolen by selecting IPP over SSL as the network communication protocol, which will encrypt the communication path.

- Although any authenticated user can view the "Spool Printing" list (WebImageMonitor), printer job history and error log, it is possible to display other users' information in the in the form of asterisks ("****").

- When Locked Print is selected as the job type, and the operator wishes to print out a Locked Print document stored in the MFP/LP from the operation panel or WebImageMonitor, it is necessary to enter a password before the job can be performed. If this password does not match the pre-registered password, the operator is not allowed to retry. This prevents illegal access to Locked Print documents.

- When User Authentication is not enabled, it is possible to view the list of Locked Print documents created by all users, however all filenames are displayed as asterisks ("****"). When User Authentication is enabled, the user cannot view any information on this list until authenticated. However, even after successfully logging in, the user can only view a list of his or her own Locked Print documents (the filenames for which are displayed as is, without asterisks).

- Stored Print or Store and Print documents in the HDD can be printed out from WebImageMonitor or the MFP/LP operation panel, as described earlier, and can be protected with a password. If a password has been assigned to the document, the operator will be prompted when attempting to print it out. The document cannot be opened unless the correct password is entered, which prevents illegal access to the document.

- It is possible to make a Stored Print or Store and Print document available for printing out by any authenticated user by selecting "Share" in the printer driver's Advanced Options settings when the job is sent. It is also possible to change the access privileges setting for the document from WebImageMonitor. Normally, this is set in the printer driver to grant access to either all authenticated users or to the creator of the document alone. However the user can change this setting to grant access to specific user(s) or group(s).

- In addition, it is possible to enable the Document Lock feature, whereby the MFP/LP will prohibit all access to a given document once an incorrect password is entered. This protects documents from attempts to crack the password via brute-force attacks. The operator can also change the password at any time, making it much more difficult to surmise. This is particularly helpful in cases where documents are stored in the HDD for extended periods of time.

- The language processing system is only capable of processing legal data in pre-defined formats. Therefore, even in the case that illegal fonts or firmware were downloaded to the MFP/LP on-board memory, such data could not be executed as a program nor be processed by any of the MFP/LP's internal modules.

Printing Encrypted Image Data

- As stated above, PDF Direct Print handles the sending of encrypted PDF files. The main use of this function is for sending encrypted PDF files in cases where it is not possible to encrypt the communication path itself. Once the password for opening the file has been programmed from the MFP/LP operation panel or from WebImageMonitor, it is possible to then safely send the printing data over the communication path. Even if the PDF file sent as printing data were intercepted on its way to the MFP/LP, the contents of the data are secure since the data is already encrypted.

- As stated above, the password for opening the file can also be programmed from inside DeskTopBinder. Since this allows the user to assign unique passwords to each individual PDF file, this function can be used to distribute confidential documents. Since both the printing data and distributed PDF file itself are sent along the communication path in an encrypted state, their contents are secure. Even if the PDF file were intercepted at the PC or server point, the contents of the file cannot be accessed. In addition, the password itself is also protected since it is encrypted using the group password already programmed in DeskTopBinder.

- As stated above, the PDF interpreter cross-references the password programmed in the MFP/LP with the encrypted password sent from the PC, and destroys the incoming data when these passwords do not match. In addition, the incoming data is also destroyed if accompanying information alerts the MFP/LP that printing of this file is prohibited. Since the MFP/LP will reject such data, it is not possible for the data to introduce any illegal programs or be processed by any MFP/LP modules.

Logs

- At the conclusion or cancellation of a job, the print results are stored in the job log in the HDD (for details on the job/access logs, see 1.8 Job/Access Logs). The “reason code” contained in the results allows the operator to distinguish between jobs that were cancelled due to failed authentication and all other reasons.

2.3 Scanner (MFP Models Only)

2.3.1 Overview of Scanner Operations

- Depending on the settings selected, the Scanner function does one of the following:
  1) Saves the scanned image to the HDD and then sends it via the network I/F as an e-mail (via an SMTP server), to a folder (FTP server, client PC with Windows 98 or newer), or forwarding server (via ScanRouter),
  2) Saves the scanned image to the HDD alone without forwarding it, or
  3) Temporarily stores the image to the HDD and then forwards it to one of the destinations mentioned above.

  With the third option, the page location data for the data temporarily stored to the HDD is deleted once the destination receives the transmission, or after the maximum number of transmission attempts has been reached.

- With the TWAIN I/F, the TWAIN driver can initiate a scanning job under specified conditions from a network-connected client PC, after which the image is sent back to the TWAIN driver.

- Access to the Scanner function itself or to specific features can be restricted with the use of User Authentication, the Available Functions settings for each individual user, and an external coin/card operated device. Use of the TWAIN feature is only allowed after a crosscheck with the User Code, User ID and password pre-programmed in the TWAIN driver U/I.

- Operational log entries are created for both scanning and forwarding jobs. The forwarding results can be printed out or viewed directly from the operation panel (“Scanned File Status”). These results are stored in non-volatile memory, i.e. the data is preserved even after the MFP main power is turned off.

2.3.2 Data Flow Security Considerations

- Forwarding operations are unidirectional, sending image data to pre-programmed e-mail addresses, folders and forwarding servers only. Since there is no receiving aspect, it is not possible for the Scanner function to receive any illegal data from an external interface.

- When sending image data to an SMTP server, it is possible to introduce an authentication process at the POP server before making the connection to the SMTP server (POP before SMTP), and at the SMTP server itself (SMTP authentication).

- When sending image data to an SMTP server or Windows PC (SMB), it is possible to encrypt the password using a DIGEST algorithm. When sending the file in PDF format, it is possible to pre-set the password necessary to open the encrypted PDF data at the PC side, the password necessary for changing the document’s access level, and other security settings associated with the document (Printing, Changes, Content Copying and Extraction).

- By using S/MIME when sending e-mail, which attaches a digital signature and encrypts the message contents, it is possible to prevent sender impersonation as well as the alteration of the e-mail contents.

- The TWAIN driver will not process any binary data that does not conform to the predetermined protocol of the command interface. The supported protocols are SNMPv1, v2 and v3. When using SNMP v3, it is necessary to use the TWAIN V4 driver. In order to utilize the authentication features with the TWAIN V4 driver, the operator must first set the necessary authentication information in the authentication tool that comes with the driver.

2.3.3 Protection of Data when Performing Scanning and Sending Operations

- It is possible to set the MFP or related software to perform the following operations:
  - Require user identification when sending to a forwarding server. By requiring the operator to select from a list of pre-registered senders and then enter a protection code, it is possible to protect against sender impersonation.
  - Require user ID and password authentication before data is forwarded to an SMTP server or folder (Basic Authentication). This makes it possible to control the sending of data for each registered user.
  - Require the operator to enter a protection code whenever a destination folder stored in the MFP is selected, which protects against transmission by unauthorized senders.
  - Perform user access restrictions and further prevent any impersonation of the sender:
    When User Code Authentication or Basic Authentication is enabled, and a successfully logged-in user performs a sending operation, this user is automatically set as the sender of the e-mail. If this user does not have an e-mail address, it is not possible to send the e-mail.
  - Limit the sending of e-mail to destinations that have already been programmed in the MFP. This can be done using the “Restrict use of destinations” setting of the Extended Security feature.
  - Require user ID and password authentication when attempting to retrieve e-mail addresses from an LDAP server.
  - Set the MFP so that it is not possible to register e-mail addresses in the MFP, whether obtained from an LDAP server or entered manually.

- In order for the MFP Scanner to retrieve the address book data of individual registered users from the forwarding server, Basic Authentication must be enabled at the MFP and the forwarding server software must be ScanRouter V2/EX or later. In all other cases, the MFP Scanner is either able to obtain shared Address Book data only (Basic Authentication disabled, all versions of ScanRouter), or is not able to obtain any data at all (Basic Authentication enabled, ScanRouter V1). The data obtained from the forwarding server is then deleted at the MFP when the user logs out.
  Note: Administrators cannot perform these operations.

- By enabling Basic Authentication, it is possible to protect the destination information. For each destination, it is possible to assign an access level to each registered user (View, Edit, Delete, Full-Access). Users who have View privileges for a particular destination can select the destination for forwarding, but cannot edit or delete the data. Users who have Full-Access privileges can perform all functions including sending to the destination, editing and deleting data, and making changes to access privilege settings. Users who have not been assigned any of these access privileges are not even able to view the destination list. Even when all of the above restrictions are enabled, User Administrators have Full-Access privileges for all registered destinations. However since User

Administrators cannot use the Scanner function, they are not able to send any data.

- When logged in with Basic Authentication, users are able to perform operations with either the forwarding feature or the TWAIN driver feature, not both. However with User Code Authentication, there are conditions in which one operator can utilize the Scanner via the TWAIN driver even while another operator is already logged in from the MFP operation panel (i.e. before the user logged in from the operation panel actually initiates a job).

- With the TWAIN feature, the user is logged out automatically as soon as scanning is complete. Also, the authenticated user and Machine Administrator are the only individuals who can interrupt a scanning job in progress. When the Stop key is pressed to interrupt the job, the MFP prompts the operator with the authentication dialog.

2.3.4 Protection of Document Server Documents

- When Basic Authentication is enabled, it is possible to assign access privilege to individual documents when scanning them for storage in the Document Server (View, Edit, Delete, Full-Access). These access privileges are applied even when accessing the document from DeskTopBinder or Desk Top Editor For Production. Users who have View privileges can both preview and send a document, but cannot delete or make any changes to the document (including the filename). Users who have Full-Access privileges can perform all functions including previewing, sending, editing and deleting the document, as well as making changes to the access privileges settings. Users who have not been assigned any of these access privileges cannot perform any of these operations, and are also prohibited from selecting documents in the document list screen. Even when all of the above restrictions are enabled, Document Administrators have Full-Access privileges for all registered documents. However since User Administrators cannot use the Scanner function, they are not able to send or store any data.

- It is also possible to assign a password to individual documents when scanning them for storage in the Document Server. After this, the document cannot be sent unless the correct password is entered. Additionally, when the Document Lock feature in System Settings is enabled, the MFP will block all access to a document once the password check for that document fails. Only the Document Administrator can enable/disable this setting.

2.3.5 Protection of Sending Results and Status Information

- When Basic Authentication is enabled, authenticated users are only able to view the sending results for the jobs that they performed. Results for jobs that other users performed are displayed as asterisks (“***”), preventing any leakage of information to third parties. The information is hidden in this way when displayed on the LCD, as well as when the results report is printed out. When Basic Authentication is enabled, entries in the sending results report can only be deleted by the user who performed the particular job. This prevents operations from being performed on these entries by third parties.

- Even when all of the above restrictions are enabled, Machine Administrators have Full-Access privileges for all log entries. Machine Administrators are able to view and print out all entries.

- By default, the sending results log is automatically printed out when the maximum number of entries has been reached. It is possible to disable the automatic printing out of this log in Scanner Features, which ensures that the information on the log is not leaked to unauthorized third parties, and also allows administrators to keep a record of every transmission job performed. However, when the log reaches the maximum number of entries (with this setting disabled), the MFP displays an alert message to this effect and gives the Machine Administrator the option of printing out the log.

2.3.6 Protection of the Scanner Features Settings

- When User Authentication or Administrator Authentication is enabled, users and administrators must be authenticated before they are allowed to make any changes to the settings in Scanner Features. When Machine Administrator Authentication is enabled and the Menu Protect setting is set to “Level 2”, changes to the Scanner Features settings can only be performed by the Machine Administrator. With a setting of “Level 1”, users are able to update the delivery server destination list as well as change the file compression and e-mail display language settings (System Settings). With a setting of “None”, users are able to change all items in Scanner Features.

- As explained above, the e-mail forwarding feature sends data from the MFP to external destinations via the network. By changing the network traffic-related settings, which can only be performed by Network Administrators, it is possible to prohibit or limit the conditions under which e-mails from the MFP are actually forwarded to their destinations.

2.3.7 Data Stored in the Job Log

- For each individual job performed, an entry is added to the job log stored in the HDD. The entry contains information on the job settings (e.g. scanning settings, destinations), completion status (whether completed successfully or not) and user identification (in cases where User Authentication was enabled). For more details on job and access logs, please refer to 1.9 Job/Access Logs.

2.3.8 Terminology

- **SMTP** (Simple Mail Transfer Protocol) [RFC2822]: A protocol used for the transmission of e-mail over the Internet.
- **SMTP-AUTH** (SMTP AUTHentication) [RFC2554]: The protocol used for authentication when connecting to an SMTP server.
- **POP3** [RFC1939]: An e-mail transfer protocol used when receiving e-mail.
- **POP Before SMTP**: An authentication mechanism using POP3 protocol, developed to guard against SPAM mail (e-mail sent indiscriminately to a large number of destinations).
- **SASL** (Simple Authentication and Security Layer) [RFC2222]: A framework that provides a common authentication processing mechanism for protocols that may require authentication, such as SMTP, POP3 and LDAP.
- **CRAM-MD5** [RFC2195]: A message digest functional algorithm that uses the MD5 algorithm to encrypt the challenge string and password.
- **DIGEST-MD5** [RFC2831]: A message digest functional algorithm developed as a countermeasure to dictionary and brute-force attacks. DIGEST-MD5 also supports realm designation (FQDN).
- **S/MIME** (Secure Multipurpose Internet Mail Extensions) [RFC2315]: A public key encryption standard used to encrypt the contents of e-mail for secure sending/receiving.
- **LDAP** (Lightweight Directory Access Protocol) [RFC1777], [RFC2251]: A protocol used for accessing directory services that manage items such as user address books.
- **SMB** (Server Message Block): A protocol used to enable file sharing between Windows PCs.
  Note: The Ricoh MFP(s) to which this document applies support NTLM v1.
- **FTP** (File Transfer Protocol): A protocol used when transferring files over a TCP/IP network.

2.4 FAX (MFP Models Only)

2.4.1 Overview of FAX operations

- The FAX function sends the scanned image data from the scanner engine to the other party's machine via a telecommunications line as a G3 or G4 FAX. Conversely, the MFP will only accept incoming FAX data that conforms to G3/G4 standards. The incoming document is then forwarded on to the printer engine for printing out.

- For Internet FAX transmission, the scanned image data is converted into a format for transmission as en email file attachment, after which it is sent to its destination via the network I/F. Conversely, the e-mail FAX data received as an Internet FAX is converted into image data and then forwarded on to the printer engine for printing out.

- It is possible to store transmission files in the Document Server for sending at a later time. The file is saved to the HDD, after which commands can be issued from the operation panel or through the network to send the file to its destination. Conversely, incoming FAX data can be stored in the Document Server for printing out at a later time. The incoming FAX is saved to the HDD, after which commands can be issued from the operation panel or via the network to print out the file.

- With LAN FAX transmission, the image data received from the PC is then sent to its destination via a telecommunications line or network I/F.

- With all FAX transmission features, including Internet FAX, it is possible to restrict individual user access with the use of User Codes. For reception, it is possible to configure the MFP to receive only those transmissions accompanied by a predetermined code. Operational log entries are made for each transmission and reception job. This data is stored in non-volatile memory, and can be viewed by printing out the Journal.

- With IP-FAX transmission and reception, the printing and scanning processes are the same as with normal FAX communication. The data is sent out/received over the IP network in accordance with ITU-T recommended G3 FAX protocol

- With the Mail to Print feature, if the MFP receives an e-mail via Internet FAX reception with a JPEG or PDF file attached, the file will be stored to the HDD and then printed out by the Printer function.

2.4.2 Data Security Considerations

- The FCU supports only G3 and G4 FAX protocols. Therefore, even if an initial connection is established with a terminal that does not use these protocols, the MFP will view this as a communication failure and terminate the connection. This prevents access via telecommunications lines to internal networks, and ensures that no illegal data can be introduced via these lines.

- Internet FAX supports TIFF files and text-based e-mail only, which is true for both reception and transmission. If the data received through this function is in any other format, a communication error will result.

- The Mail to Print feature is only capable of accepting JPEG and PDF file attachments. If these attachments are in any other format, a communication error will result.

- Internet FAX can also be set to forward incoming FAX data to specific destinations that have been preset in the MFP. With servers using SMTP reception/delivery, the receiver can set the server to prohibit the delivery of incoming Internet FAX documents from specific senders, restricting SMTP access.

- With LAN FAX transmission, the language processing subsystem is only able to process data that conforms to LAN FAX standards. If any other type of data is received, an error will result and the processing will be terminated.

- IP-FAX uses SIP for session initiation. SIP is a protocol that conforms to the H.323 and RFC3261 standards prescribed by the ITU-T Recommendations. If any data is introduced which does not conform to these standards during transmission or reception, it will not be possible to establish SIP-based communication and the connection will then be terminated. Once a session is successfully established, communication is only performed in accordance with ITU-T recommended G3 FAX protocol. Since the MFP does not support any other type of communication protocol, if it attempts to connect to another machine that is not a FAX, it will not be possible to establish G3-based communication and the connection will then be terminated.

- Internet FAX operates under a SIP environment and undergoes a DIGEST authentication process, whereby the MFP's encrypted password must be registered with the SIP server and inside the MFP itself. When calling or registering with the SIP server, this server will initiate DIGEST authentication, after which the MFP sends the appropriate request message (encrypted password) to the server. Once the MFP is authenticated, the operator can send and receive Internet FAXes.

- When User Authentication is enabled, it is possible to set the authenticated user as the "Sender" of the FAX data. Similarly, for Internet FAX transmission, it is possible to set the authenticated user as the "Sender" of the e-mail, i.e. the user who appears in the "From" field of the e-mail.

- It is possible to restrict the use of the FAX function to specific users as well as to specific Document server documents, preventing any unauthorized access to this information.

- In order to guard against the reception of unnecessary or unwanted data, such as SPAM e-mail, it is possible to register a list of authorized senders so that the MFP only accepts incoming data from these senders. Conversely, it is also possible to register a list of unauthorized senders, so that the MFP rejects any incoming data from these senders.

- For more details, please refer to 2.3 Scanner (MFP Models Only).

2.4.3 Protection of the Journal and Documents in Document Server Storage

- When User Authentication is enabled, only authenticated users are permitted to perform any changes to the documents they have transmitted, including the deletion or cancellation of a transmission job or the addition of address(es). When the Journal is printed out, only the results for the authenticated user appear on the printout.

- The only operation Machine Administrators are capable of performing on FAX jobs is job cancellation. They are not authorized to perform other operations such as adding or deleting destinations. Also, when the Machine Administrator prints out the Journal, the communication results for all users are printed out on the report.

2.4.4 Protection of FAX Transmission Operations

- By setting restrictions on Address Book destinations in addition to enabling User Authentication, it is possible to limit access to the destinations listed in the Address Book. After clearing authentication, general users are able to select only those destinations that have been set to allow this. In addition, the MFP can be set so that users can only transmit data to destinations registered in the MFP.

- It is possible to assign access restrictions to individual Document Server documents, so that only users with the required access privileges can perform operations on the document. Since this feature requires a specific access level to perform specific operations, it prevents unauthorized operations from being performed on the document (e.g. viewing, deleting). Also, documents that have not been assigned any access level cannot be sent as a FAX or printed out.

2.4.5 Protection of FAX Features Settings

- When Administrator Authentication or User Authentication is enabled, authentication is required in order to view or change any of the settings in Fax Features.

- Administrators can set the MFP so that general users are unable to make changes to the Fax Features settings, preventing any unauthorized alteration of these settings.

2.4.6 The “Extended Security” Feature

- It is possible to set Extended Security to prohibit the transfer or forwarding of data, preventing any unauthorized sending of data to external destinations.

  Note:

  - The access control used for SMTP reception/delivery operates in accordance with RFC2305.
  - The SMTP-AUTH feature operates in accordance with RFC2554.

- The Journal log (FAX job history log) is able to store up to 200 entries. When User Authentication is disabled, the Journal is automatically printed out every 50 jobs.

  When User Authentication is enabled, by default, the Journal is not automatically printed out. This is in order to prevent the private user information contained in the report from being accessible to all users. In this case, the oldest entry will be overwritten once the Journal reaches its 200-entry capacity. To ensure that this information is not lost, it is possible to have the entries sent by e-mail to a specified destination, as well as to set the MFP to automatically print out the Journal even when User Authentication is enabled (overriding the default setting).

2.4.7 Job Log

- At the conclusion of a FAX job, an entry is made in the job log containing information on the specific operation performed (transmission, reception, forwarding, storage, etc.), results of the operation, and in the case of transmission/reception, the sender/receiver data.

- For more details on job and access logs, please refer to 1.9 Job/Access Logs.

2.4.8 Protection of Internet FAX Transmissions using S/MIME

- When the MFP forwards FAX reception data to other destinations as an e-mail using S/MIME, it encrypts the entire e-mail message (incl. file attachment) and also attaches a digital signature. This precludes the possibility of data leakage, data alteration, and sender impersonation.

2.4.9 Preventing FAX Transmission to Unintended Destination(s)

- To prevent a FAX from being sent to the wrong destination, it is possible to require the operator to input the destination FAX number twice for confirmation.

- For the same purpose, it is also possible to prohibit the operator from specifying more than one destination per transmission by disabling Broadcasting, a feature that allows the same FAX original to be sent to multiple destinations simultaneously. This prevents a FAX from being sent to an unintended destination when, for example, the operator accidentally touches an additional Quick Dial key.

2.5 NetFile (GWWS)

2.5.1 Overview of NetFile Operations

- NetFile operates via communication with the following applications installed on a network-connected client PC: DeskTopBinder, Desk Top Editor For Production, SmartDeviceMonitor for Admin, ScanRouter, Web SmartDeviceMonitor Professional IS.

Performing Operations on Document Server Documents (MFP models only)

- From DeskTopBinder or Desk Top Editor For Production, it is possible to print out Document Server documents that were stored using the Copier, FAX and Scanner functions or those that were edited and then returned to the MFP from one of the two DeskTop applications mentioned above. Commands issued from these applications allow documents stored using the FAX function to be sent as FAX data, and those stored using the Scanner function to be forwarded to ScanRouter. In addition, it is also possible to download Document Server files from the MFP to the PC, make changes to the bibliographic information of these documents or delete the documents themselves, all from within DeskTopBinder or Desk Top Editor For Production.

  Documents stored using each principal machine function can be protected with a password. Users are prompted for this password, even when attempting to perform the above operations from inside DeskTopBinder or Desk Top Editor For Production.

Restoring Files Back to the MFP (MFP models only)

- When Copier or Printer files that were originally sent from the MFP to Desk Top Editor For Production in TIFF or JPEG format are then restored to the MFP, the data is saved to the HDD as a separate file from the original one.

Viewing and Changing User Information Stored in the MFP/LP

- User data stored in the MFP/LP can be captured, added to, deleted, and changed from inside SmartDeviceMonitor for Admin, however this requires User Administrator access rights.

Viewing and Changing Machine Settings Stored in the MFP/LP

- Some machine settings stored in the MFP/LP can be viewed and changed from inside Web SmartDeviceMonitor Professional IS. At present, it is possible to change a portion of the System Settings that can be changed from the MFP/LP operation panel, however these operations require authentication as a Machine Administrator, Network Administrator or User Administrator.

Transferring Job Log and Access Log Data to Web SmartDeviceMonitor Professional IS

- The Netfile job log contains data related to job status (initiation, completion, any changes during the job), while the access log contains data related to operational events (authentication, operations performed on documents, administrator operations). Both logs include a date and time for each entry. As mentioned in section 1.9, it is possible to have the MFP/LP send the log data to Web SmartDeviceMonitor Professional IS whenever any of the events described above occurs.
  Note: See “**Supplementary**” below for a list of the specific events for which Netfile job log entries are created.

- Only users who are registered with an administrator-level User Account in Web SmartDeviceMonitor Professional IS can access the contents from a Web SmartDeviceMonitor Professional IS client station.

Deleting Print Jobs

- From inside DeskTopBinder, it is possible to delete, pause, or resume any individual print job sent from the printer driver. From inside Web SmartDeviceMonitor Professional IS, it is possible to delete all print jobs at once or the job in progress.

2.5.2 Data Flow

- Netfile supports SOAP for the sending and receiving of XML messages.

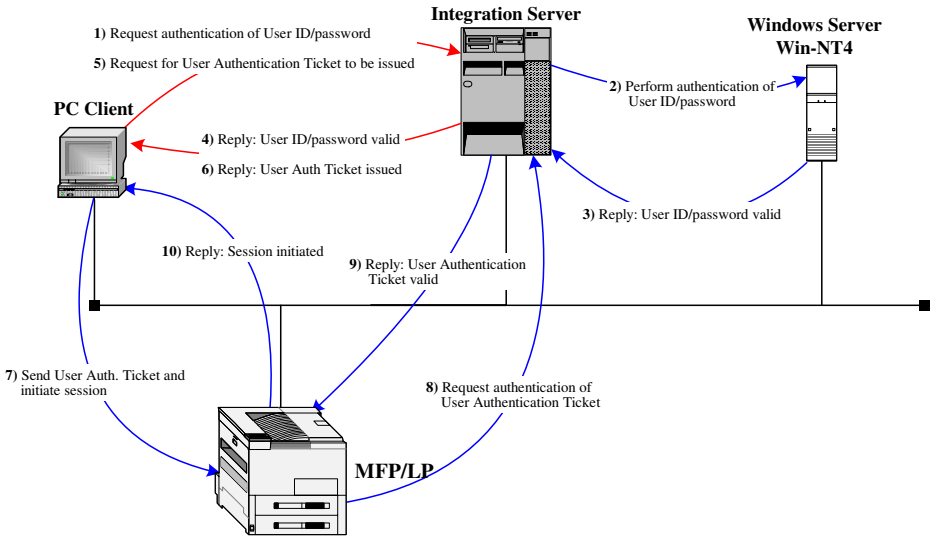
2.5.3 Supplementary

- Job log entries **(MFP models only)**:
  Entries are created in the Netfile job log whenever any of the following events occur:
  - A print job is initiated from DeskTopBinder on a Document Server file
  - A transmission job is initiated from DeskTopBinder on a FAX Document Server file
  - A sending/forwarding job is initiated from DeskTopBinder on a Scanner Document Server file
  - A download is initiated from DeskTopBinder on a FAX Document Server (Reception) file
  - A download is initiated from DeskTopBinder on a Scanner Document Server file
  - A captured Document Server file is restored to the MFP from Desk Top Editor For Production

- User Authentication Tickets **(MFP models only)**:
  - If User Authentication is enabled when a user tries to connect to the MFP over the network from a client PC station, normally, the User ID and password sent to the MFP will be used to authenticate that user. However with the use of pre-issued User Authentication Tickets, users can access the MFP without having to input the necessary authentication information each time a session is initiated.

    Authentication using such tickets is possible when performing the following operations from SmartDeviceMonitor for Client:
    - Forwarding of stored documents via ScanRouter
    - Operations on stored FAX reception documents

  - First, to be issued a User Authentication Ticket, the user connects to the Integration Server from a PC client station, at which time authentication is performed using the User ID and password. Once the server authenticates the user, the ticket is sent to the MFP. When user then accesses the MFP, e.g. to download stored images or perform other operations, the ticket is sent from the PC client to the MFP along with the request to initiate a new session. The MFP then communicates with the Integration Server to verify the identity of the user.



Network Topology for a System Using Integration Server Authentication (Sample)

2.5.4 Data Security Considerations

Usage of Documents Stored in the MFP (MFP models only)

- The protections provided for documents stored in the MFP are the same, regardless of the access method (over the network versus from the MFP operation panel). The ACL operates in accordance with the settings in the MFP.
  Note: Please refer to 2.1.5 Protection of Document Server Documents for more details.

- For password-protected documents, it is not possible to perform any operations on the file unless the correct password is entered. As described above ("Protection of Passwords for Stored Documents"), communication between the MFP and DeskTopBinder or Desk Top Editor For Production is performed using text written in HTTP and XML format, for both sending and receiving. The password is embedded in this text data when it is sent to the MFP. Since User Codes and passwords are encrypted before being sent, the information itself would be indecipherable even if it were intercepted along the communication path.

- For each individual user, it is possible to restrict the use of specific functions of DeskTopBinder and Desk Top Editor For Production. To use any of these functions, however, users need to be pre-registered in the MFP.

- User access control can also be performed for FAX reception documents stored in the MFP. Operations on these documents can only be performed by users already registered in the FAX function as individual users or as part of a group.

Restoring Files Back to the MFP (MFP models only)

- Netfile will reject any data it receives that does not conform to preset formats, regarding it as illegal data. If the operator attempts to restore image data from Desk Top Editor For Production to the MFP, and the data does not conform to the standard format, the File Format Converter will not be able to convert the file and the data will be destroyed without any adverse effect on data stored in the MFP. It is therefore not possible to introduce illegal data when restoring data to the MFP.
  Note: Since Netfile treats the data it receives through this process as a separate file from the one originally sent to the PC, the destruction of such illegal data does not affect the original file

Viewing and Changing User Information Stored in the MFP/LP

- As mentioned above, user data stored in the MFP/LP can be captured, added to, deleted, and changed from inside SmartDeviceMonitor for Admin, however this requires User Administrator access rights (see 1.7 Data Protection for more details).

Viewing and Changing Machine Settings Stored in the MFP/LP

- As mentioned above, in order to view or change the machine configuration settings obtained by Web SmartDeviceMonitor Professional IS, users must have an administrator-level User Account registered in this utility. Similarly, the network settings can only be changed by users logged in as Network Administrators, and the user settings can only be changed by those logged in as User Administrators. The access control settings for an individual user can only be viewed by the user who is registered with that account, or by any of the administrators mentioned above. These administrators are the only individuals who can view the user counter values.

Sending the Log Information to Web SmartDeviceMonitor Professional IS

- Please refer to 1.9 Job/Access Logs.

User Authentication Tickets (MFP models only)

- Performing User Authentication with authentication tickets provides stronger security by eliminating the need to send the user's password over the network each time.

Deleting, Pausing or Resuming Print Jobs

- To delete the current job or all active jobs at once, the operator must have Machine Administrator-level access privileges. In addition, the operator must have already logged in to SmartDeviceMonitor for Admin as a Machine Administrator.

- As mentioned above, the operator can delete, pause, or resume a print job from DeskTopBinder. The printer driver uses a track ID to identify each individual print job. When the operator initiates the deletion, pause, or resumption of a print job, DeskTopBinder sends Netfile the request along with the track ID for the job in question. As long as the track ID is not stolen from the communication path between the PC and MFP/LP (which can be protected against by enabling SSL encryption) or from the PC itself, it is impossible to perform any unauthorized operations on these print jobs.

2.6 Web Applications

2.6.1 Web Server Framework

The MFP/LP Web Server was developed exclusively by Ricoh, Co. Ltd.

Encrypted Communication Support

- The Web server installed on the MFP/LP supports SSL communication. Since the MFP/LP is accessed via an HTTPS connection, all input/output data is encrypted (incl. authentication ID, password, cookie). This allows for safe and secure communication between WebImageMonitor and the MFP/LP. It is possible to set the MFP/LP so that it will reject HTTP-based communication, which does not encrypt the data mentioned above, such that it will only accept HTTPS-based communication.

User Authentication Support

- WebImageMonitor supports the access control functions described above in “Authentication/Access Control”. These functions provide greater security by prohibiting unauthenticated users from changing any settings as well as limiting the number of items that can be viewed.

Protection Against Cross-site Scripting (XSS)

- “Cross-site scripting” (XXS) is a security threat that refers to the intentional introduction of malicious script into data stored on a Web server, with the intent to cause damage or loss as a result of a valid user accessing the Web content associated with that server. Potential damage from XXS includes such common security threats as:
  - User information is accessed, such as data stored in cookies
  - Files stored on the PC are accessed or destroyed
  - URL redirection to malicious Web sites

- As mentioned above, authentication is required before any changes to the MFP/LP settings can be made from WebImageMonitor. This ensures that users without valid accounts are not able to introduce script containing malicious data.

- The MFP/LP sanitizes all HTML data that is sent from an MFP/LP Web application to WebImageMonitor. One of the strongest known countermeasures against cross-site scripting, data sanitizing deletes or neutralizes selected character strings designed to function as HTML tags or script.

Protection Against URL Buffer Overflows

- URL buffer overflow attacks occur when intentionally oversized URL strings are sent to a Web server with the intent of overflowing the buffer’s storage capacity, causing the server to shut down. WebImageMonitor prevents such trouble by limiting the length of the URL strings it will accept, rejecting any requests that exceed this limit.

- In addition, authentication is performed before any settings can be changed, ensuring that malicious data cannot be introduced via illegal access.

Protection Against Session Hijacks

- A “session hijack” refers to when the session ID stored in a cookie is obtained in order to illegally access or otherwise use a session for malicious purposes.

- WebImageMonitor employs the following countermeasures to minimize the threat of session hijacks:
  - The session ID is randomized, which makes it very difficult for third parties to surmise
  - Communication is protected by SSL, preventing theft of any data or messages exchanged
  - The above-mentioned countermeasures for cross-site scripting prevent cookies from being illegally accessed
  - Cookies created by WebImageMonitor do not contain any personal information.

- In addition, the session ID is given an expiration date, minimizing any potential threat to the MFP/LP in the unlikely event the session ID were somehow stolen:

Protection Against the Setting of Illegal URLs

- The optional URL setting in WebImageMonitor can only be changed by users authenticated as Network Administrators.

Concealment of Personal Data

Even when User Authentication is disabled, it is possible to conceal the job history and other personal data from the view by changing the Service mode settings in the WebImageMonitor GUI. In such cases, the data can only be viewed by Administrators.

2.6.2 WebDocBox (MFP models only)

Overview of WebDocBox Operations

- WebDocBox allows users to issue commands via a Web browser to view, capture, print, send (e-mail, FAX, forward) and delete Document Sever image files that were saved to the MFP HDD using the Copier, Printer, Scanner and FAX functions, as well as those that were restored to the MFP using Desk Top Editor For Production. It is also possible to view thumbnails of these images.

Data Flow

- WebDocBox supports HTTP, a protocol used by Web browsers installed on network-connected computers. The session is initiated when the first request for connection is received from the Web browser, after which WebDocBox sends commands to the shared service layers in accordance with the specific operations requested. If 30 minutes passes with no additional access attempts from the same browser, the session is terminated. To initiate a new session, it is then necessary to access the WebDocBox top page (the main screen that displays the list of Document Server files).

Data Security Considerations

- As a security feature common to all Web applications, it is possible to perform access control by allowing connection only with users who provide a specific IP address when the session is initiated. Users who do not provide an authorized IP address are not even able to view Document Server data. In addition, it is possible to prevent the viewing and altering of data through the use of encrypted communication (HTTPS over SSL).

- With the use of User Authentication, it is possible to limit the conditions under which remote operations can be performed on Document Server files. Only users who have been pre-approved for access and clear the authentication process are allowed to perform the remote operations. Additionally, it is possible to place limits on the specific operations that each registered user is capable of performing. Users are unable to perform operations that have been prohibited, even if they clear the authentication process. This prevents any potential leakage or alteration of image data.

- It is possible to protect individual Document Server documents with a password (see 1.7.2 Document Server Documents (MFP models only) for more details).

- It is possible to restrict remote access to stored documents using the same ACL mentioned in section 1.52. Users logged in as Document Administrators are able to disable the password lock as well as view, edit and delete all documents. However, Document Administrators are not able to send (FAX, e-mail, forward), capture or print out the documents.

- When sending stored image files to the PC in PDF format, it is possible to encrypt the file as well as set a password for decrypting the PDF data at the PC side. This prevents any illegal use of the data in the unlikely event the transmission is intercepted.

- When transmitting stored Scanner files as e-mail attachments, using S/MIME, it is possible to encrypt the entire e-mail (incl. the file attachment), as well as attach a digital signature. This precludes the possibility of data leakage, data alteration, and sender impersonation.

Job Log Data

- An entry is added to the job log stored in the HDD for each individual job performed. The entry contains information on the job settings (e.g. simplex or duplex, paper size), completion status (whether completed successfully or not) and user identification (in cases where User Authentication was enabled). For more details on job and access logs, please refer to 1.9 Job/Access Logs.

3 Optional Features

3.1 @Remote

3.1.1 Overview of @Remote Operations

- "@Remote" refers to a remote machine management service that manages and monitors the MFP/LP status from a remote location called the @Remote Center. Two communication paths are possible, the first being a direct connection between the MFP/LP and @Remote Center, and the second a connection between these two points via an intermediary device (RC Gate) connected to the MFP/LP in the same LAN.

- When communicating as a "client", the MFP/LP continually monitors its own status and informs RC Gate or @Remote Center when action is required, such as when parts have reached their periodic replacement limit or an abnormal machine condition is detected. When communicating as a "server", the MFP/LP receives requests from RC Gate or @Remote Center for status information such as the amount of toner remaining in the MFP/LP, after which it provides this information to whichever has requested it.

- @Remote communication to and from the MFP/LP is only possible when the relevant SP mode switch has been turned ON. It is therefore possible to prohibit communication with RC Gate or @Remote Center by turning this switch OFF.

3.1.2 Data Security Considerations

- As mentioned above, communication between the MFP/LP and RC Gate is conducted on an SSL-encrypted communication path. Since digital certificate-based authentication takes place before any data exchange is performed, this ensures that RC Gate is the only remote device to which the MFP/LP can be connected.

- The MFP/LP's digital certificate for the @Remote function is embedded in the MFP/LP during the last stage of factory assembly.

- With the use of SSL communication, symmetric key cryptography ensures that the data being transferred cannot be leaked to third parties. Security is increased even further by the fact that the symmetric key used is not a static key, but rather one that is generated every time a new session is initiated.

3.2 The "Copy Data Security" Feature

3.2.1 Overview of Copy Data Security Operations

- The Copy Data Security feature acts to discourage unauthorized copying of confidential documents. There are two aspects to the feature:
  - Marking the copy/print with a visible, embedded pattern
    Note: The marking aspect is a standard feature on MFP/LP models.
  - Detecting the pattern if a copy is attempted, and then replacing the image with a vertical line pattern
    Note: The detection aspect is provided as an optional feature on MFP models only (Copy Data Security Unit).

- Marking:
  If the user selects the Copy Data Security feature when making the first copy of a document or printing out the document for the first time from the printer driver, a pre-defined pattern will be embedded in the background area of the resulting image to demarcate that copying of the image is prohibited. Users can select from among several patterns, as well as add a text string such as "Copying of this document is prohibited" or the date, time or name of the user who created the original document (details below).
  Note: Documents for which the Copy Data Security feature has been selected cannot be saved to the Document Server.

- Detection, replacing image with vertical line pattern:
  If a user then attempts to make a copy of an image containing the embedded pattern (or store the image to the MFP Document Server), and the optional Copy Data Security Unit is installed on that MFP, the pattern will be detected and a buzzer will sound. Then, on the printout, the original image is replaced with a vertical line pattern.

  The amount of toner consumed by this vertical line pattern can be adjusted separately for each of the relevant MFP functions: Copier, Scanner, and FAX. There are four vertical line patterns from which to choose, ranging from high to low toner consumption (the more toner consumed, the narrower the interval between the lines in the pattern). The default setting, which consumes the most toner, is roughly equivalent to a solid gray image. In addition, a log entry of the event will be added to the access log, along with the date, time and username.

  If a user attempts to make a copy of an image containing the embedded pattern on an MFP (incl. non-Ricoh products) on which the optional Copy Data Security Unit is not installed, the resulting image will not be replaced with the vertical line pattern, but will be much more indecipherable due to the superimposition of the selected pattern on the original image. In addition, if the user entered a text string to be embedded into the pattern when printing out the original document, the text will be made visible when a copy of the document is made. This optional text field can be set to a number of different character strings to suit the operator's needs, such as "Copying of this document is prohibited", the date on which the document was created, or the name of the user who created the document. By making this information visible, it is possible to further deter the unauthorized copying of documents.

Note:

- The exact appearance of the optional text string (size, image density, etc.) will depend on the type and condition of the machine duplicating the image.
- Even while the optional Copy Data Security Unit is still installed, the Machine Administrator can disable the detection/graying function using the machine settings (there is no need to remove the unit to do so).

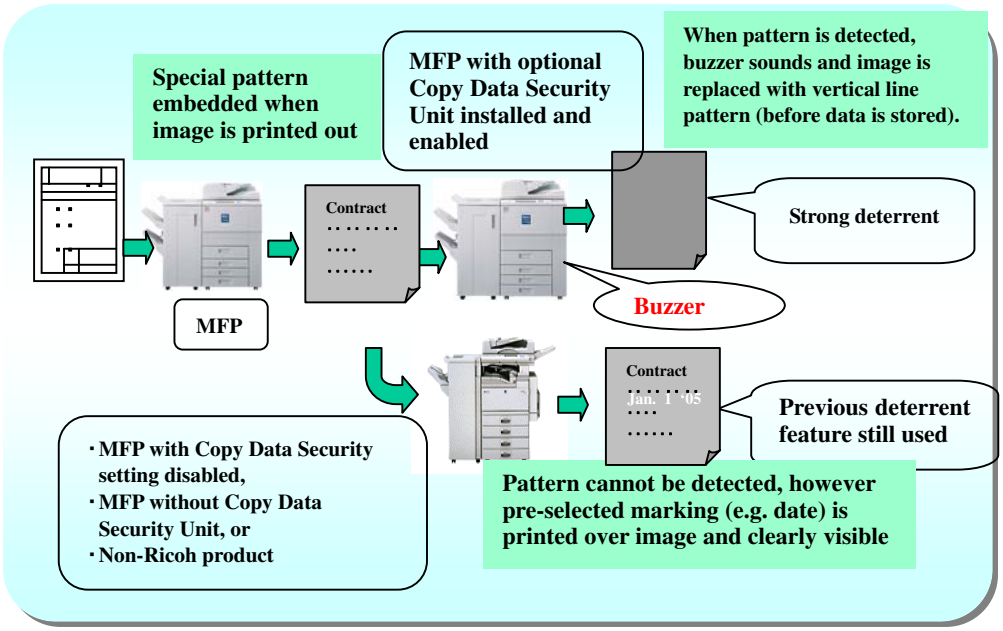
3.2.2 Data Flow

- Marking:

  The data flow for when the Copy Data Security feature is selected at the time a print job is performed is virtually the same as that of regular print jobs (see 2.2 Printer). The printer language-encoded data sent from the host computer is interpreted by the language processing subsystem, after which it is converted into image data. It is then combined with the background pattern selected by the user and stored temporarily in the Page Memory in binary bitmap format.

- Detection, replacing image with vertical line pattern:

  The optional Copy Data Security Unit functions as an image processing component during the scanning of the image. As the scanning engine scans the image, the Copy Data Security Unit examines the data for the presence of an embedded pattern. If the unit detects the presence of the pattern, which in effect alerts the MFP that this is a confidential document, the buzzer is sounded and the image is replaced with the vertical line pattern. Following this, an entry for the event itself is stored in the access log, along with the username.



4 Device SDK Applications (DSDK)

4.1 Overview of Operations

- DSDK applications developed by Vendors are able to make use of the scanning, printing and other functions of the MFP/LP by calling the VAS (Virtual Application Service), which wraps the GW-API for the standard principal functions of the MFP/LP. This arrangement allows SDK applications to run as additional principal functions themselves once installed.

- There are two types of DSDK applications that are able to run on the MFP/LP: Type 1 and Type 2. Type 1 applications are written in the C programming language, and are usually developed for use with productivity-oriented principal machine functions. Type 2 applications are Java-based, and are composed of main program files (JAR files) which run on top of a CVM (Compact Virtual Machine) Java core developed by Sun Microsystems. The GW system regards the CVM Java core itself as a single Type 1 SDK application.
  Note: CVM ver1.1/J2SE1.4 (or equivalent) is required.

- Type 2 applications initiate MFP/LP scanning and printing operations by calling an extended class (called an MFP class), which then uses the JNI (Java Native Interface) to call the VAS directly or libraries provided by a Type 1 application.

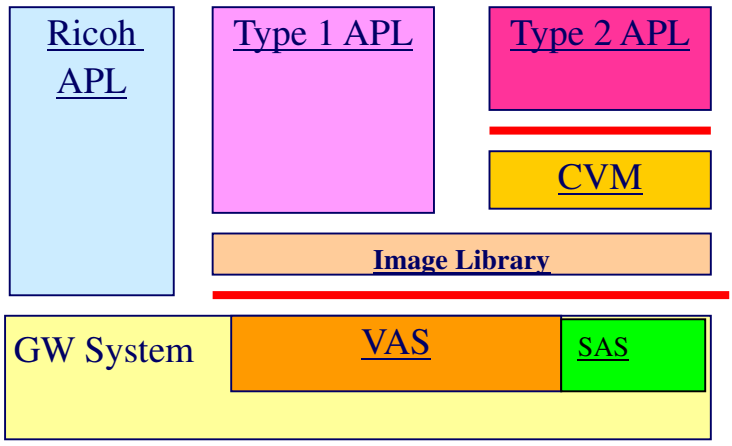


Fig. 1

4.1.1 Installation

- DSDK applications are installed via Type 1 or Type 2 SD cards into partitions and directories in the MFP/LP HDD or SD card itself that are specifically allocated for DSDK applications.

- The SAS (SDK Application Service) in the MPF contains an installer for DSDK applications. When the main power is turned ON, the SDK installer inside the SAS checks the pre-defined area in the SD card for the necessary installation files and then performs the installation. For more details on the authentication process performed at installation, see 4.3.2 Authentication of SDK Applications at Installation below.

- **(MFP models only):** Type 2 applications can be further divided into Xlet applications and Servelet applications. Xlet applications have the capability of displaying their own screens on the MFP operation panel, whereas Servelet applications do not.

- **(MFP models only):** A maximum of three Type 1 applications can be installed on the MFP at one time, depending on the amount of virtual memory (VM) that the applications require. As mentioned above, the GW system regards the CVM Java core itself as a single Type 1 application. Therefore if one Xlet and one Servelet application are installed at the same time, the MFP will allow one additional Type 1 application to be installed (see Fig. 2 below).

- **(MFP models only):** A maximum of twenty applications can be installed on the MFP at any one time (total combination of Xlet and Servelet applications), depending on the total amount of VM that the applications require.

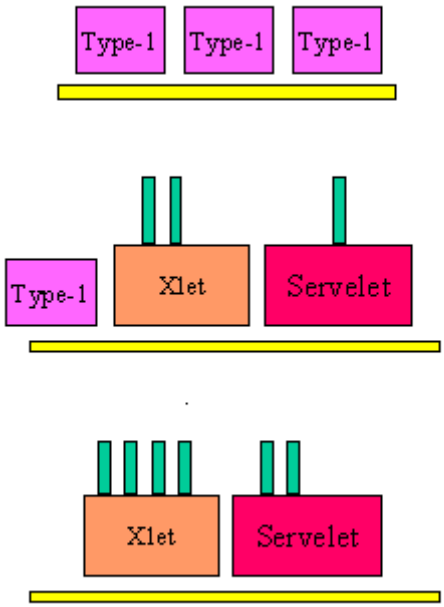


Fig. 2: Three Examples of Simultaneous Installation of Type 1 and 2 Applications

4.1.2 Overview of SDK Application Functions

- As mentioned above, Vendors can create their own DSDK applications for installation on the MFP/LP. Vendors are provided with an image library, which simplifies complex internal MFP/LP operational flows into concise, predefined methods for simple execution. This allows Vendors to develop their applications relatively easily.

  Examples of such methods include:

  - Scanning the original according to specified conditions, and then storing the image on the HDD **(MFP models only)**.
  - Searching for an image file stored on the MFP/LP HDD, and then retrieving or printing out the file.

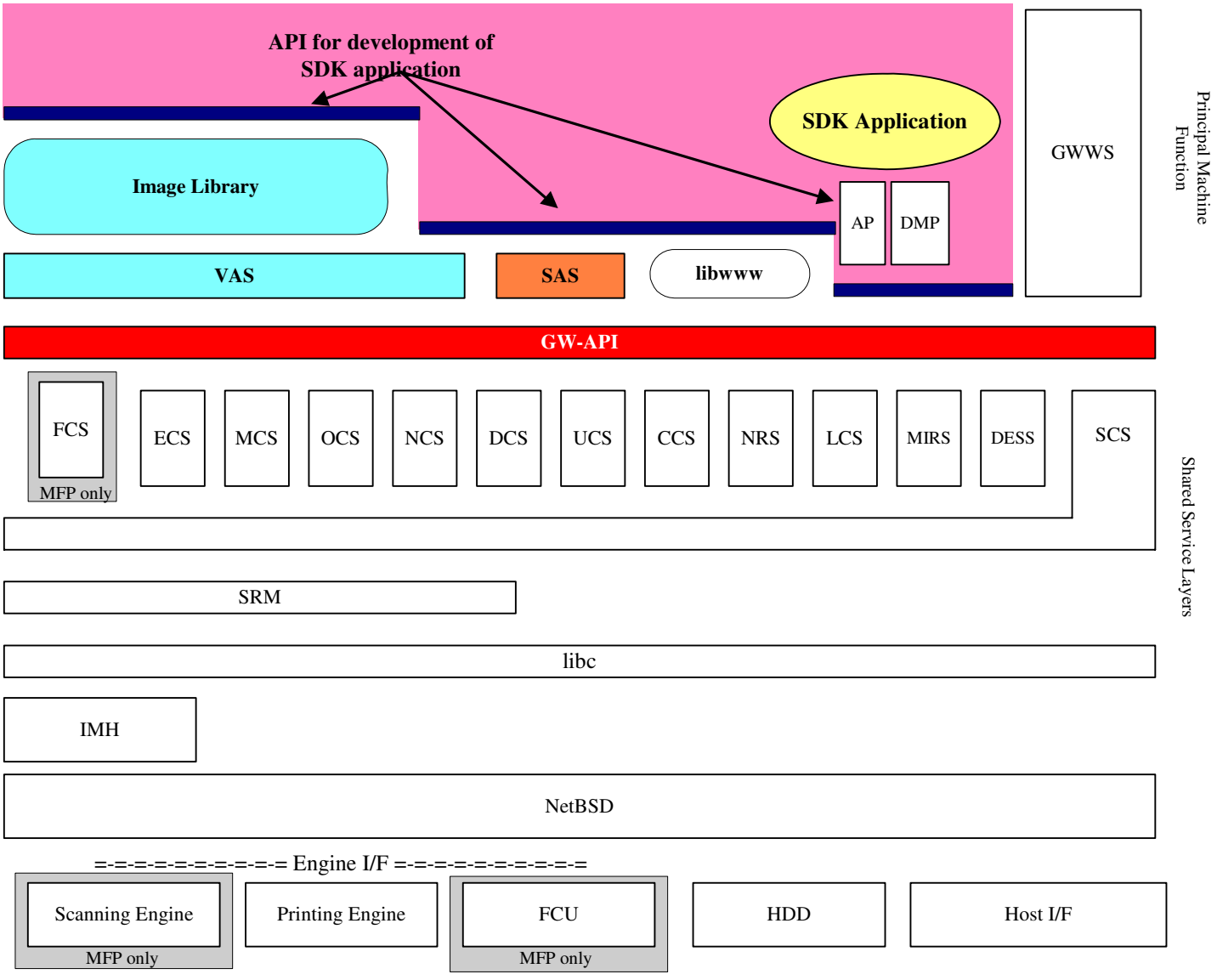


Fig. 3: DSDK – MFP/LP Hardware Configuration

4.2 Data Flow

4.2.1 Scanning Functions: Sending Data Over the Network with the Copier and Scanner (MFP models only)

- DSDK applications are capable of utilizing the scanning features of the MFP Copier and Scanner. For an overview of the MFP Copier and Scanner operations, please refer to 2.1 Copier (MFP Models Only) and 2.3 Scanner (MFP Models Only).

- The Image Library calls the ECS, MCS (IMH) and SCS service layers via the VAS and GW-API, after which Scanner or Copier operations are initiated (e.g. Scanning→ HDD storage→ Loading from memory→ Printing). The Image Library is a static library, and is contained within the SD card along with the SD application(s). The application generates and controls its user interface by calling the operation panel control I/F (OCS).

- When sending a scanned image stored in the machine over the network to a network-connected server or client station, the raw file is read out of HDD memory and then converted from Ricoh-original format to Unix FFS (Fast File System) format. The image data is converted to TIFF, JPEG or PDF format, after which the SDK application transmits the entire file over the network using the NCS (Type 1) or by opening its own unique socket (Types 1 and 2).

4.2.2 FAX Functions (MFP models only)

- Of the several FAX transmission features provided by the FCS (Fax Control Service), SDK applications are allowed to utilize the LAN FAX feature only. Therefore, as the MFP only allows LAN FAX to send to one destination at a time, the SDK application is not able to utilize such features as Broadcasting or Batch Transmission.

- With FAX reception, SDK applications are able to access FAX images that have been received and stored in the MFP HDD, and then transfer them to DeskTopBinder or Desk Top Editor For Production.
  Note: Incoming FAX images are automatically stored to the HDD when “Store Incoming Faxes” is enabled.

- When the FCU (Fax Control Unit) receives an incoming FAX, a notification is sent to the FCS, which then writes the incoming data to the work area of the HDD. The FCS informs libFAX that a transmission has been received, after which libFAX is able to access the file and retrieve it from the HDD. If the file is to be transferred to DeskTopBinder or Desk Top Editor For Production, it is converted to TIFF format and then sent to its destination.

4.2.3 Network Functions

- As mentioned above, a Type 1 SDK application is able to perform network communication either by using the NCS or by opening and closing its own unique socket. Since Type 2 applications are Java-based, they must use the network classes provided by Sun Microsystems, and are therefore restricted to socket-based network communication.

4.2.4 Printer Functions

- SDK applications are able to make use of a printer data filter, which allows the application to edit the incoming printing data received by the MFP/LP, convert it to a different PDL, and change job control commands such as the paper tray selection or printing mode. Following this, the SDK application sends the edited PDL data to the printer port of the loop-back address (the 127.0.0.1 local address), which the MFP/LP Printer function then receives just as if the PDL data had come directly from an external source. The data then follows the normal flow described in section 2.2 and is printed out by the printing engine.

4.2.5 Machine Administrative Functions (MFP models only)

- In addition to the principal machine functions of the MFP (e.g. Printer, GWWS), once installed, the SDK application can be selected in the “Function Priority Setting” so that it its screen is displayed when the main power is turned ON and the MFP reaches the Ready condition.

- It is possible to create a user interface for communication with a network-connected authentication server in order to authenticate individual machine users, thereby restricting the use of the application. The user interface can be customized for each individual user, and will automatically log out the user and return to the default screen if no operations have been performed after a certain amount of time has passed.

- It is also possible to maintain a machine usage log. The SDK application creates the log files and writes them to the SDK area of the HDD.

- SDK applications are able to obtain, edit, delete, and add user information via the DMP (Device Management Package). The DMP enables this functionality by using the GWWS function as a Java Web service client. Java applications on the PC are also able to use the DMP, making it possible to perform changes to the Address Book from a PC.

4.2.6 Authentication Functions

- The AP (Authentication Package) module is installed on the machine as a standard feature. This module allows the user to do the following:
  - Use SDK applications in conjunction with the IC Card Authentication explained in section 1.5.2.
  - Set up their own customized authentication system by adding an external server and then using this in place of the servers explained in section 1.5.1

4.3 Data Security Considerations

4.3.1 Preventing the Installation of Illegal Applications

- The following are used to prevent the installation of illegal SDK applications or altering of authorized SDK applications already installed in the MFP/LP:
  - Product ID (comprised of a vendor code, country code and code representing the application type)
  - Digital Authentication (Type 2)
  - SDK Authentication (Types 1 and 2)

    Note: The "SDK Authentication" listed here refers to an internal authentication process developed by Ricoh in order to certify the SDK application as described in section 4.3.6 below. This is not related to any of the functions described in section 4.2.6 above.

- When the Vendor begins developing an SDK application for installation on the MFP/LP, a contract is created between the Vendor and Ricoh. In addition to the necessity for strict confidentiality of information, this contract specifies the scope of responsibilities regarding product quality, as well as the details of sales-related agreements made between both sides.

- Having agreed to the terms of the contract, the Vendor requests Ricoh to assign and provide a product ID for the proposed application. In addition to being a completely unique number by which the Vendor can be identified should the need arise, the product ID is also used by the Vendor to create an installation directory for the SDK application and by Ricoh to authenticate the application through SDK Authentication. As explained below, without the correct product ID, there is no way to install the SDK application on the MFP/LP.

- The MFP/LP is designed so that each SDK application, once authenticated, is installed in its own unique directory. This ensures that the objects, data files and other contents of one SDK application cannot be overwritten or accessed by another.

4.3.2 Authentication of SDK Applications at Installation

The following two processes are performed in order to authenticate SDK applications. This ensures that only authorized applications can be installed in the MFP/LP, and also controls the range of operations and extent of access granted to the applications once installed.

SDK Authentication (Types 1 and 2)

- Once the development of the SDK application has been completed, and Ricoh has authorized its installation on the MFP/LP model(s) in question, Ricoh provides the Vendor with: 1) a file containing the unique product ID mentioned above in its raw form, and 2) a "key file," which contains two hash values generated from the product ID and SDK application object code, which are then embedded inside randomly-generated data. The locations of these hash values inside the key file are not disclosed to the Vendor.

- Using a special tool, Ricoh generates a unique key file for every SDK application that is approved. Among the entire group of specialists at Ricoh engaged in SDK application-related activities, only a select number of

engineers have been granted the access rights to use and manage this special tool.

- When the SD card is inserted in the MFP/LP slot, the SAS reads the raw form of the product ID contained in the product ID file, as well as the hash value for the ID contained in the key file. The SAS then applies a unique hash function to the raw form of the product ID, and compares the resulting value with the hash value read from the key file.

- If these two values match, the SAS then reads the raw form of the SDK application object code stored in the SD card, as well as the hash value for the code contained in the key file. The SAS applies a unique hash function to the entire code, and then compares the resulting value with the hash value read from the keyfile. If these two values match, the name of the SDK application appears on the installation screen and the application can be installed on the MFP/LP.

- As demonstrated above, it is not possible to install an SDK application on the MFP/LP unless both of the following conditions have been satisfied:
  - The SD card contains the key file and raw form of the product ID provided by Ricoh, as well as the raw form of the application object code developed by the Vendor, AND
  - The two hash values generated by the MFP/LP for the product ID and application object code match those contained in the key file on the SD card.

Digital Authentication (Type 2 only)

- For Type 2 applications, Ricoh embeds a digital signature inside the JAR files received from the Vendor, assigns an appropriate access level, and then returns the files to the Vendor. This allows the MFP/LP to authenticate the application as well as restrict its operations once installed.

- As a general rule, Ricoh assigns relatively restricted access privileges to Type 2 applications. These applications are normally prohibited from performing operations such as file storage to MFP/LP media or opening and closing sockets to communicate over the network. Vendors who wish to utilize such functions must make this request to Ricoh when applying for the digital signature. After having fully ascertained all relevant details on the proposed SDK application, including the Vendor's specific purpose for using the application on the MFP/LP in question, and having determined that the application poses no security threat to the MFP/LP, Ricoh approves the application and assigns the appropriate access level.

4.3.3 Prevention of Access to Address Book Data and Machine Management Data

- By calling the DMP (Device Management Package), SDK applications are able to view and change the contents and settings of the MFP/LP Address Book. However, these operations are limited to those users who have been authenticated by the CCS.

- As mentioned in section 1.2.1, the Address Book data is managed by the UCS. For details, refer to section 1.7.

4.3.4 Protection Against Attacks on Principal MFP/LP Functions, Prevention of Damage to the System

Buffer Overflow Attacks on the MFP/LP VM

- After completing the development of the SDK application, the Vendor must apply to Ricoh for the items necessary to carry out the SDK Authentication and/or Digital Authentication processes described above, and at that time declare the expected VM consumption of the application. The proper method for measuring VM is described in the SDK Development Kit provided by Ricoh to the Vendor. Ricoh then performs tests on the proposed application to verify that the actual VM consumption matches that which the Vendor has stated on the application form, and then makes a judgment as to whether or not to approve the application and provide the Vendor with the requested authentication items.

Alteration or Deletion of MFP/LP Principal Function Program Objects

- As mentioned above in section 3.1, each SDK application is installed in its own unique directory on the HDD, which is determined by its unique product ID. It is impossible for the application to access any other areas.

- Even in the event that an SDK application attempted to write a large amount of data to the SD card or MFP/LP HDD, e.g. with the aim of rendering machine principal functions unable to write data, this would not succeed since the application cannot access any area aside of its own isolated partition on the HDD. In addition, as a general rule, Ricoh prohibits SDK applications from writing to any machine media or SD cards. Even in cases where Ricoh has given the application writing capabilities upon request from the Vendor, the application is only able to write to a specialized SD card for SDK applications.

4.3.5 Protection Against Attacks from External Sources

- As mentioned in section 2.3, an SDK application is able to perform network communication either by using the NCS (Type 1) or by opening and closing its own unique socket (Types 1 and 2). In the latter case, all communication including the content of all messages and data exchanged is encrypted, and specialized protocols and authentication procedures are employed. As a result, these safeguards protect the MFP/LP from any attacks from external sources.

4.3.6 Certification of the SDK Application

- Having completed the development of the production-level (product release) version of the SDK application, the Vendor must then request Ricoh to certify the application. When applying for Ricoh certification, the Vendor must provide Ricoh with the application's functional specifications, entire object code and all relevant evaluation results.

- Following this, Ricoh examines the information provided by the Vendor to ascertain in detail the full scope of the operations of the application, as well as to what extent the application has already been tested. These results are then documented (If deemed necessary, Ricoh may perform further testing on the application). As mentioned in section 3.1, if Ricoh determines that the application poses no particular issues or problems, the Vendor is provided with the necessary authentication files. By providing these files, Ricoh is certifying the application.

- If the Vendor then makes any changes to the application after receiving the authentication files from Ricoh, this Vendor must go through the entire certification process again to obtain new authentication files. It is therefore impossible for an SDK application to be successfully installed on the MFP/LP without the correct authentication files described in section 3.1.

- Ricoh utilizes this system to manage and control the specifications, operations and quality of SDK applications developed by Vendors, preventing the illegal installation of any SDK application that has not been fully certified as described above.