RIX

Radio Image Transmission System

Product Planner

January 1998

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MOTOROLA

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RIX System Overview

The RIX™ Remote Image Transfer System permits the system operator at a central site to see what is happening at multiple remote sites located throughout a territory. To see means precisely that: a video interface, added to the MOSCAD SCADA RTU, captures and digitizes, upon command, a single video frame from a CCTV camera. This digitized image is compressed per the JPEG standard and passed to the MOSCAD RTU for transfer to the operator at the central site. When MOSCAD SCADA is not available, a low-power UHF two-way radio may be added to the video interface. The low-power radio provides direct communications from the remote sites to the operator at the central site. Up to six CCTV cameras may be connected to a single video interface, and there may be as many as 255 remote sites so equipped in the system.

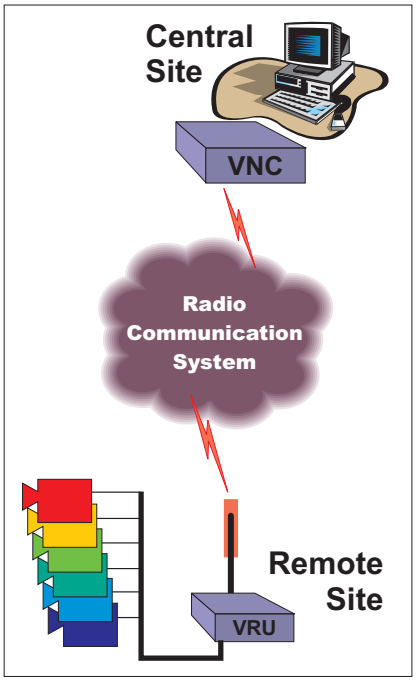

Figure 1. Components of VRU System

Snapshots

RIX retrieves single image *snapshots*, not full-motion video. Several single-image acquisitions from a selected site may occur and the images transferred to the central site either singly or as a group. The transfer speed is determined by the bandwidth of the communication system design. If organized as a group, the individual images may be viewed individually or at approximately their capture rate.

Components

A RIX system, be it standalone or part of a MOSCAD solution, requires one or more Video Remote Units (VRU), one Video Network Controller (VNC) either via hardware or functionally provided by the MOSCAD FEP, plus the Video Control Center (VCC) that the operator uses to initiate manual commands and to view the captured images. These components will be described in the Sections that follow.

Video Remote Unit

The Video Remote Unit (VRU) is provided in an enclosure suitable for desktop use. It has connections for two (expandable to six) video cameras in a standalone system, or six cameras in a MOSCAD system. Operating power (+13.8 Vdc) may be obtained from the companion MOSCAD RTU or from an external power source capable of 2.6 amp. A TNC connector to an external antenna is provided in standalone systems when the VRU contains an internal UHF radio, or a DB9-

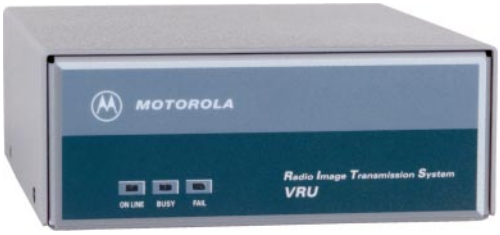

Figure 2. VRU in Desktop Enclosure

female connector is provided for an RS232 connection to the MOSCAD RTU's CPU module.

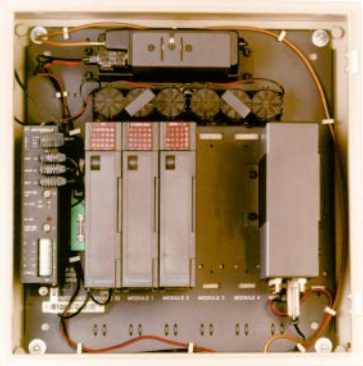

Figure 3. VRU in MOSCAD RTU

VRU in MOSCAD

The V194 option, to install the VRU within a MOSCAD RTU, is available; see Figure 3. The large enclosure is retained but only two I/O modules are permitted. The V426 Replace CPU300 with CPU400 option must also be ordered.

Cameras

Standard video cameras, selected for their auto-iris, auto-focus, or other capabilities, may be connected to the 75 ohm BNC-type video input connectors on the VRU. The cameras may be in either NTSC or PAL format and must provide the standard composite video (1Vptp, negative sync) output. Color, BW, and/or infrared camera technology may be intermixed according to individual site and system requirements. Note that Motorola does **not** supply any video cameras with the VRU.

Additional I/O

Additional I/O connectors are provided. A video monitor (in either NTSC or PAL format, depending upon the video cameras) may be connected to locally check the operation of the VRU; a dry-contact input is available to begin a locally-commanded image acquisition session; an RS232 connector is available for the connection of the Video Service Software.

Image Size

The size of the image, in pixels, is defined in the JPEG image standard. The larger image is 320x240 pixels (SIF size; NTSC standard) or 384x288 (CIF size; PAL standard). These sizes are achieved by a size reduction of 4:2:2 as defined by JPEG[1]. The smaller image is 160x120 pixels (QSIF; NTSC standard) or 192x144 pixels (QCIF; PAL standard). The image size (in pixels) remains constant and is not altered by the compression step.

File Size

The size of the file, in kbytes, that is transferred to the system operator depends upon the size of the image (large or small) and upon the compression factor selected. Simply stated, compression examines a block of pixels to determine the average color within the block. A single color code is assigned to the entire block. The entire image is similarly treated, and the resultant file is smaller than the source file. The greater the compression factor, the larger is each block. High compression levels, i.e. 0.6 bits/pixel, result in very small files but the blocks are visible, whereas small compression levels, i.e. 1.0 bit/pixel, result in larger files but with negligible block visibility. Highly compressed images (small file sizes) take less time to transfer but show more distortion; lightly compressed images (large file sizes) take more time to transfer but provide better image fidelity. It is difficult to predict the size of a compressed file, although empirical evidence suggests that a small image will compress to 2½ to 5½ kbyte and a large image will compress to 8 to 13 kbyte. RIX permits the system-wide definition of three compression levels that the operator may specify when acquiring the different images.

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1 *A color image, when digitized, is represented by one Luminance and two Chromanance variables and denoted YCrCb. A certain portion of the raw input, denoted as 4:4:4, may be reduced in size, to 4:2:2, to achieve the loss-less size reduction defined in the JPEG standard. This size reduction technology is utilized in RIX. Note that a raw BW image has no Chromanance component, as shown in its 1:0:0 notation, but is size reduced for display compatibility with color images.*

Data Protocol

The data transfer protocol utilized by RIX differs in the standalone and MOSCAD configurations. In a standalone system, the protocol is based on a widely-used, highly-successful Motorola mobile data protocol. The compressed file is connected to an internal radio/modem for direct transfer to the operator at the central site. In a MOSCAD system, a cable connected to the VRU output passes the data bytes into Port 2 of the MOSCAD CPU module (at 38.4 kbps). MOSCAD then transfers this data, as it does all data, using the MDLC data protocol to the operator at the central site.

Radio/Modem

A 3 watt UHF radio/modem is available with the standalone configuration; it is installed inside the VRU's enclosure. This radio is type-accepted to operate on 25 kHz bandwidth channels at a 19.2 kbps data rate. Contact the product group if use with an external radio/modem is required. No antenna is included; select an antenna (typically directional at the remote sites) that is appropriate for the system design. The Video Service Software (VSS) is used to set the data speeds at the output of the VRU according to the radio/modem selected.

Temperature Range

The VRU will operate over a -30 to +60°C temperature range (storage range is -40 to +85°C). However, CCTV cameras from the video industry typically have a temperature range of -10 to +60°C. Consequently, heated enclosures are commonly used with video cameras that are installed in cold locations or in locations that are subject to ice/snow build-up, but no heaters are normally required for the VRU or its companion MOSCAD RTU.

Video Network Controller

The Video Network Controller (VNC) is the interface between the multiple distributed VRUs and the operator at the central computer. It is co-located with the central computer and converts the data protocol used for over-radio communications into a format that the computer and VCC software understand. VNC functionality is required in both standalone and MOSCAD RIX systems.

Standalone VNC

In a standalone system, the VNC functions are provided by VNC hardware, known hereafter as the VNC. The VNC is packaged in a desktop enclosure that is identical in appearance to the VRU. The VNC is available with or without an internal 3 watt UHF radio/modem, the same radio/modem that is used in the standalone VRU. No antenna is included; select an antenna (typically omni-directional at the central site) that is appropriate for the system design. A DB9-female connector is provided for the RS232 connection (typically at 19.2 kbps) to the central computer.

Figure 4. Standalone VNC in Desktop Enclosure

MOSCAD VNC

In a MOSCAD system, VNC functions are provided by MOSCAD modules that are added to the FEP (FIU). When the MCP-M is used as the FEP, an empty module slot is available; when MOSCAD RTU hardware plus the G-FIU firmware is used as the FEP, the I/O modules must be selected so there is also an empty module slot. In either platform, a Series 400 CPU module with V4.x firmware must be ordered (V425 factory install, F6936 field install) and inserted into that formerly-

open module slot. An RS485 cable (FKN4400) must be ordered and connected between Ports 1A of the original plus added CPU modules. The MOSCAD Programming ToolBox must be used to define the network connection between the two CPU modules so that Store-&-Forward activity may occur, plus download the RIX firmware, included with the Video Control Center, into the added CPU module. Port 2 on the added CPU module then provides the RS232 connection (typically at 19.2 kbps) through cable FLN6457 to the central computer.

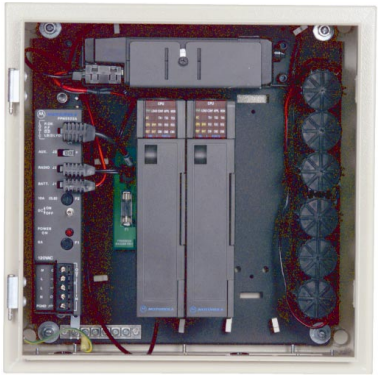

Figure 5. MOSCAD MCP-M w/VNC Additions

Video Control Center

The Video Control Center is the operator interface to the many video cameras distributed throughout a RIX system. It consists of the VCC software, by Motorola, operating in a PC computer. The computer must meet the minimum requirements detailed in the Ordering section. The preferred computer operating system is Windows NT. The Windows environment provides a convenient point-&-click interface to the on-screen displays and operator controls.

Image Display Format

Two different image display formats are provided. One display format (Figure 6) shows four small images—these images may be obtained from one camera at a single site, from different cameras at one site, or from cameras at different sites, and may be intermixed with images retrieved from those stored on the computer's hard disk drive. A second display format (Figure 7) shows a single large image obtained from one camera at any site or retrieved from those stored on the computer's hard disk drive. A button on each display format permits the operator to easily switch to the alternate display. Each image on display includes information on the source site, camera, date, and time that the image was captured. An activity *marker* is apparent while any image is being updated with a new retrieval, and a progress bar shows the status of any retrieval in process.

Figure 6. Four Small Image VCC Display

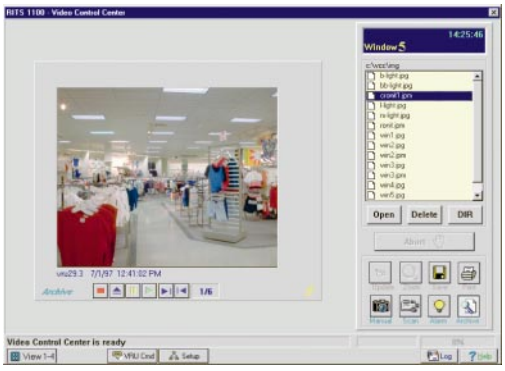

Figure 7. One Large Image VCC Display

Control Panel

At the side of each display format is the operator's control panel. The visible and active controls are appropriate for the operations that may be attempted—see Figures 8-10. System setup and command buttons appear at the bottom of the display area.

Manual Operation

The operator may initiate an image acquisition action at any time by selecting (clicking on) an image display area in either display format and then clicking the *Get Image* button—a list of available site-camera combinations is provided to the operator. The operator may select the desired site-camera, select color or BW, and choose one of three defined levels of compression. The operator then presses the Get Image button to begin the acquisition action. The activity marker will blink within the selected display area, the progress bar will show the acquisition progress, and the new image will replace the older image. The Save button will preserve the image on the hard disk drive, and the Print button will route the image to the system printer.

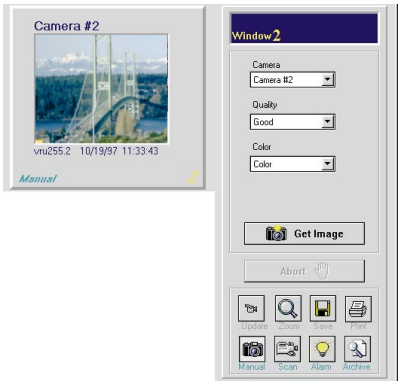

Figure 8. Control Panel for Manual Mode

Scan Operation

The VCC software will automatically and repetitively retrieve (scan) images from one or more sites as quickly as the radio communication system permits. The operator may place a display areas into the Scan mode of operation by individually selecting (clicking on) a display area in either display format and then clicking the *Start Scan* button—a list of predefined and scan-empowered site-camera combinations is provided to the operator. The operator may select the desired site-camera, and then repeat these setup operations for additional display areas. The operator then presses the Start Scan button to start the acquisition actions. The activity marker will blink within the active display area, the progress bar will show the acquisition progress, the new image will replace the older image, and the process will repeat for the next scan-enabled display area. The Save button will preserve an image on the hard disk drive, and the Print button will route the image to the system printer.

Figure 9. Control Panel for Scan Mode

Alarm Operation

The VCC software may instruct the VRU to wait for a local (on-site) trigger signal. When the VRU receives this signal (e.g. a door switch activated in a standalone system, or a MOSCAD relay closed by the decision-making algorithm active within the MOSCAD RTU), one or more frames will be digitized, compressed, and passed through the communication system to the system operator. The activity marker will blink within the active display area, the progress bar will show the acquisition progress, the new image will replace the older image, the image's border will change to red, and an audible alert will be heard. If multiple frames were processed as a group, the display will include a control panel that permits the operator to step through the images or to play the images in a near real-time representation of the captured activity. The Save button will preserve an image on the hard disk drive, and the Print button will route the image to the system printer.

Figure 10. Control Panel for Alarm Mode

Archive Operation	The operator may retrieve an image from those stored on the hard disk drive by selecting a display area in either display format and then clicking the Archive button—a directory listing of available images is provided to the operator. The operator may Open an image file, Delete an image, or Change to a different image directory. Images that were retrieved as a group will be displayed with the control panel that permits the operator to step through individual images or play them at approximately their capture rate. The Print button will route the image to the system printer.
Setup Button	The Setup button will reveal a set of tabbed cards by which the operator or system manager may define new sites and cameras, enter site-camera combinations into the scan-enabled list, define site-camera combinations for alarm-mode operation, define the amount of compression for each of the three available levels, and more.
Command Button	The Command button reveals a simple menu with which the operator may verify that communications to a selected site is available, may set the date and time within the VRU, may read the date/time as set in any VRU, and more.

Ordering Guide

The examples shown here illustrate the order writeup for both a standalone RIX system and a MOSCAD RIX system. Each example includes three remote sites capable of handling one or two video cameras, a two-way radio communication system, and the central computer hardware and software. The computer hardware is shown by its requirements and not by specific model/option numbers. Video cameras, lens, enclosures, and connecting cables are not shown and must be added according to need.

Standalone RIX

Remote Sites			
1	3	F2995	VRU with UHF 3 watt radio
2	3	FPN5123	PS, 3 amp, 117 Vac
3	3	TBD	Protective enclosure
4	3	TDE7853	Antenna, Yagi, 10 dB
5	3	TBD	Line kit, 30 feet
Central Site			
6	1	F2996	VNC with UHF 3 watt radio
7	1	FPN5123	PS, 3 amp, 117 Vac
8	1	TDE7232	Antenna, Omni, 3 dB
9	1	TBD	Line kit, 30 feet
10	1	FVN4598	VCC software
11	1	multiple	Computer hardware per Table 1
12	1	lot	Misc. Line cords, mounting clamps, etc.

Internal Radio Data

Transmitter power output:	3 watts
FCC Type Acceptance Nr.	ABZ9QCT4814
Emission Designator:	FCC: 20K0F1D
Rules Part:	FCC: 90

Computer Hardware

The computer hardware must be the product of a reputable PC manufacturer and satisfy the minimum requirements listed in Table 1.

1. Pentium-based PC
2. 32 Mb RAM
3. 500 Mb hard disk
4. 2 serial data ports
5. Video display that supports 800x600 pixel resolution and 64k colors (16.7 million colors recommended).
6. Windows NT

Table 1. Minimum VCC Computer Requirements

MOSCAD RIX

Remote Site			
1	3	F6974	MOSCAD RTU UHF 20 watt
1A	3	V194	ADD: RIX Video kit for MOSCAD
1B	3	V426	ALT: Replace CPU300 with CPU400
1C	3	V245	ADD: Mixed I/O *(for Alarm mode I/O)*
2	1	F2316	MOSCAD Programming ToolBox
3	3	TDE7653	Antenna, Yagi, 10 dB
4	3	TBD	Line kit, 30 feet
Central Site			
5	1	F4274	MOSCAD MCP-M UHF 20 watt
6	1	F6936	CPU Series 400
7	1	FKN4400	Cable, RS485
8	1	TDE7232	Antenna, Omni, 3 dB
9	1	TBD	Line kit, 30 feet
10	1	FLN2563	RIX VCC software
11	1	multiple	Computer hardware per Table 1
12	1	FLN6457	Cable, RS232 *(VNC to computer)*
13	1	lot	Misc mounting clamps, etc.

Glossary

BNC	A small coaxial connector commonly found on CCTV components.
CCTV	Closed Circuit TeleVision. The process of taking full-motion images, transporting them over (typically) a private cable system, and displaying those images on a TV-like display device.
CIF	An image size in a PAL system as defined by the JPEG standard.
FEP	Front End Processor. MOSCAD hardware used as the link between the radio communication environment and the central computer. Also known as Field Interface Unit (FIU).
G-FIU	Generic Field Interface Unit. A MOSCAD product commonly used at the central site to connect data obtained from remote sites via two-way radio the the controlling computer.
I/O	Input/Output. An expression that denotes the physical input and output capability of a SCADA RTU.
JPEG	Joint Photographic Experts Group. A group that initially defined the JPG image digitization & compression standard.
JPG	An industry-standard image digitization & compression protocol; currently administered by the International Standards Organization.
MOSCAD	The product name for Motorola's SCADA product. See the MOSCAD System Planner R4-11-03 for a description of this product.
NTSC	National Television Systems Committee. The 525 line TV standard used in North America and portions of South America.
PAL	Phase Alternate Line. A 625 line TV standard, variations of which commonly used throughout the world.
RTU	Remote Terminal Unit. The in-field portion of a MOSCAD SCADA system.
SCADA	Supervisiory Control And Data Acquision. The industry name for the monitor and control of operations.
SIF	An image size in an NTSC system as defined by the JPEG standard.
ToolBox	A MOSCAD product. Used to define and configure the MOSCAD RTU for proper operation.
UHF	Ultra-High Frequency. Radio communications in the 403-470 MHz frequency spectrum.
Video Control Center	A component of a RIX system. Software for a PC computer that manages a RIX system and displays images obtained from the remote sites.
Video Network Controller	A component of a RIX system. It is the interface at the central site between the communications to the remote sites and to the controlling computer.

Video Remote Unit	A component of a RIX system. It is installed at a remote site to digitize & compress images from up to six cameras upon command by the control center.
VRM	Vehicular Radio Modems. Motorola products for mobile data applications that transfer digital data over dedicated two-way radio circuits.

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