SONY

SONY PROFESSIONAL SOLUTIONS, EUROPE

Product Marketing

Camera Monitoring – HD Cameras

Applications Note

Table of Contents

Camera Monitoring – HD Cameras

The picture and waveform monitoring requirements for a camera system can be quite complex. This document attempts to show some of the possible configurations, and how they can best be achieved with Sony camera systems. For SD systems readers should refer to the separate document on SD Camera Monitoring.

Monitoring Scenarios

When installing a camera system, there are some fundamental questions that need to be addressed to determine the best equipment configuration. Each user will have different requirements, and the physical layout of the installation with vary from place to place, but nevertheless there are likely to be some common features.

- Picture monitoring format

  A typical camera control environment consists of several source monitors, one for each camera output, plus a single Engineering Preview monitor. Ideally, all the monitors would of course be HD, but for cost reasons, some customers may choose to use SD. One common scenario is the use of small individual SD (either SDI or VBS) monitors for each camera output, plus a larger HD Preview monitor for camera setup and control. Although this setup monitor could use an analogue composite (VBS) signal, it's rather unlikely that any users would choose this scenario, so it will not be considered in this document.

- Waveform monitoring format

  If SDI monitoring is used (HD or SD), it is common practice to use the waveform monitor itself to select individual R/G/B signals as required. Compared to SD systems, this makes the connections much simpler, using only a single router layer, with the same signal connected to the picture and waveform monitor. Depending on the type of WFM used, it my be possible to control the display from the RCP.

- Joystick Override (Preview)

  In Europe, the normal operating style is to use the override on the RCP Joystick to select the camera to appear on the preview monitor. This is not difficult, but must be planned into the system.

- MSU location

  If the MSU is located in the same physical area as the RCPs, it is normally sufficient to use a single monitoring facility for the RCP Preview and the MSU setup. If the MSU is in a different location, this is obviously not possible.

Monitoring Concept

The scenario described above, with SD source monitors and HD control monitoring, is shown in the following diagram.

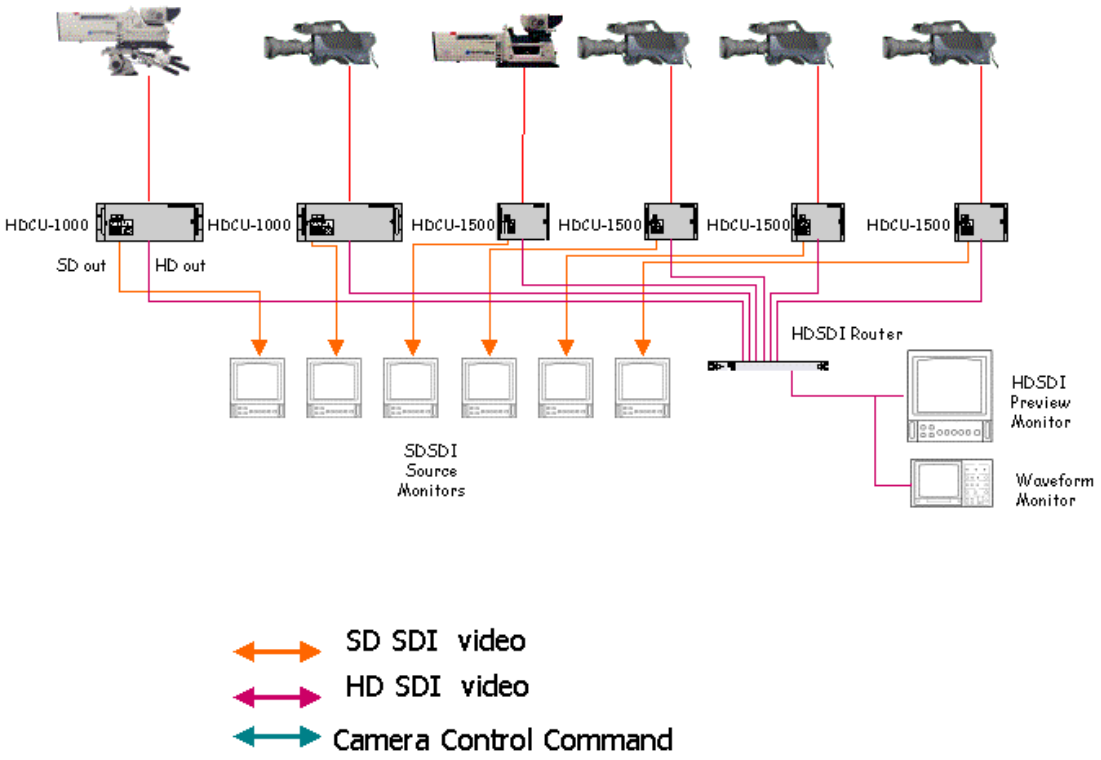


Figure 1. HD Monitoring Concept

This diagram shows SD SDI feds to the source monitors, but for even lower cost, these could be SD composite.

HDCU-1000 and HDCU-1500 Monitoring Facilities

Both HDCU-1000 and the HDCU-1500 include both HD SDI and SD SDI outputs, as well as composite (VBS) outputs, as standard. A high performance down convertor is standard in the CCU, and provides full colour correction to account for the different colour space characteristics of the HD and SD formats. The VBS out is designed purely for monitoring purposes, and does NOT have full chroma genlock.

HDCU-1000

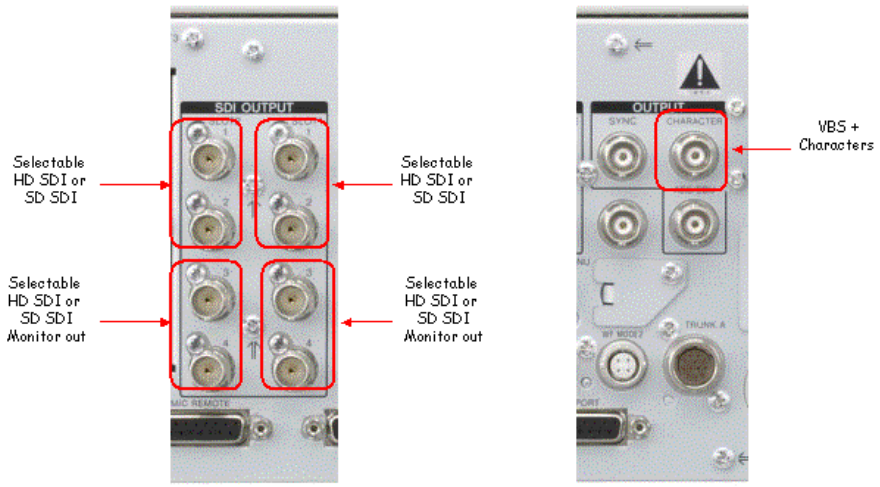


Figure 2 HDC-1000 Outputs

The SDI outputs are switchable (in pairs) as either HD or SD. Aspect ratio conversion is available for the SD outputs. This is switchable to provide a variety of formats, including 16:9, 4:3. 14:9, and various letterbox settings.

> *Note that ALL the SD outputs must have the same aspect ratio. It is not possible to assign some as 16:9 and others as 4:3.*

The top four SDI outputs are designed as main program feeds. The lower sets of outputs can be used as Monitor outputs. In the camera documentation this is referred to as “character display”, but in fact provides more functionality. As well as the main video feed, they can also have the following additional features.

- Character display
  - → Setup menu for the HDCU configuration. Controlled by internal switch, or by MSU menu
  - → Character display giving status information - switched by the CHAR button on the RCP
- Skin Detail Gate
- Multi Matrix Gate
- Level Gate Displays a “zebra” signal on the monitor output
- Aspect Marker Can display a 4:3 (or other) protection area on the monitor output. Note that this is not available when SD output is selected and the aspect ratio is set to anything other than 16:9

The monitor (character, marker and gate) information can be switched off for pairs of outputs.

The VBS output is (also rather confusingly) described as "CHARACTER" out. In fact this carries video plus characters. But note that this output does NOT have the gate signals available, only the character display.

> *Because of this, it is strongly recommended that one of the SDI monitor feeds is used to feed either the source monitor, or the preview monitor of the installation*

For full details of the output configurations an monitoring settings, please refer to the HDCU-1000/1500 Installation Manual

HDCU-1500

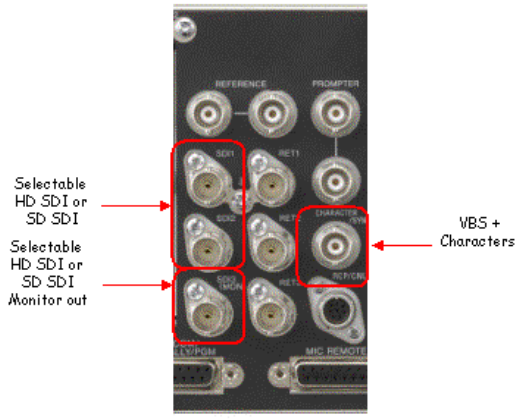


Figure 3 HDCU-1500 Outputs

The HDCU-1500 has only 3 SDI outputs. The top two are switchable HD/SD, and the lower one is selectable HD or SD, with or without monitoring. In some cases this will not be sufficient, so an option board is available for either HDCU-1000 or HDCU-1500. This option board (HKCU-1005) provides 4 additional SDI outputs, switchable in pairs HD or SD, 2 of them with optional monitoring. Again, the VBS output is described as "CHARACTER" out, and carries video plus characters (but no gate).

HDCU-3300 (HD Super Motion System)

The HDCU-3300 provides 3x speed outputs to feed a Slow Motion server. In addition, it has normal speed (50/60 Hz) outputs that can be used for as a conventional camera source, and for monitoring. As far as the control system is concerned, the HDC-3300 HD Super Motion camera has full compatibility with the other Sony HD cameras, so can be simply integrated with conventional HDC-1500/1000 cameras. The HDCU-3300 offers similar facilities to the HDC-1000, as shown here.

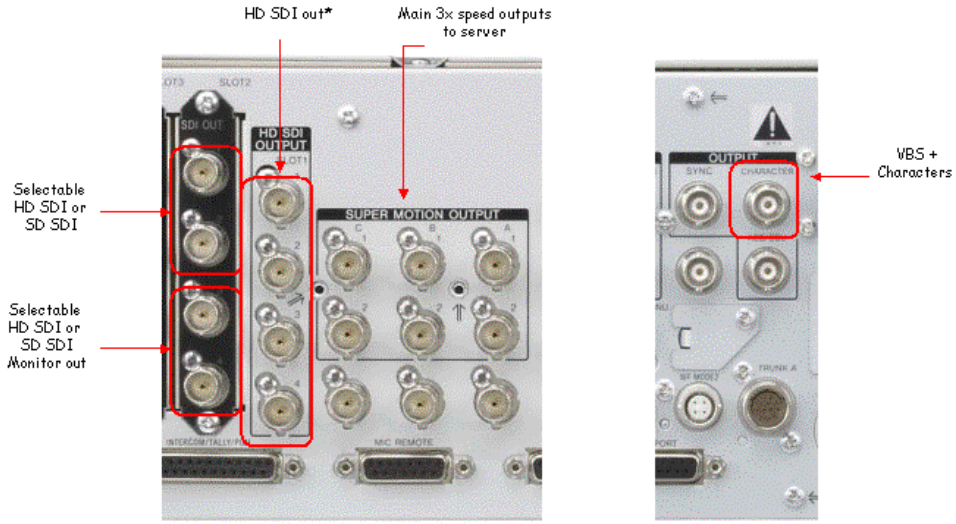


Figure 4 HDCU-3300 Outputs

**Note: Slot 1 outputs of the HDCU are HD only, and do NOT have the normal HD/SD timing options. They are therefore not suitable where timing is important, such as the main Vision Mixer feed, but in most cases can be used for monitoring purposes.*

Basic 6 Camera System with CNU-700

As already mentioned, this document will not consider the use of SD composite monitoring, since this is a poor solution for an HD camera system. The simplest configuration we will consider here uses a CNU-700 for camera control, and an SDI router to provide the picture and waveform monitoring. This could be a dedicated 6x1 router, or could form a part of a larger router system. The system configuration will be exactly the same regardless of whether HD or SD monitoring is used; only the type of router and monitor will change. We will assume that a single picture monitor is used for camera control from both MSU and RCPs

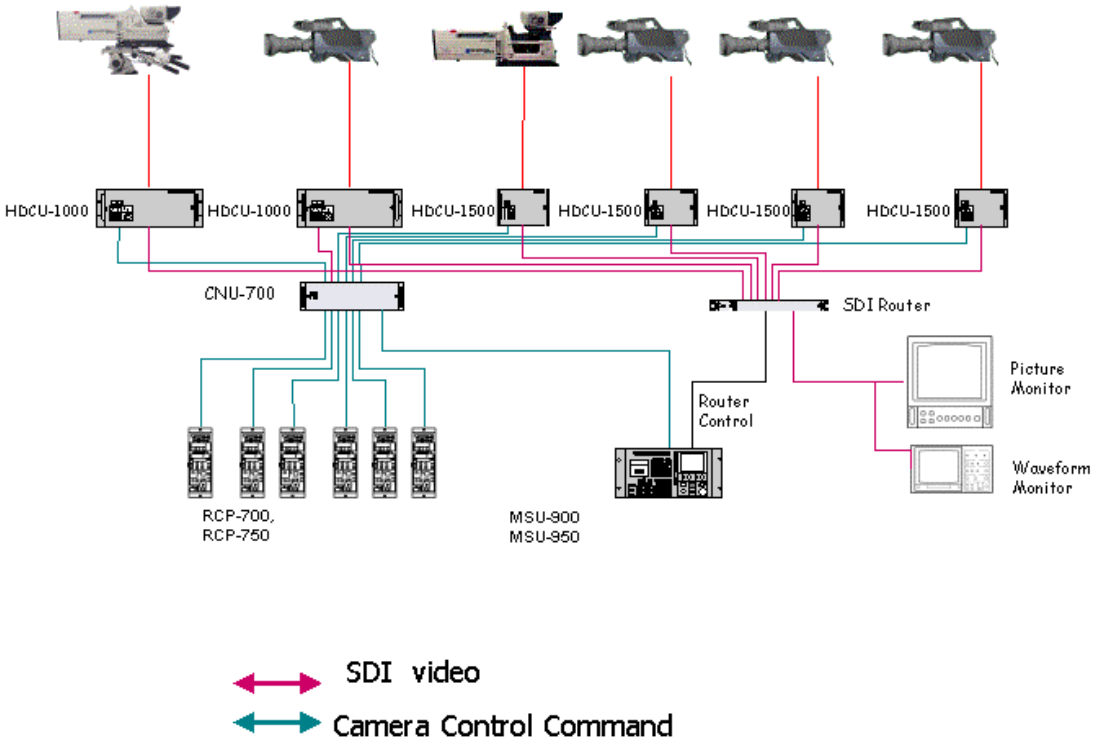


Figure 5 6 Camera System with CNU-700

For simplicity, the waveform monitor is fed with the same signal as the picture monitor. Many camera installations now are based on SDI. The controls on the waveform monitor can then be used to view the R/G/B signals and in most cases can also give a parade (sequential) display. Some models can also provide a simulated “composite” display, to help with colour balancing. For even more convenient operation, the WF Remote connector (15 pin D-Sub) on the HDCU rear panel may be connected to the remote control of some waveform monitors (eg Tektronix WFM-700), and this will allow R/G/B/Seq selection from the RCP.

Note that on the HDCU-1500, the single remote control connector must be configured for WF Remote operation, rather than MIC Gain control. Again, refer to the appropriate manual for full details.

Camera Selection

It is perfectly feasible to use a separate router control panel to choose the camera that is displayed on the Preview monitor. However, the user needs to choose the picture using this control panel, and then choose the same camera number on the MSU to be able to control that camera. There is a big risk that mistakes will be made! So, it is desirable to link the two together.

This can be achieved by using the I/O Port (50 pin D-sub) connector on the MSU, to implement the camera select function.

The MSU I/O port can act as an input or output, and can be configured in different ways. For this application, we need to select *Mode 1*, as follows

EXT I/O Port Assignment (Mode 1)

D sub Pin#	Name	In/Out	Function
	EXT I/O_44 - 47		**Mode Set**
14	EXT I/O_47	In	**H (Open)**
46	EXT I/O_46	In	**H (Open)**
30	EXT I/O_45	In	**H (Open)**
13	EXT I/O_44	In	**L (GND)**
			H H H L : Mode 1

Then we use the camera select outputs to control the external switcher

EXT I/O Port Assignment (Mode 1)

D sub Pin#	Name	In/Out	Function
	EXT I/O_20 - 27		**Camera Select 1 - 12**
41	EXT I/O_27	Out	CAM8 out (Low Active)
25	EXT I/O_26	Out	CAM7 out (Low Active)
8	EXT I/O_25	Out	CAM6 out (Low Active)
40	EXT I/O_24	Out	CAM5 out (Low Active)
24	EXT I/O_23	Out	CAM4 out (Low Active)
7	EXT I/O_22	Out	CAM3 out (Low Active)
39	EXT I/O_21	Out	CAM2 out (Low Active)
23	EXT I/O_20	Out	CAM1 out (Low Active)
	EXT I/O_40 - 43		
45	EXT I/O_43	Out	CAM12 out (Low Active)
29	EXT I/O_42	Out	CAM11 out (Low Active)
12	EXT I/O_41	Out	CAM10 out (Low Active)
44	EXT I/O_40	Out	CAM9 out (Low Active)

Clearly, the switcher will need to be able to handle these active-low control signals, so some hardware interface may be required, but this should not create a big problem.

Another alternative would be to retain the external router control panel, and use the MSU I/O ports as inputs, allowing the external panel to control the MSU camera selection.

12 Camera System with CNU-700

Increasing the number of cameras to 12 is very simple, requiring only the addition of a BKP-7930 System Expansion board to the CNU-700, to allow control of cameras 7-12. The SDI router will of course need to handle 12 inputs.

Adding RCP Preview Function

It is quite a common requirement to use the joystick override (the switch on the RCP which is activated by pressing down on the joystick) to select the appropriate camera on the preview monitor. In a basic system, with a single picture monitor used for both RCP and MSU control, this is also simple to achieve.

RCP-750 Preview Modes

The preview function of the RCP-750 has 3 different modes, selectable from the RCP menus.

Maintenance Menu > RCP Config > Preview

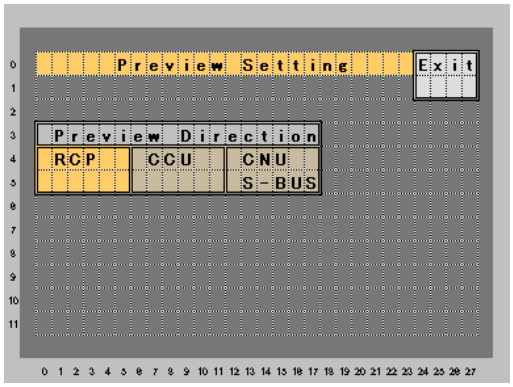


Figure 6. RCP Preview Menu

- RCP Preview output is available from the D-type connector on the RCP
- CCU Preview output is available from the CCU rear panel
- CNU (S-BUS) Preview is linked to MSU

For this application, the *CNU (S-BUS)* mode should be used.

This has the effect of linking the RCP preview to the camera selection of the MSU. In other words, if the joystick is pressed on camera 4, camera 4 will be selected on the MSU, and therefore on the monitoring outputs of the VCS.

No additional connections are required for this operation: command is passed from RCP to the MSU through the camera control interface. The CNU allows RCPs to be assigned to different cameras, and the preview function will follow the assignment correctly.

Some users would like momentary operation, with a single camera designated a master, which should be selected when no RCP is pressed. The other sources should only appear while the RCP is pressed. This is possible, with suitable configuration of the CNU. Again there are 3 modes:

- Momentary Preview picture only appears while preview is pressed then returns to whichever camera source was selected on the MSU (the “master” camera).
- Alternate Toggles preview picture between RCP camera and the camera selected on the MSU
- Alternate 1 Latching (another RCP preview must be pressed to change)

Note that the default camera will always be the last one selected from the MSU

Separate RCP and MSU monitoring

In some situations, where MSU and RCP are in different locations, it is necessary to provide separate picture and waveform monitoring facilities for the MSU and RCP operators. For example, a studio installation may have the MSU located in a central setup area, with the RCPs in the studio control room.

To achieve this, an additional router (or router layer) would be required, with separate control. The MSU camera select output would be connected to control one router (or router layer) as before, with the RCP preview switches controlling the second.

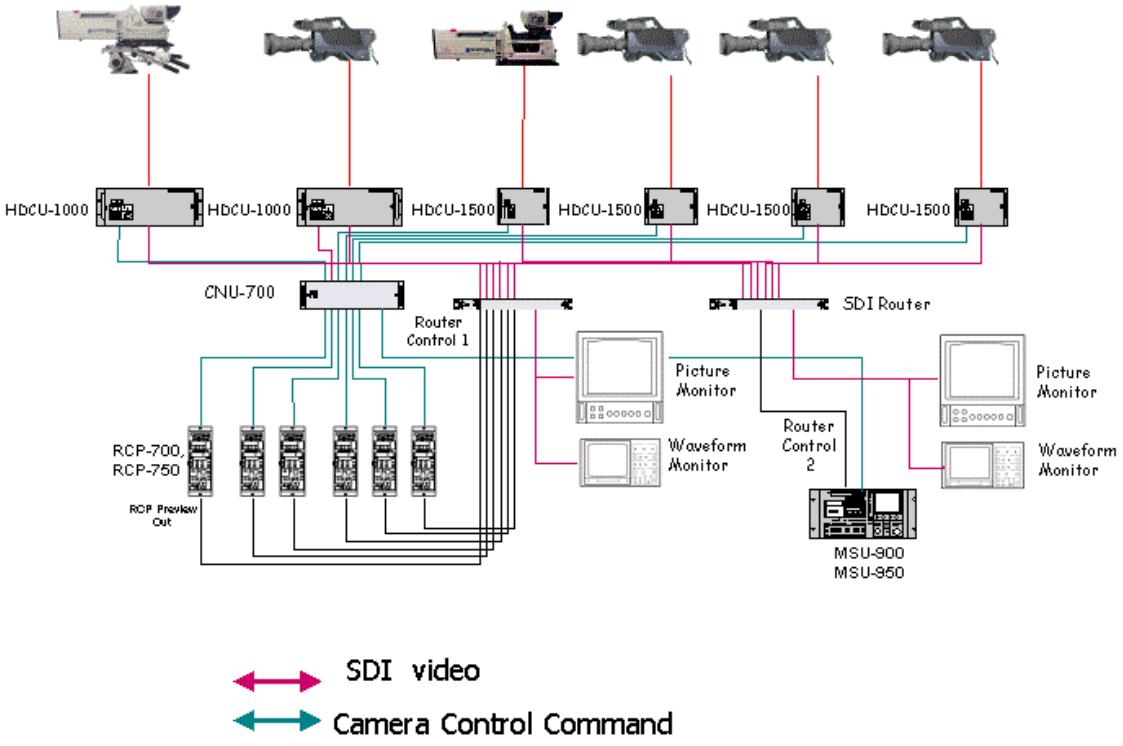


Figure 7. Independent MSU and RCP monitoring

Here we have shown two separate routers, but of course they could be combined into a single 6x2 router. If separate routers are used, 2 sets of outputs will be needed from each CCU.

This time, the RCPs must be configured to use the RCP mode, with the signal taken from the preview connector on the RCP. Although 6 cameras re shown here, once again the architecture is exactly the same for up to 12 cameras.

Systems with more than 12 cameras

The RCP preview system shown above can be expanded as required, simply by increasing the size of the router.

The MSU interface is more complicated however. The MSU has 12 camera select switches, plus an EXP (expand) switch. The EXP switch allows selection of cameras 13-24. The I/O port duplicates this arrangement, with 12 camera outputs, plus an expansion output. It would require dedicated hardware to combine these signals to control an external router.

CNU-700 Functionality

In the Sony camera control system, the CNU acts as a data distribution system, passing camera control from RCP or MSU to the appropriate camera. It is able to monitor the complete system, and this provides some extra functionality, which may not be immediately apparent.

- Camera numbering

  The CNU manages the camera number that is used by the system to uniquely identify each camera channel. This is determined by the physical cable connection of the CCU to CNU – whichever CCU is plugged into CCU connector "1" will be camera 1, etc

- Character output

  The CNU also has an SD composite character output, which can display various system information, such as camera setting data, RCP assignment, etc. It can be a useful tool to quickly see the overall situation of all the cameras in a system.

- Status monitoring and diagnostics

  Cameras and HDCUs include continuous real time diagnostics. Any faults are reported in various places depending on the nature of the fault (camera viewfinder, warning lights on the HDCU boards, MSU display, etc). The CNU can provide a convenient central reporting of any fault conditions, which are displayed on the CNU character output.

- RCP Assignment

  The CNU allows RCPs to be assigned to any camera, using an MSU menu.

- S-Bus Integration

  If required, the camera control system can be integrated with the studio/OB van router using the Sony S-Bus control protocol.

RCP Assignment

The Sony camera control system allows each RCP to be assigned to different cameras, as required. This makes a much more flexible control environment, but introduces a further complication to the monitoring system. With an assignable system, the router needs to know the camera number of the RCP joystick that has been pressed, in order to provide the correct picture to the monitor. With a CNU based system, the CNU manages the RCP control routing. However, the preview function is difficult to manage with this type of installation.

> There is one important limitation with RCP assignment; an RCP can only be assigned to a CCU connected to the same CNU. So for systems of more than 12 cameras, and therefore more than one CNU, the RCP assignment is very limited

To overcome this situation, the latest (V1.10) camera system software includes the capability to take the Preview signal from the CCU, rather than the RCP. Thus, the preview follows the assignment of the RCP. For example, if a particular RCP is assigned to camera 5, pressing the RCP preview will activate the preview output from CCU 5.

To use this facility, simply change the RCP Preview mode

RCP-750 Maintenance Menu > RCP Config > Preview set to *CCU mode*

The CCU connections are as follows:

Mic remote connector (15pin D-Sub)

Pin11 Logic level, Low Active (47k ohms pull up)

Unlike the MSU I/O port, which has open-collector outputs, the CCU preview connection is *5v logic level*. Care must be taken that the associated router is able to accept this input level.

S-Bus System Integration

An option board is available for the CNU-700 (BKP-7933) that provides an S-Bus control interface. S-Bus is a control interface used by the Sony routers, and this option board allows integration of the camera control system with the Sony router.

In theory this offers some useful functionality. With the S-Bus system, control and tally signals are interlocked so that they, along with video and audio signals, can be simultaneously switched from a central terminal. Each input/output source can be given a name, which can then be displayed on the source name display panel of a DVS-9000 Series or MVS-8000A Series Video Switcher. RCP assignment can be managed from the router control system, and the camera system control, tally and the monitoring will follow. Preview function can also be managed by this system.

However, in practice there are some system limitations which mean that this is really only applicable to simple systems, and in this case the S-Bus integration may be seen as an unnecessary complication.

Since the S-Bus control is integrated within the CNU, this configuration is not available with IP Control.

Two Studios with Shared Facilities

One situation that may arise is where two studios share resources. A number of cameras may be available, with CCUs in a common engineering area, and cameras physically moved from studio to studio, depending on the program requirements. The control areas need to be equipped to support the maximum number of cameras that will be required. So, for example, there might be a total of 8 cameras, shared between the two studios, with each control room equipped with 6 RCPs.

This can be achieved using the CNU system, by providing one CNU plus BKP-7930 expansion board, to connect the 12 RCPs. RCPs can be assigned to cameras as required.

Limitations

Camera numbers cannot be duplicated. So for example, cameras in one studio could be numbered 1 to 4, with cameras 5 to 8 in the second studio. This may not be acceptable to the end user.

The same type of configuration can be extended to more cameras. So for example, two CNUs could support up to 24 RCPs. But the previous RCP assignment limitation would apply, in that RCPs can only be assignable across one CNU, not between CNUs.

IP Camera Control

So far, we have assumed a conventional CNU-based control system. However, recent Sony camera products include an alternative control infrastructure based on IP (Ethernet) Control. In such a system, the CNU is not used; instead an Ethernet switch provides the data distribution system. The following diagrams show how such a switch can be incorporated.

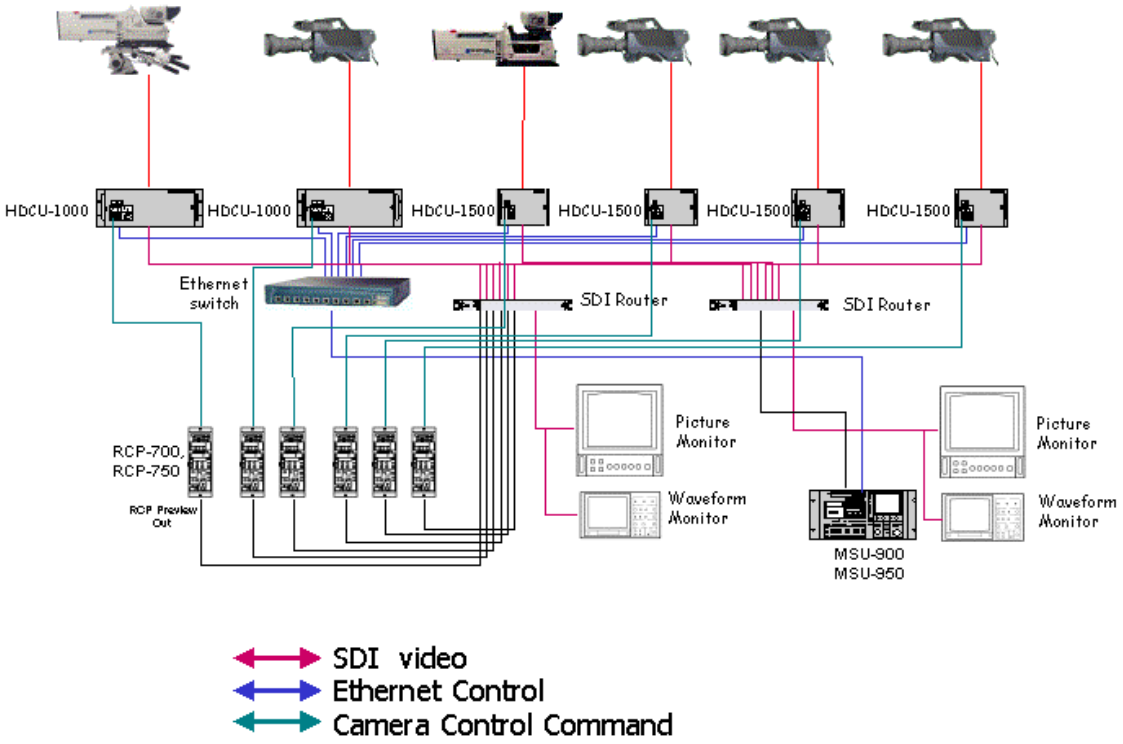


Figure 8. 6 Camera IP Control System

If this is compared with Fig. 6, it can be seen how the Ethernet switch has replaced the CNU. The rest of the system remains the same, with a single monitor for MSU and RCPs. RCP control is now taken directly to the CCU using normal 700 series control cables. Keeping the dedicated CCA cable connection provides a measure of safety, because in the event of failure of the LAN, RCP control is still available.

Advantages and limitations of the IP Control System

An IP-based control system can offer some clear advantages over one using a CNU.

- Lower system cost
- Simpler cabling
- Integration with station infrastructure
- More freedom in RCP assignment (no 12 camera limitation)

However, when choosing an IP system, users should take into account following factors

- No central status monitoring
- No S-Bus integration
- It is not possible to have a system with more RCPs than cameras. *

- Each CCU must be given unique IP address
- Manual Camera numbering

These two last points need further explanation. With a CNU-based system, it is the CNU and associatd cable interconnections that determine the system. CCUs, RCPs and cameras can be physically moved without influencing the configuration. In the case of IP control however, within any camera system each HDCU (and MSU) needs a unique IP address. This must be set using the HDCU menu and the board edge switches inside the HDCU front panel. Similarly, the camera number must be set using DIP switches on the board. While not difficult, both are rather inconvenient and time consuming. Furthermore, if a CCU is physically moved, control data will be sent to this unique address, regardless of it's location in the system. If cameras and CCUs or RCPs are regularly moved from studio to studio, OB van to OB van, or if equipment is regularly hired in from rental companies, this additional setup can be a significant problem.

* *See comments later regarding RCP-920*

RCP Assignment with IP Control

Just as with the CNU based system, RCP assignment is possible with the IP control system. The RCP is physically connected to one CCU, which provides the data pathway, and power for the RCP. However, the data from the RCP can be routed to any camera via the Ethernet connection.

Systems with 2 MSUs

There may be a requirement to use more than one MSU in a system. For example, some studios may locate the CCUs in a central equipment area (in the UK, often known as CAR – Central Apparatus Room). It might be convenient to have an MSU in this area, as well as another in the studio operational control room.

This can be achieved using either CNU or IP based systems, but if a CNU-700 is used, it must be fitted with a BKP-7930 expansion board, to provide the additional MSU connector. For IP control, some further IP configuration is required, with one MSU designated a master, the other as a slave unit. The monitoring possibilities for this type of system can be very complex, but using the I/O port of each MSU to control the picture routing should offer a good solution.

Note that RCP assignment is only possible from the "Master" MSU.

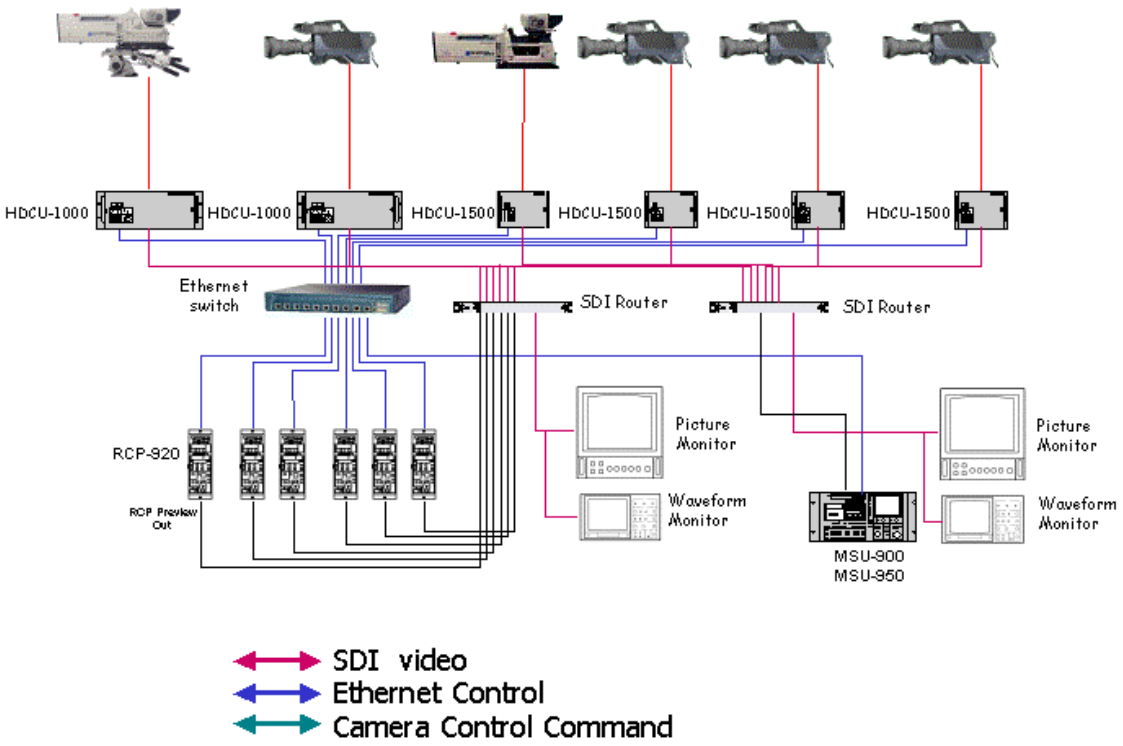
Multiple Monitoring Positions

There are some applications, especially for OB vans use, where several operator positions are provided, each with their own Picture monitor. So a 24-camera OB truck might have 4 operator positions, each operator controlling 6 cameras. This can be achieved by modifying the preview control configuration, and providing further routers (or, more likely, router layers). Preview control can be taken from the RCP, or from the CCU. Taking the preview output from the CCU allows RCPs to be assigned to different cameras as required.

A more complicated scenario is where the number of operator positions is dynamic. A simple sporting even might be covered by two operators, with control of 12 cameras each. But for a more complex, faster moving sport, might require 3, 4 or even more operators. This creates a difficult situation, since the RCP preview needs to control different monitors, depending on the program requirements. This type of environment will need a complex external router control system. It is hoped that future enhancements to the IP control system will provide better support for this type of configuration.

RCP Control over Ethernet

As well as the conventional (CCA-5-xx) control interface, the new RCP-920 and RCP-921 remote control panels also offer Ethernet connection capability. This does not directly affect their functionality, only the necessary cable connections. For convenience, the RCP-920/921 also support PoE (Power over Ethernet), enabling them to take their power directly from the Cat-5 cable, so long as a suitable PoE switch is used. The preview control can be taken directly from the RCP, as shown here, or from the HDCU.



Note that with this installation, it is possible to have more RCPs than there are CCUs, thus addressing one of the IP Control limitations previously mentioned.

Conclusion

The Sony camera control system is extremely flexible, and it is possible to configure control architecture to suit most operational requirements, from simple to the most complex. Integration with existing router systems is possible, and the recent introduction of an IP-based network infrastructure further strengthens the system possibilities.