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Remote Camera Server

User Manual

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1 General

1.1 Purpose and Scope

This document is the User Manual for the Remote Camera Server, a camera control system, developed for the European XFEL by Fiebig Astrotechnik, see www.astrocobtrol.de.

The User Manual provides information for setup, routine operation and maintenance. Its intended readership are mainly system engineers and IT administrators.

The specification of the communication protocol to operate the RCS from user workstations is provided in the Interface Control Document [ICD].

1.2 Referenced Documents

[NDS] Nuovo-5000EP_Datasheet.pdf, neousys-tech

[ICD] RCS API Specification, Fiebig Astrotechnik

[SDK] Andor SDK 3.13 Software Guide, Andor Technology

1.3 Abbreviations

ICD	Interface Control Document
IPC	Industrial PC
CL	Camera Link
NTP	Network Time Protocol
SDK	Software Development Kit
REST	Representational State Transfer (a web protocol)
RCS	Remote Camera Server

2 Introduction

The Remote Camera Server (RCS) provides a facility to connect a camera with a CameraLink (CL) interface to the network via Ethernet and thus enable its remote operation through a REST API. It is specifically designed for Andor Zyla 5.5 and 4.2 CL cameras.

The RCS system is based on an industrial grade, embedded PC (IPC), running under a dedicated Linux server operating system. The IPC carries a 10-tap CL frame grabber card, model Bitflow Karbon 4, to which the camera is physically connected. To the remote side, two GBit Ethernet adapters are provided. For information about mechanical, dimensions, power supply, etc. please refer to the [NDS].

The intended connectivity is to connect the primary network adapter to the intranet for monitoring & control, while the secondary network adapter may optionally be connected to the internet for software updates or network services like NTP.

The application software on the IPC directly controls the camera and provides a REST API for remote monitoring & control and image transfer. One or more clients can connect to the RCS via TCP/IP. See [ICD] for the REST protocol and image transfer protocol.

The concept is illustrated in the following diagram.

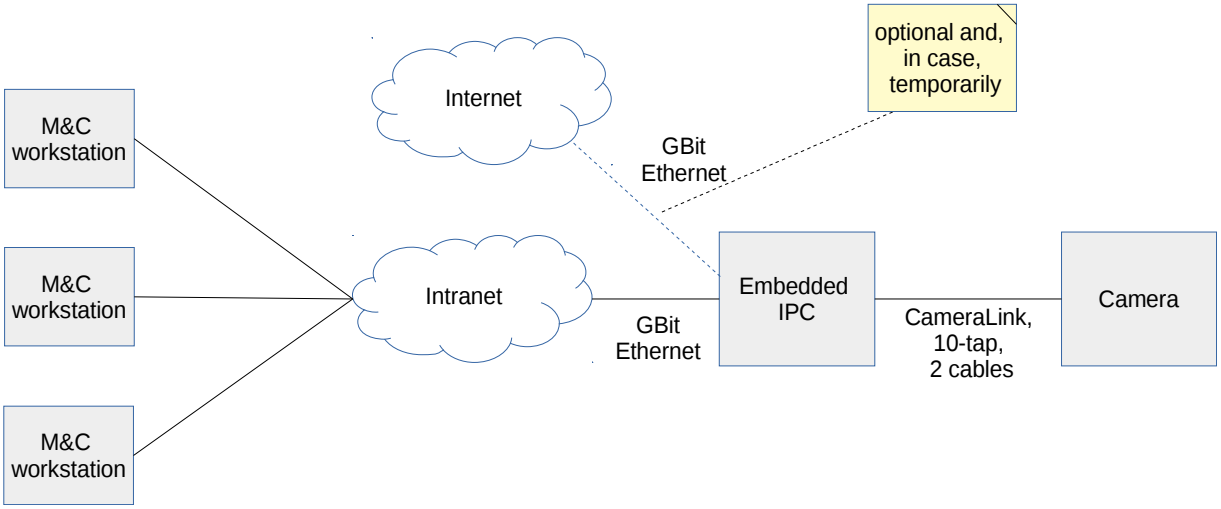

Figure 1: RCS environment

3 Startup

The following power-up sequence must be kept:

1. Camera
2. RCS

otherwise the driver's camera connection cannot be opened.

The system starts automatically when power is (re-)applied, e.g. after a power failure. In this case, there is no need to press the small power button on the front side. The power button needs only to be pressed when the system has been halted by command.

> *The system has been configured this way to support remote and automatic operation. It can alternatively be configured in BIOS such that the power button needs to be pressed to power on.*

On startup the system signals health by two short beeps. On any other beep pattern, please call support.

The software boots automatically on power up. The boot time is about 25 seconds. Latest after 30 seconds a client should be able to connect to the REST API port.

Further, wake on lan is enabled for the primary network adapter (see section "Network Configuration" below).

4 Operation

For operations the RCS provides two TCP server ports on its primary network adapter (see "Network Configuration" below):

- REST API port: 55555
- Image Stream port: 55556

These network ports are configurable in file ccapp/RestServer.ini (see section "Maintenance Login" below). However, be aware that on changing the port numbers the firewall setup needs to be modified accordingly, see section "Security" below.

A client must connects to the REST API port; up to 3 clients in parallel are supported. Clients monitor & command the camera by sending REST requests on the API connection. See [ICD] for the protocol specification.

4.1 Camera Simulator

Note: If the camera is not connected or not powered on RCS startup then the Andor driver still reports the availability of two SIMCAM devices, which are camera simulators. RCS would connect to the first SIMCAM.

The SIMCAMs do not provide all features of a real camera, but can be used for basic testing, e.g. if the SW works principally.

A client can check on startup whether connected to a real camera or a SIMCAM by examining the "model" field in a response to "get device ingo" request.

One the RCS has connected to the simulator only a power cycle can connect it again to the real camera, because it needs to be connected already on power up, otherwise the drivers would not detect it.

4.2 Camera Status

The camera status can be queried by a REST request. Note that it may take a minute or longer until the camera becomes available on a cold restart of both, camera and RCS. Until then, the device status will be reported "not connected", and transit to "idle" once the camera is available.

Status values are:

- not connected camera is not (yet) available
- idle camera is not acquiring
- active camera is acquiring
- error a device error occurred, camera not usable

Note that in acquisition mode "fixed", where the camera acquires the number oif images defined in setting "FrameCount", the state remains "active", even when the camera has delivered the requested number of images. To start a further acquisition the camera must explicitly be stopped at first.

In state "error" the only way to recover is usually a "restart" command, or a "reboot" if that does not succeed.

4.3 Image Stream

To get the acquired images a client connects to the image stream port; up to 3 clients in parallel are supported. This connection is one-way, images are transferred from RCS to client, no requests or responses are exchanged here.

If a client is not fast enough to consume the images, a certain amount is buffered on RCS. When the buffer gets full, further images to client are dropped. There are two buffers: an internal cyclic buffer, whose size can be configured in ZylaController.ini (see section "Maintenance Login" below) and a stream socket buffer whose size can be configured in RestServer.ini. Note that a Zyla 5.5 full frame image has between 5.5 MB and 22 MB, depending on the pixel encoding (see [SDK]).

4.4 Image Event Subscription

A client can subscribe to image notifications and receives a message with an image key for each newly acquired image on a specified client URL. A single image can then be queried with the according key. The image will be returned base 64 encoded in the response, i.e. on the API connection.

4.5 State Control

The system operational state can be controlled via REST API commands:

Command	Function
POST /Api/system/restart	Restarts the camera deviec backend. Can be used in case of problems with camera HW or if the backend hangs on the camera driver. The API stays operational during a restart.
POST /Api/system/reboot	Reboots the system immediately and without further notification
POST /Api/system/shutdown	Puts the system into halt state; equivalent to power off

From the shutdown state the RCS can be re-started by wake on LAN. Note that this is only supported on the primary network adapter.

5 Network Configuration

The system provides two GBit Ethernetadapters:

#	logical name	frontside socket	MAC	controller	role
1	enp0s31f6	right	78:d0:04:26:85:52	Intel I219-LM	primary
2	enp5s0	left	78:d0:04:26:85:53	Intel I210	secondary

Adapter 1 is intended to be used for operations. It is configured for DHCP, i.e. the user‘s network must provide a DHCP server.

Adapter 2 is not enabled, it is intended to be used only temporarily for system updates; to enable it uncomment the according lines in /etc/network/interfaces.

The NTP demon is installed and active. However, no NTP server is configured by default, because the user's network infrastructure is not known. In order to use NTP it is recommended to provide an NTP server/proxy on the intranet in order to avoid exposing the system to the internet, just for NTP access. The chosen NTP server needs to be configured in file /etc.ntp.conf.

Remote login via SSH is supported, as well as data transfer via SFTP or SCP, see section "Maintenance Login" below.

6 Security

The RCS system is designed and configured for operation in a closed intranet environment. It is not specified to be exposed to the open internet. The network security concept is based on this prerequisite.

The configuration of kernel and distribution is dedicated to the purpose in scope and sensitive to changes. Therefore, automatic Updates are disabled. If the user considers a security update to be necessary, be careful on updating the kernel, because there is a high risk that the Bitflow drivers would not be compatible and the system becomes inoperable.

Configure your DHCP server to provide no default gateway to RCS network adapters in order to prevent internet access.

In case, an internet access is necessary, e.g. for security updates, please do that by temporarily enabling the secondary network adapter enp5s0 in /etc/network/interfaces and adding according firewall rules.

The ufw firewall is configured to allow incoming connections only on the following ports:

TCP 22: SSH / SFTP / SCPP

UDP 123: NTP

TCP 55555: REST API

TCP 55556: image stream

Note: on changing the application ports (in ccapp configuration files) the firewall rules need to be adapted accordingly.

BIOS and operator account are secured by passwords, see section Maintenance Login below. Remote login requires SSH (secure shell), data transfer requires SFTP (FTP via SSH) or SCP (secure copy).

The SSD is not encrypted, due to its operational scenario to run 24/7 and in order to avoid the need need to enter a password on every boot.

7 Maintenance

7.1 RCS Login

For maintenance purposes it may be necessary to log-in to the RCS. Note that the system server has no graphical desktop installed and therefore there is only a shell login via SSH: user ops (short for "operations"), initial password Xfel12## (please change it as soon as possible).

Login to the console is also possible by connecting a monitor via DVI port and a USB keyboard to the RCS.

There are two software components available i the ops account:

~ops/

andor-sdk3.13/	the Andor SDK 3.13
ccapp/	the camera control application

In directory ccapp there are the located:

RestServer, ZylaControll, LogServer	executables
*.ini	configuration files (1)
runapp.sh	script to start the applications (2)
stopapp.sh	script to stop application gracefully
killapp.sh	script to kill application and tidy up resources
...	more scripts for internal usage
listdevices	test script to see if the camera is basically detected

(1) Configuration files may be modified to adapt the system to the operational use case, e.g. set buffer sizes. Changes will become effective on next system start.

(2) These scripts can be used to manually start and stop the application. Caution: the runapp script is called on booting to start the application. Any modification may affect auto-start of the system.

7.2 BIOS Login

Modification of BIOS settings also needs to log-in on the console. The BIOS screen is entered by pressing [F2] after the boot double beep. The BIOS password is the same as the ops user password.

7.3 Log Files

The camera control software maintains dedicated log files. On each start of the application a new log file is created with name log_<date>T<time>.txt in the /var/log directory.

There is an automatic size limitation for log files. Any file is limited to 100 MB in size, and the summary volume of all log files is limited to 1 GB. When the log file size gets exceeded, an new log file is started. When the volume size gets exceeded, the oldest log file will be deleted automatically.

For maintenance & support please be prepared to download the latest log file, or one in which the problem should be evident and send it to Fiebig Astrotechnik for diagnosis. Log files can be downloaded from the RCS via SFTP (FTP through SSH).

7.4 Temperature Monitoring

The temperature of the camera sensor can be queried by a REST request, see [ICD] and [SDK].

The CPU temperature can be queried from the shell by command `sensors`.

7.5 Fan

The system includes a small fan to cool the CL card. This is necessary to avoid over-temperature in case of full power camera operation. Please mount the IPC such that the Fan outlet is not obstructed.

Since it is a moving part, it has a relatively small MTBF compared to other system components. The fan emits an audible sound, which is the only sound to be heard from the RCS. Please check from time to time that it is still working and call support, if not.

[end of document]