Notice: PRE-RELEASE for comments

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# Contents

Overview ................................................................................................................................. 2

Getting computer ready ........................................................................................................... 2
  Using Terminal to Configure ................................................................................................. 3
    Configuring Computer for Multiple Cards ........................................................................... 4
  Using Network Dialog to Configure ...................................................................................... 5
  DATE Configuration ............................................................................................................... 6

DATE ........................................................................................................................................ 10
  Start Data Taking .................................................................................................................. 10
  Stop Data Taking ................................................................................................................... 13
  Using Data ............................................................................................................................. 14

Common Errors ......................................................................................................................... 15

Appendix – Text Files ............................................................................................................... 17
Overview

The slow-control of the SRS system is carried out using UDP over IP protocol on the available Gigabit Ethernet port of the FEC cards. When using a SRU unit to bundle many FEC cards together, the SRU will act as a packet switch, forwarding the slow-control frames to the FEC cards via the DTC links.

The components of the slow-control system are: the slow-control PC (SC-PC), the network (point-to-point connection/network switch/SRU), the FEC card and the peripherals that need to be configured. Peripherals can be either virtual devices (usually residing in the FEC firmware) or real hardware objects which are connected to the FEC FPGA, located on the FEC card, the A/B/C-Module Card or on the front-end hybrids. Generally the real peripherals have a logic interface located in the FEC firmware, which translates the slow-control commands in the format that the external device understands. The slow control protocol assures that, from the user point of view, the real or virtual attribute of a peripheral is transparent.

Getting computer ready

After connection with SRS system using SPF (see below), it is needed to configure computer to establish connection using UDP.

You can configure network cards of a Linux computer:
1. Using terminal

In the second option, you should always save the changes before apply. To apply for changes, you need to Deactivate and Activate the card again. First option saves and applies the changes automatically as you execute the commands. Below, you find the former method on the left and the latter method on the right.

The changes on Ethernet require super user privileges. To enable super user type: su on the terminal. You will be asked to enter the password for user.

Using Terminal to Configure

Enter super user mode and type /sbin/ifconfig to see available devices. Note the card name you would like to use for connection. If the “UP” text inside brown box is not written on the device details, you will need to activate device by typing: /sbin/ifconfig ethernet_device_name up.

It is needed to assign an IP at the same subnet such as 10.0.0.3 to establish a connection. To assign an IP type /sbin/ifconfig ethernet_device_name IP_address_to_be_used. For the picture above, the command should be: /sbin/ifconfig eth2 10.0.0.3.

To check if your changes are applied, you can type: sbin/ifconfig ethernet_device_name anytime. Please see image below:
Configuring Computer for Multiple Cards

If you have more than one card, to connect your computer with multiple cards using one Ethernet and switch, plug the RJ45 connectors of all cards and computer in switch.

The cards need different IP addresses to send data at the same time. To enable this, it is needed to create aliases for each card. To create aliases, enter super user mode and type the following: `/sbin/ifconfig ethernet_device_name:X IP_address_for_new_alias netmask 255.255.255.0`.

The :X part is where you create alias for your Ethernet. For instance, typing `/sbin/ifconfig eth2:0 10.0.1.3 netmask 255.255.255.0` lets a second UDP connect the second card (The remote card must have 10.0.1.x IP address to be used (ping 10.0.1.x to check) and UDP setting must be checked using `editDb`). After command execution, type `/sbin/ifconfig` to see changes. To change IP addresses of cards see “Connection, Programming and Testing FEC and ADC Cards” manual.
For 3\textsuperscript{rd} card on SRS we would type: \texttt{/sbin/ifconfig eth2:1 10.0.2.3 netmask 255.255.255.0}.

\begin{verbatim}
[srsdaqpc] /home/daqSRS/slow_control > ping 10.0.1.2
PING 10.0.1.2 (10.0.1.2) 56(84) bytes of data.
64 bytes from 10.0.1.2: icmp_seq=1 ttl=64 time=0.721 ms
64 bytes from 10.0.1.2: icmp_seq=2 ttl=64 time=0.047 ms
64 bytes from 10.0.1.2: icmp_seq=3 ttl=64 time=0.052 ms
64 bytes from 10.0.1.2: icmp_seq=4 ttl=64 time=0.047 ms
64 bytes from 10.0.1.2: icmp_seq=5 ttl=64 time=0.050 ms
64 bytes from 10.0.1.2: icmp_seq=6 ttl=64 time=0.051 ms
64 bytes from 10.0.1.2: icmp_seq=7 ttl=64 time=0.052 ms
--- 10.0.1.2 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6000ms
rtt min/avg/max/mdev = 0.047/0.145/0.721/0.235 ms
\end{verbatim}

(Above, ping result for second card connectivity. Ctrl+C to stop)

The created aliases are removed at each start, if you would like to keep aliases at each reboot type \texttt{gedit /etc/rc.d/rc.local} in super user mode and copy-paste the following text to the end of the file (Do not forget to change the Ethernet name you are using for connection):

\begin{verbatim}
#setting IP alias interfaces
echo "Setting IP Aliases..."
/sbin/ifconfig eth2:0 10.0.1.3 netmask 255.255.255.0
#/sbin/ifconfig eth2:1 10.0.2.3 netmask 255.255.255.0 # uncomment for third card.
\end{verbatim}

To remove aliases before restart type \texttt{/sbin/ifconfig eth2:X down}. Like all IP operations, this operation also needs super user privileges.

To continue the setup with multiple cards see the \url{Date Configuration}.

**Using Network Dialog to Configure**

Follow \texttt{System -> Administrator -> Network} to open Ethernet Device dialog. Double click on the device you would like to configure and choose “Statically set IP addresses” to enter the IP you would like to use to establish connection. Press Ctrl+S (or File -> Save) to save changes. Click on Deactivate and Activate again to apply for changes.

To make sure you applied for changes you can use terminal and type: \texttt{sbin/ifconfig eth2} (no SU is needed).
Preferably, the MTU (Maximum Transmission Unit) can be increased to allow the packet to be sent in fewer pieces. Type `sbin/ifconfig ethernet_device_name mtu desired_number` to change the MTU. For dialog, check the “Set MTU to” box and edit textbox with the desired number. After change, save changes and restart the device.

**DATE Configuration**

If it is the first time of using DATE or any error (in red) is shown on the log or the data is not taken, the configuration must be checked. Typing `editDb` (case sensitive) on the terminal will pop the database editor up to make changes.

```
[srsdaqpc] /home > editDb
[srsdaqpc] /home >
```

Choose **Equipment** tab and click one of the active equipments. In the following picture `udp 1` is active and chosen.

![DATE Configuration Database Editor - Host: srsdaqpc DB: DATE_CONFIG](image)

Check if `ipHost` (the computer) and `ipBoard` (destination) IPs are correct.

Please make sure that the first two parts of IP address of PC and card are the same (10.0) to use default configuration files without modification. You can also only change the third part of IP address. The last part must be 3 for PC and 2 for card. Some examples:

<table>
<thead>
<tr>
<th></th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card</td>
<td>10.0.0.2</td>
<td>10.0.0.2</td>
</tr>
<tr>
<td></td>
<td>10.0.5.2</td>
<td>10.0.0.2</td>
</tr>
<tr>
<td></td>
<td>10.0.10.2</td>
<td>10.1.0.2</td>
</tr>
<tr>
<td></td>
<td>10.0.3.2</td>
<td>10.0.3.2</td>
</tr>
</tbody>
</table>

**Green:** fixed. **Orange:** Must match with card and PC IP.

To check your Ethernet IP that is used to connect the card use:
The picture shows that the computer has two active network cards. The Ethernet that is used to connect card has the IP "10.0.0.3" and is named eth2.

If you have other cards in SRS, you should enable the other UDPs according to your number of cards to enable connection and as it told before, you have to create alias for multiple connections. Please see the image below for second UDP settings.
Please note that in the image, both *ipHost* and *ipBoard* addresses are changed. To configure one Ethernet for multiple cards please read Configuring Computer for Multiple Cards section.

It is possible to add more equipment by using *New* button. Choose *RorcDateUDP* to add new UDP connection equipment and click *Create*.

Please choose an equipment type:

- RorcDataUDP

Create

Enter an *EQUIPMENT_NAME* and an *EqId*. Change IP settings according to your card and click *Add*. Your new equipment will be listed on the left panel:

![Equipment list](image)

The newly added equipment will not be active after creation. You should activate before use.

Close the terminal and go to *Files* tab of database editor. Click on SOR.commands{} and *Edit file*. 
After edit file command the following editor will be shown.

The parameters (0 1) indicate the “first card” (0) and the “last card+1” (1) to connect. The picture above explains that only one card is to be connected. For example, typing 0 3 here would result in the connections to FEC cards “0 1 2.” The IPs of these cards should be configured 10.0.0.2, 10.0.1.2 and 10.0.2.2, respectively. If the first card you connect does not have 10.0.0.2 IP address, you should also change the first parameter according to your card IP (e.g. “2 3” for having one card with IP 10.0.2.2).
If the file is changed, click *Commit* to save changes and enable other tabs. If you want to undo, click *Rollback* to discard changes.

Type `[/home/daqRS/slow_control > gedit start0.txt]` to start text editor with `start0.txt`.

Check the IP address at the first line. It must match the IP address that your destination card has.

See [Appendix – Text Files](#) for description of file.

## DATE

The software framework of the ALICE DAQ is called DATE (ALICE Data Acquisition and Test Environment).

Connect the card to Ethernet port of computer and ping using terminal to check if the card is found by computer. If the IP address of card is 10.0.0.2 (default) use:

```
ping 10.0.0.2
```

If you get any replies, the connection will be possible. If not:

- Check cable
- Check device is on (the lights inside SRS must be on)
- Check your Ethernet is configured. See above.
- Check Ethernet is active (You can activate Ethernet using System > Administrator > Network and choosing the ethernet you would like to use then clicking *Activate.*)

### Start Data Taking
If the trigger is plugged in and settings are okay, starting data taking is possible by following 5 buttons above and later using the terminal to write:

(Note that the current directory is `home/daqSRS/slow_control` and `slow_control` has no file extension.)

If you have multiple cards, you should start them at the same time to prevent errors. To start all cards type: `./slow_control startAll.txt`
After step 1, clicking Define in Disconnected Configuration shows the following dialog that helps select detectors:

Clicking on DETECTOR will show the available detectors shown in the picture below:

After step 2, another window should show the current status of LDC (Local Data Concentrator). On the left, LDC is running (the picture is taken after step 4):

Current Trigger Rate should increase on LDC Status Display window (see below). See using data. If you do not see any changes, make sure is trigger plugged in and see Date Configuration.
**Stop Data Taking**

To stop data taking:

If you have one card, first, type the following:

```
[srsdaqpc] /home/daqRS/slow_control > ./slow_control startTest.txt
[srsdaqpc] /home/daqRS/slow_control > ./slow_control stopTest.txt
[srsdaqpc] /home/daqRS/slow_control > .
```

at the same directory.

If you have multiple cards type: `./slow_control stopAll.txt`

The LDC status display should show that current trigger rate is decreasing:
Then click **Stop** on main window of DATE. It is possible to leave trigger plugged in.

**Using Data**

The taken data can be seen on-the-fly or can be written to file. To see available commands with dump data just type:

```
[srsdaqpc] /home/daqSRS > eventDump @aloneldc: -h
```

Usage:
```
$date$/monitoring/Linux/eventDump [-b][-c][-s][-a][-i][-N #][-f "filename"] [-n number][-t "table"][-T "table"] [-# [b|t|n|e]number] dataSource
```

- **-b**: brief output (skip long events)
- **-s**: silent
- **-c**: check event data
- **-a**: use static data buffer
- **-i**: interactive
- **-N**: use the given timeout (Network only)
- **-f**: write selected events to raw file
- **-n**: maximum number of events to process
- **-t**: monitoring table to be used (e.g. -t "ALL yes SOB no")
- **-T**: as "-t" but the table is extended
  (e.g. -T "All yes 1 4 Phy y 1 5|2 SOB NO 1&5 3")
- **-e**: dump content of equipment header
- **-D**: dump content of common data header (implies "-e")
- **-#:** wait for given event
  (b:bunchCrossing o:orbit e:orbit-bunchCrossing <nothing> :serial number)
The *aloneldc* on the command parameter is the name of the LDC that is also shown on the *LDC Status display* window.

Type `eventDump @aloneldc: | less` to dump all events on the terminal (Use Ctrl+C to stop). Below, find some commands to use the data:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>`eventDump @aloneldc:</td>
<td>less`</td>
</tr>
<tr>
<td><code>eventDump @aloneldc: -f /tmp/data -n 1000</code></td>
<td>Save first 1000(^{th}) data after executing the command into binary file named <em>data</em> in folder /tmp/</td>
</tr>
<tr>
<td><code>eventDump /tmp/data &gt; /tmp/data_ascii</code></td>
<td>Convert data binary file into data_ascii format to make readable.</td>
</tr>
</tbody>
</table>

**Common Errors**

The picture above shows that the *destination is unreachable*. It may be turned off or configured incorrectly.

If you are having problems with getting data or the log has red entries, the DATE might encounter error(s).
The easiest way to solve connection problem errors is to check the configuration of your Ethernet and DATE configuration.

If you can contact the SRS, but cannot receive any data, the port you are trying to connect can be blocked. Try to disable firewall by typing: `/etc/init.d/iptables stop`. This will allow all ports to be reachable (You need super user privileges to disable firewall). The firewall will be enabled automatically after rebooting the system.

```
[srsdaqpc] / > /etc/init.d/iptables stop
Unloading iptables modules: [FAILED]
rm: cannot remove `/var/lock/subsys/iptables': Permission denied
[srsdaqpc] / > su
Password:
[srsdaqpc] / > /etc/init.d/iptables stop
Flushing firewall rules: [ OK ]
Setting chains to policy ACCEPT: filter [ OK ]
Unloading iptables modules: [ OK ]
```

You can use Wireshark to check if packets are being sent by your computer and/or the card. To run Wireshark type `wireshark` on the terminal. Wireshark needs su password to run. If you are using a switch, it is also possible to understand that data taking is started via blinking switch leds.

The details about errors can be seen by typing `infoBrowser`. InfoBrowser also logs all messages including errors. By default, it is enabled. If not, click `Online` to activate. Using `infoBrowser`, you can also export messages and make searches for previous messages. Making it offline enables to filter the messages by filling the fields at the bottom of the window.

![infoBrowser Main Window](image)
If you receive “not responding error” like the picture below you should check your network settings and UDP configuration in editDb. You should also check SOR.Commands file to make sure that available cards in SRS are between parameter range.

(Not responding error)

If you are getting Trigger Lost error, you might not have been started the cards at the same time. Try to stop data taking using StopAll.txt. On the main window of DATE, click Start Processes and start the data taking again then use startAll.txt file.

If you are getting “LOCKEDBY” error, try to restart DATE again.

If you are getting “No data generating equipment” error, you do not have active equipments. Activate using editDb and Equipments tab.

Appendix – Text Files

In this chapter, the structure of a text file will be explained briefly.

The following text file has SCS request format and used to start first card:

DATE for SRS Volkan Gezer – volkangezer@gmail.com
Line 1: Destination IP address
Line 2: Port number to be connected
The following lines after 2\textsuperscript{nd} have 32-bit length.

The \textit{Request ID} is used to match the request with reply.

\textit{SubAddress} has to be written if the port requires this address. See below.

For \textit{Cmd Field 1} and 2 see the picture below:
For instance, to write pairs it is needed to write AAAA for 31...16 and FFFF for 15...0 (since \textit{CMD\textsubscript{LENGTH}} is not implemented).

Since \textit{CMD info} is not used for write pair command, it is possible to write 00000000 (8xzeros) for \textit{Cmd field 2}.

Since the \textit{write pairs} command is followed by address & data pairs, you could give registers addresses and values to change their values.

The port we are currently using in DATE is 6039.

<table>
<thead>
<tr>
<th>Name</th>
<th>Port (hex)</th>
<th>Port (dec)</th>
<th>Use</th>
<th>I/F type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APVAPP_PORT</td>
<td>1797</td>
<td>6039</td>
<td>runtime</td>
<td>reg</td>
<td>APV Application registers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>APV trigger sequencer and event builder</td>
</tr>
</tbody>
</table>

The following table shows the register addresses after connection to 6039 port:

\textbf{APV Application Registers (port 6039)}

Subaddress: not used (anything)
reading from its memory for each trigger

<table>
<thead>
<tr>
<th>BCLK_FREQ</th>
<th>02</th>
<th>2</th>
<th>40000 (0x9C40)</th>
<th>Period of the trigger sequencer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCLK_TRGDELAY</td>
<td>03</td>
<td>2</td>
<td>256 (0x100)</td>
<td>Delay between the external/internal trigger and the APV trigger</td>
</tr>
<tr>
<td>BCLK_TPDELAY</td>
<td>04</td>
<td>2</td>
<td>128 (0x80)</td>
<td>Delay between the external/internal trigger and the APV test-pulse</td>
</tr>
<tr>
<td>BCLK_ROSYNC</td>
<td>05</td>
<td>2</td>
<td>300 (0x12C)</td>
<td>Delay between the external/internal trigger and the start of data recording</td>
</tr>
<tr>
<td>EVBLD_CHMASK</td>
<td>08</td>
<td>2</td>
<td>0xFFFF</td>
<td>Channel mask for the data transmission. Even bits are masters and odd bits are slaves</td>
</tr>
<tr>
<td>EVBLD_DATALENGTH</td>
<td>09</td>
<td>2</td>
<td>3000 (0x0BB8)</td>
<td>Length of the data capture window</td>
</tr>
<tr>
<td>EVBLD_MODE</td>
<td>0A</td>
<td>1</td>
<td>0</td>
<td>Event Builder mode register. Bit 0 = use 32-bit framecounter Bit 1 = use 24-bit timestamp</td>
</tr>
<tr>
<td>EVBLD_EVENTINFOTYPE</td>
<td>0B</td>
<td>1</td>
<td>0</td>
<td>Controls the data format.</td>
</tr>
<tr>
<td>EVBLD_EVENTINFODATA</td>
<td>0C</td>
<td>4</td>
<td>0xAABB0BB8</td>
<td>Data for the optional info-filed in the data format</td>
</tr>
<tr>
<td>RO_ENABLE</td>
<td>0F</td>
<td>0</td>
<td></td>
<td>Readout Enable register (bit 0). Triggers are accepted for acquisition when this bit is 1</td>
</tr>
<tr>
<td>RST_REG</td>
<td></td>
<td></td>
<td>FFFFFFFF</td>
<td>Reset register. Bit 0 = APV sync reset</td>
</tr>
</tbody>
</table>

The `start0.txt` file and descriptions as text (starting from the first line):

1. Destination IP: 10.0.0.2
2. Connection port: 6039 (decimal)
3. Request ID: 10000000000000000000000000000000 (2^31)
4. Subaddress: 0 (anything for this port)
5. Command: Write pairs: aa-aa-ffff (cmd-cmd type-cmd length)
6. Cmd info: 0 (not used for this command)
7. Address of register: 0F (RO_ENABLE, See table above)
8. Value of register: 1 (Triggers are accepted for acquisition)

See below for all available port connections:

<table>
<thead>
<tr>
<th>Name</th>
<th>Port (hex)</th>
<th>Port (dec)</th>
<th>Use</th>
<th>I/F type</th>
<th>Description</th>
<th>User level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS_PORT</td>
<td>1777</td>
<td>6007</td>
<td>runtime</td>
<td>reg</td>
<td>System registers. Dynamic control of IP</td>
<td>expert</td>
</tr>
<tr>
<td>Source: SRS Slow Control Manual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEC_BI2C_PORT</td>
<td>1787</td>
<td>6023</td>
<td>debug setup</td>
<td>I2C</td>
<td>Access to the FEC I2C line B. Used to program the on-board EEPROM</td>
<td>expert</td>
</tr>
<tr>
<td>APVAPP_PORT</td>
<td>1797</td>
<td>6039</td>
<td>runtime</td>
<td>reg</td>
<td>APV Application registers. APV trigger sequencer and event builder</td>
<td>user</td>
</tr>
<tr>
<td>APV_PORT</td>
<td>1877</td>
<td>6263</td>
<td>runtime</td>
<td>I2C</td>
<td>Access to the I2C registers of the APV chip</td>
<td>user</td>
</tr>
<tr>
<td>ADCCARD_PORT</td>
<td>1977</td>
<td>6519</td>
<td>runtime</td>
<td>I2C</td>
<td>I2C registers of the ADC CCARD.</td>
<td>user</td>
</tr>
</tbody>
</table>