

Initial design of a GNU radio interface for the new version of the Jicamarca Acquisition Radar System (JARS 2.0)

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Abstract

In this poster the initial design of a new software interface to control the novel ethernet based radar acquisition system JARS 2.0 of the Jicamarca Radio Observatory is presented. This interface will be implemented using the open-source software development toolkit GNU Radio; which besides controlling the JARS 2.0, it will obtain the acquired data for its further processing.

The aim of the project, although in its development stage, will be to use the benefits of the GNU Radio to process, plot and even save the data in a standard way.

Introduction

The Jicamarca Radio Observatory (JRO) has one of the most powerful incoherent scattering radar to study the equatorial ionosphere. The specific location of the Jicamarca Radio Observatory made it unique as the magnetic field of the earth pass through it and the pointing direction is vertical to the ionosphere.

One of the acquisition systems developed at Jicamarca is called JARS (Jicamarca Acquisition Radar System), an eight-channel digital reception system that can collect data at a rate of 1 MHz per channel. This system is in charge of acquiring the modulated signal, digitize it and send it to the acquisition computer through a PCI (Peripheral Component Interconnect) interface.

Currently, a new version of JARS is being developed: JARS 2.0. This acquisition system uses an ethernet interface to communicate with the computer and it uses a similar software than the previous version to the acquisition control. This software is named JROAcquisition, and is coded using C and C++ language. The different libraries, dependences and data types used in JROAcquisition make the compilation process a tedious task.

We chose GNU Radio to design and implement an interface to manage JARS 2.0 because we will be able to simulate the different configuration of the radar and see which is the best to detect any kind of specific phenomenon before operate the radar in high power.

JARS 2.0

The hardware of JARS 2.0 is composed by four principal parts: the external clock board, the acquisition boards, the bus board and the control board. A simple diagram is shown in figure 1.

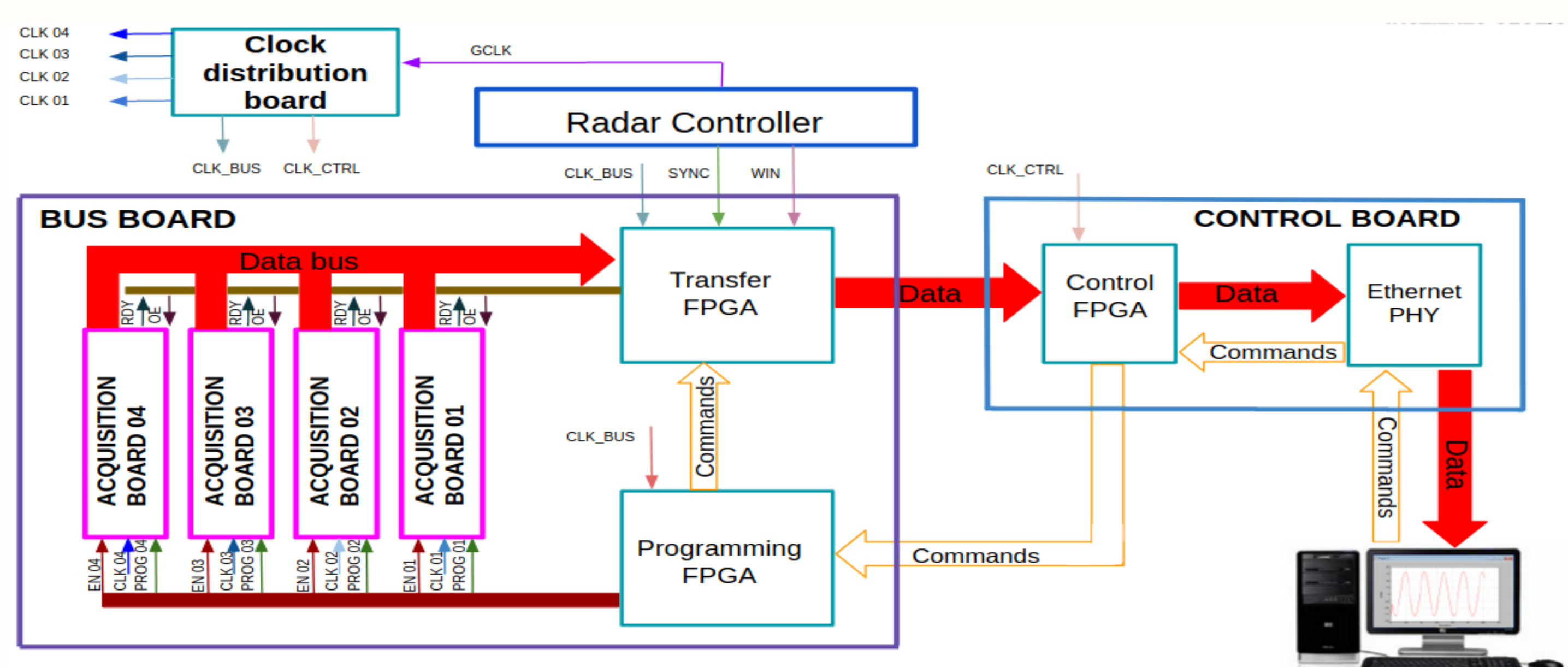


Figure 1: Hardware parts of JARS 2.0

We will obtain the acquired data through a gigabit ethernet, which make possible to obtain data at the rate of 1 Gbps, improving the result graphics in the data analysis.

Proposed design of the GNU Radio Interface

General idea

The proposed GNU Radio design interface is shown in the figure 2.

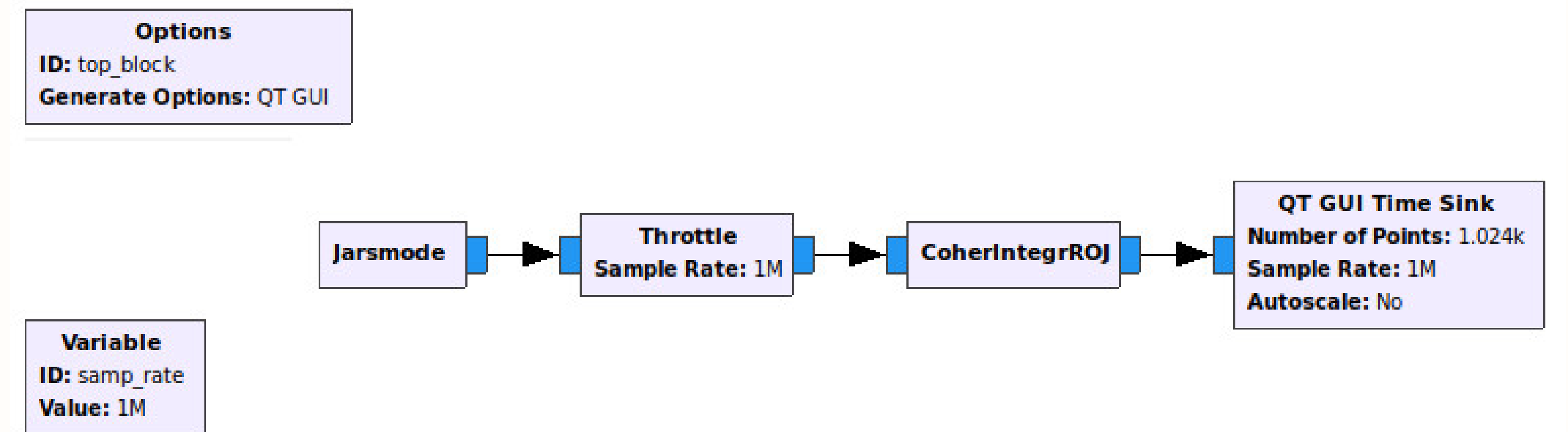


Figure 2: Jarsmode interface in a GNU Radio-companion flow graph

This interface will be coded inside the first block named: Jarsmode. This first block will give us the data acquired for the JARS 2.0 as a data type `std::complex`, which it means a sampled quadrature signal. The second block is the Throttle block. This is a core block which establish the rate at which the samples will pass through the blocks in the flow graph. The third block is named CoherIntegrRoj. This block will do a coherent integration of the obtained samples. This block will be a new and personalized out-of-tree block, which means it is not part of the core blocks which come with GNU Radio. The last block is the QT GUI Time sink. This is a core block which show us the sampled quadrature signal, after be processed, in time.

We also have the option to save the acquired data in hdf5 format because of GNU Radio has blocks which can do this for us, as Digital RF sink.

Jarsmode interface

This block will be designed as an Out-of-tree block of GNU Radio, which means it will be a new and personalized block out of the general blocks given for the GNU Radio core. This interface will configure the JARS 2.0 with the help of a metadata file with extension `.racp`, which contains all the parameters needed for the configuration of the radar, as: IPP(inter pulse period), NSA (numbers of samples), DH(height resolution), etc. This interface will follow the structure of an object oriented programming (OPP). The different stages that conform this interface will be shown in the next flow diagram.

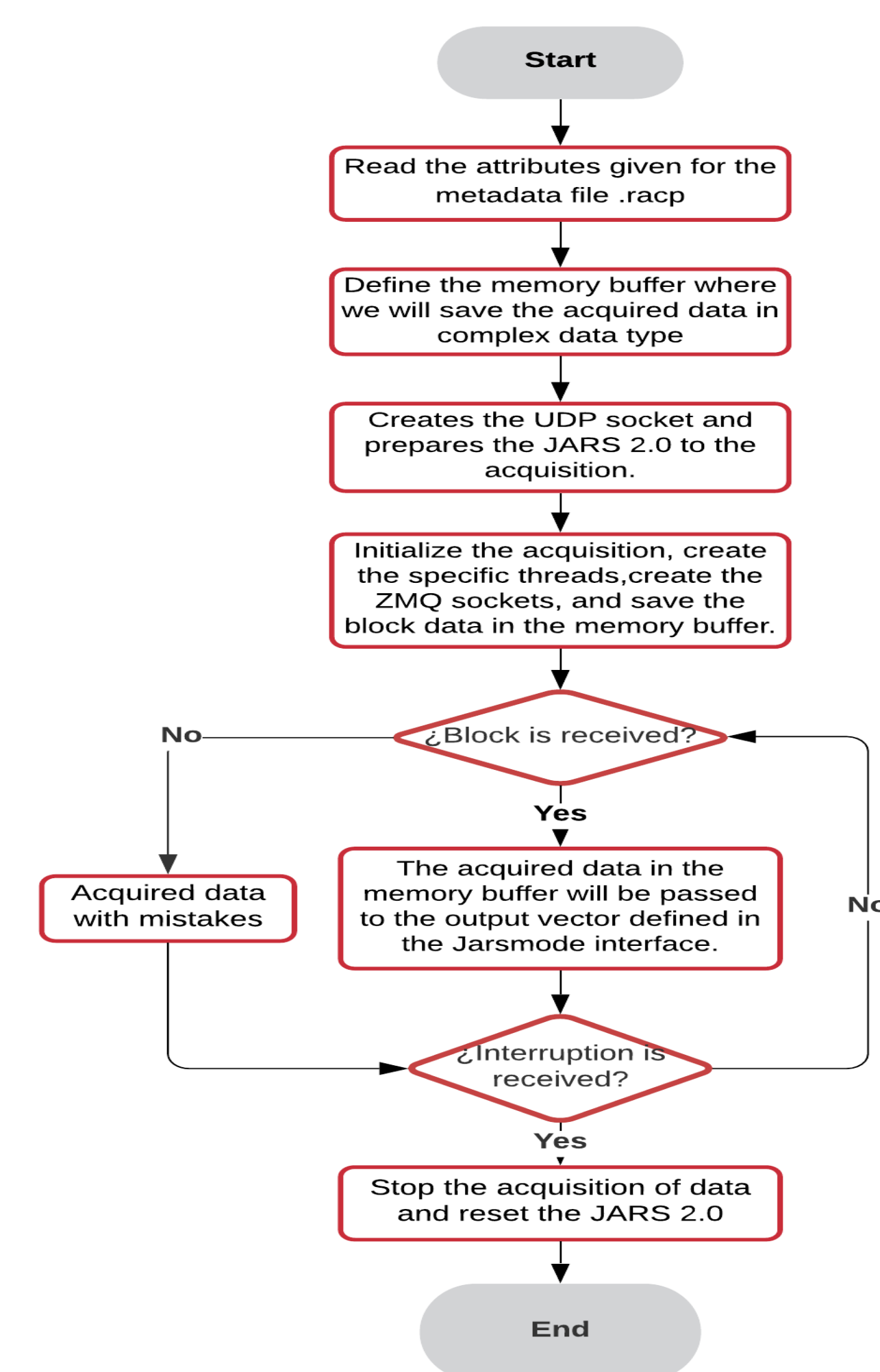


Figure 3: Flow diagram of the Jarsmode interface

Conclusions

- The structure of the interface Jarsmode is defined and it will replace the JROAcquisition software to control the JARS 2.0.
- The GNU Radio Jarsmode interface will help scientists and users of the Jicamarca Radio Observatory to manage and process the data obtained by our radars in a user friendly manner.

Bibliography

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