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# Introduction

The NEOSTEL program will lead to the detailed design of a telescope able to fulfil the specific requirements for the survey of the Near Earth Objects. In particular, the NEOSTEL Telescope must provide the performances needed to guarantee NEO catalogue build up and maintenance, joined to accurate tracking capabilities, suitable to perform the so called “Wide Survey” observation strategy. Therefore the telescope design is focused to obtain the necessary resolution over a very wide FoV; a suitable diameter primary mirror must be provided to allow detecting NEO objects down to the required limiting magnitude.

For this purpose, an important concept is introduced, that greatly simplifies the overall optical design, consisting in the so called Fly-Eye (FY) architecture. The FY design consists in splitting the overall FoV in sub FoVs on which an array of corrector elements are placed, in form of arrayed small sized lenses. The Fly-Eye Telescope design is modular in nature, allowing for “serial” production.

## Document Scope and Organization

## Acronyms

|  |  |
| --- | --- |
| **AD** | Applicable Document |
| **CGS** | Compagnia Generale per lo Spazio (formerly Carlo Gavazzi Space) |
| **NEOSTEL** | NEO Survey Telescope |
| **CTI** | Creotech Instruments S.A. |

## Applicable Documents

1. Statement of Work P2-NEO-V ‘NEO Survey Telescope Detailed Design’, SSA-NEO-TEL-SOW-0001, Issue 1, 17/12/2013
2. Space Situational Awareness - NEO System Requirements Document, SSA-NEO-RS-RD-0001, Issue 1, Revision 4, 05/04/2013

## Reference Documents

1. CGS Proposal “NEO Survey TELescope Design NEOSTEL”, S14-003 Is.1, April 2014
2. NEOSTEL Kick-Off Presentation

# Overall CCD & Camera system Status

The overall Camera System status is as follows:

* Revised (by CTI) version of PDR was delivered to CGS (2015.03.23)
* Main Open Issues are: shutter design, fixing of the camera to secondary mirror structure and cooling system (peltiters, chillers, temp. characteristics). Those issues are priorities to solve at this moment
* Exchange of information between CGS and CTI was carried on regarding specific requirements of the shutter module, cooling system and overall shape of the PDR document
* Schematics of: camera CCD and analogue front-end, mainboard, power supply, CCD drivers, shutter driver, readout, communication and control module electronics design are advanced to 95%
* PCB layouts design started
* Sensor data acquisition system based on the Zynq System on a Chip design has developed. Data acquisition from ADCs was tested on 2 channels (from 16).
* CCD control module was initially tested, but no real world tests of CCD frame acquisition were carried out.
* SW Coding and testing standards are being investigated at this moment
* There are no major risks present up to the Report date, all risks are specific to a standard design project
* Project Planning is being updated and priorities of work packages are set

# Project Progress During the Reporting Period

The activities performed during the reporting period (2015.03.01 – 2015.04.03) are listed and described.

## CCD & Camera System

**3.1.0. Management**

During the reporting period 3 internal meetings of the CTI NEOSTEL team held. The main subject of the meetings was task progress by sub-teams. Issues of common responsibilities of the sub-teams were discussed: cooling system, electrical connectors, PTP implementation, shutter concept.

Formal issues related to the contract and prepayment were discussed with CGS and implemented.

**3.1.1. H/W Design**

* Continuation of routing high speed signal traces.
* Shutter Module PCB schematics are ready
* First iteration of internal CTI prototype of FPGA board is being tested
* Main board schematics and PCB layout continued

**3.1.2. Zynq System**

* All mentioned below steps done on ZC706 Development Kit
  + Basic PTP operation tested on ZynQ devkit
  + Full 1 GbE implementation in FPGA finished with automatic init at boot
  + Self – clocked ADC readout cores with constant delay preliminarily implemented and initially tested on 2 ADCs using 150K test pattern samples provided by ADC manufacturer
  + Implemented and initially tested ADC interface between readout cores and DMA Engine (single readout mode)
  + Implemented and initially tested DMA Engine using before mentioned test samples
  + DMA Engine control implemented in bare metal
  + CCD control module (microprogrammed FSM based on BRAM) implemented and integrated with ADC interface
* Timestamps are going to be done in SW in the initial phase if the resolution will be insufficient, hw implementation might be a possible solution.

**3.1.3.** **S/W design / development**

* Operating System research regarding asynchronous multiprocessing AMP with virtualisation and trusting zone' (Linux + RTOS) was carried on. There will be no virtualization. TrustZone won't be used. AMP is going to be used.
* Self-booting design will be implemented. Research is done, simplified procedures are tested using ZC706
* EPIC on ARM - transport and implementation verified. Tested using Xilinx Toolchain/BSP – ported EPICS Base 3.15. Optimal Epics extensions, IOCes and databases are being developed.
* Coding and testing standards are being investigated

**3.1.4. Mechanics design**

* Concept of Modular Shutter (rectangular shape) is indicated
* IP 68 specification of the camera (+shutter) is indicated
* Proto of Water block (cold plate) is sent to production
* Flow rate meter is added to design (interior of the camera)

**3.1.5. System engineering**

N/A

# Next Activities

In this section, the activities to be performed in the next reporting period are listed and described.

## CCD & Camera System

In the next reporting period the following activities will be performed:

* Development of Concept of Communications management, data management and monitoring data will be continued
* Development of Camera CCD and Analogue Front-End, mainboard, power supply, CCD drivers, shutter driver, readout, communication and control module electronics design will be continued
* Development of Sensor data acquisition system based on the Zynq System on a Chip design will be continued
* AFE Board and Main Board (Peltier Control, Power Supply and ADC) will be shielded
* Mechanics/control – Shutter. Proposal/confirmation of following items is being prepared now and will be sent to CGS within wk.16:
  + Shutter Module – Camera signal and connectors specification
  + Camera – Shutter fastening to secondary mirror structure
  + Shutter module: detailed concept of (dis)assembly of shutter module without disassembly/readjustment of the camera,
  + Volume confirmation of rectangular shutter (31x338)
  + Sealing concept of Shutter Module
* Cooling
  + Physical model (prototype) of Cooling block (cold plate) is being prepared (wk.19). Temperature parameters of cooling block will be measured (gradient, efficiency)
  + Parameters of cooling block will give input to software simulation of the CCD chamber temperature (wk. 22)
  + Software simulation of the CCD chamber and physical test of Cooling Block will give answer about:
    - Cooling Block performance
    - Peliter performance (feasibility of 1 or more Peliters modules)
    - Chiller performance (feasibility of 1 chiller per 4 cameras)
* EPICS/PTP development is blocked. For further development we require information about interaction model (EPICS) that is going to be used:
  + - database scanning
    - version of EPICS
    - functionality of EPICS (functions, alarms, values)

Without these data we are unable to describe/finish EPICS and API/Linux

# Updated Schedule

There were no changes to the schedule – it remains as attached to the PR01.

# Action Item List

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Action Item ID** | **Description** | **Actionee** | **Due Date** | **Current Status** | **Notes** | **Closure Date** |
|  |  |  |  |  |  |  |

# Document Status List

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Doc. Reference** | **Title** | **Issue** | **Date** | **Status** |
|  |  |  |  |  |

# Risk Status Register

The risks involved in the Camera design are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Risk** | **Remedy** | **Control** |
| 1 | Precise definition of the S/W standards and requirements | Exchange of information with CGS | Status of questions / answers records |
| 2 | Definition of interfaces to other NEOSTEL subsystems | Exchange of information with CGS | Status of questions / answers records |
| 3 | Software analysis and testing tool availability | CTI is in the process of procurement / leasing of required S/W tools | Procurement status records |
| 4 | Availability of components | Contacts to suppliers are established and availability of components monitored | Component availability and order status records |
| 5 | Component traceability | Components from CERN component library or equivalent will be used only | Records compatible with CERN component library are kept |