

The NUSTAR* Control System (NSC): A Conceptual Approach

by H. Simon and H.J. Wörtche

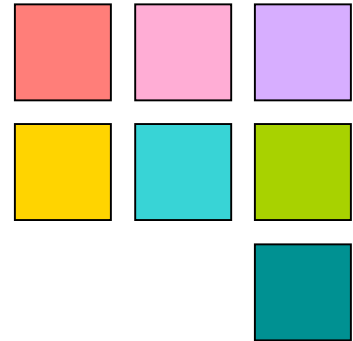
Version 1.0, 3rd March 2006

Revised Version 1.1, 26 April 2006

The NUSTAR Control System

1. Introduction

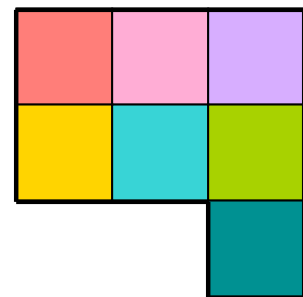
The below presented approach for a NUSTAR Control System (NSC), is based on the idea, that the NCS provides control of the main NUSTAR detectors. We envision a NUSTAR experimental setup as consisting of one or a combination of *specific* detector systems (EXL, R3B, ILIMA, LEB, ELISe, HISPEC, DESPEC), which might change in their specific configuration and might also be set up at varying locations. The specific detector systems, which are set up at specific locations of the FAIR facility and which are bound to run in combination for an experimental investigation, constitute what is referred to as *experimental setup*. Because of this flexibility it is required, that the NSC offers the feature of fast, effective and reliable adaptation to the actual experimental setup. This requirement is a very specific feature of the NSC and is reflecting in the below described conceptual approach.



2. Basic concept

The NSC concept is based on the approach to leave the actual control of a *specific* detector system to a *specific* system inherent controller, so called *local controllers*, which will be

- interconnected to the other *local* controllers,
- connected to the GSI/FAIR infrastructure,
- connected to the data acquisition and related software management and
- interfaced to the experimentalist by means of the *Docking Station B* (DSB).



Local controllers are specified in terms of required functionality rather than requiring a specific hard-, firm- or software combination. Local controllers get all non static (i.e. all information that is likely to change within their life time) from the DSB. They provide access to the locally attached hardware, and are starting point of all field bus installations. As a minimum requirement they provide logging (i.e. status change) information to the DSB. They come also with the electrical interfaces for monitoring signals and interlocks.

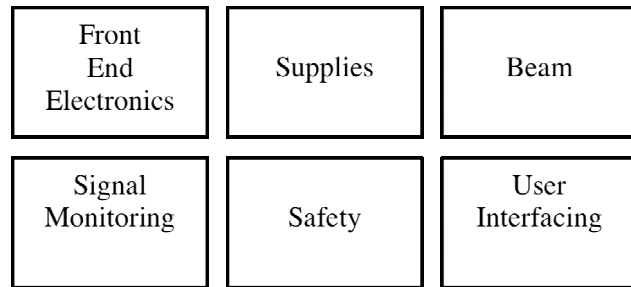


Figure 1 Building blocks of NUSTAR control system

2.1 Docking Station B (DSB)

The heart of the DSB is a central data-base system and a network of digital and analog connections and interfaces to the various (specific) detector systems. At any time, the dynamic and static sections of the data-base system will comprise all information of an actually running experiment, i.e.

- a *model* (which will be described in detail below) of the experimental setup
- all control parameters
- all low-level and high-level software including code revisions
- ...

The DSB programming environment provides the means to define and set up the model that reflects a particular experimental setup. In order to facilitate the programming and reduce setup time, complex subunits can be combined as being building blocks of a more complex total setup. The DSB combines all interlock signals and conditions and leads to an appropriate reaction.

2.2 The *model*-concept

A data-bank based model of a detector or supplies component, e.g. a VME card, a HV supply unit, a front-end board, is used to derive

- a representation of the component in the human interface (GUI, synoptic, ...)
- a coordinate in the detector setup,
- a definition of the parameters,
- a description of the parameter interdependencies and limits,
- a definition of the interlock and warning conditions and
- a status.

The total of all hierarchically ordered models forms a representation of the actual experimental setup. The hierarchy corresponds to the database structure. Within the setup, the local controllers take the role of the bottommost units in the experimental setup. Towards the higher levels in the control system local controllers provide standardized means of communication and messaging as well as electrical interfaces for monitoring signals and interlocks. Their function to allow access to the locally attached hardware is represented as set of accessible parameters of a certain type and a source of messages or local status information within the modeling. Components that appear repeatedly in a setup, like e.g. a constant fraction discriminator, can be supported by providing model libraries. The *docking station B* can be seen as the topmost instance for the slow control where all information is kept, handled, and distributed to the various subunits. Subunits can also be external independent slow control systems, like e.g. the accelerator control system. The models for all components can start from simple lists of controllable parameters, and should be developed up to the appropriate complexity, so that during experiments a reliable operation and control of these components by non-experts can be achieved.

2.3. Data flow/Communication

(to be elaborated, push/pull)

The communication and data sharing can be achieved by an interface description as above, which requires essentially a communication channel and an implementation of this slow control systems protocol that corresponds to the desirable functionality of any subunit. The shared information (a set that should be kept small) is defined within the modeling process of the subunit.

3. Design

The slow control system design will not put requirements on utilizing certain hard- and software, but will put the necessary restrictions by specifying functionalities and quality standards for its subunits being its building blocks. The main idea behind this design is to be able to accommodate the expected diversity of local controllers, provided by the different detector groups.