IRMIS UNIVERSAL COMPONENT-TYPE MODEL*

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Abstract

The IRMIS toolkit provides a relational description of the accelerator/facility hardware and how it is assembled. To create this relational model, the APS site infrastructure was successively partitioned until a set of familiar, "unit-replaceable" components was reached. These items were grouped into a set of component types, each characterized by the type's function, form factor, etc. No accelerator "role" was assigned to the components, resulting in a universal set of component types applicable to any laboratory or facility.

This paper discusses the development of the universal component-type model. Extension of the component types to include port definitions and signal-handling capabilities will be discussed. This signal-handling aspect provides the primary mechanism for relating control system software to accelerator hardware. The schema is being extended to include references to the device support for EPICS-supported component types. This suggests a new approach to EPICS database configuration in which the user, after selecting a particular hardware component, is provided with links to the support software to be used in building the EPICS application..

INTRODUCTION

In an operating facility, the best (and usually the only) indicator of failed hardware is software – a display screen, an alarm handler, script, etc. This immediately leads to the questions:

- what do we mean by 'hardware'?
- is it possible to have a common, or universal definition of 'hardware'?

This paper presents a generic approach to describing the facility hardware and how it is assembled. It proposes a mechanism by which EPICS-based control system software can be related to the facility hardware.

THE IRMIS 3-HIERARCHY COMPONENT MODEL

The IRMIS component schema was developed from the point of view of documenting how the constituent parts making up a facility are *assembled* rather than from a modeling point of view of how the facility *functions*. In this approach, the facility is successively partitioned to the point where one reaches the replaceable component level. Components derived in this manner are common familiar infrastructure elements (buildings, rooms, racks), COTS items (chassis, processors, I/O boards), instruments, etc. The schema is generic in nature and can effectively be used to describe any complex assembly of components – a factory, a detector or an accelerator.

An IRMIS component belongs to a specific component class or 'component-type' characterized by the type's name, description, manufacturer and a set of functions that the component can perform. No site-dependent 'roles' are assigned to the components. This suggests the possibility of a universal component-type definition.

The IRMIS schema has been described elsewhere [1]. In this model, each component in the facility belongs to up to 3 hierarchies – a housing hierarchy (required for all components), a control hierarchy and a power hierarchy. Components are added to the database in a top-down fashion, in which added components become children of existing parents in each of the hierarchies to which the component belongs. To assist in the assignment of these component parents, the IRMIS schema contains the concept of component 'interfaces' defined for each hierarchy. The partial ERD is shown in Figure. 1.

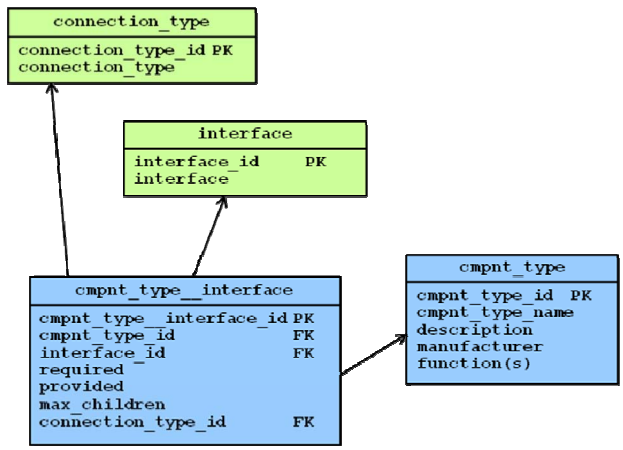

Figure 1: IRMIS Component-Type ERD fragment, showing interfaces associated with component types.

In Figure 1, the cmpnt_type__interface association table† both required interfaces and provided interfaces are associated with each component-type. In order for a child

† In the ERD drawings, user configurable entities are indicated in blue. Resource lists (pick-lists) are indicated in green.

component to be added to the IRMIS database the interface that the child component-type 'requires' must match at least one of the interfaces that the parent component-type 'provides'. This business rule has proven invaluable in preventing inadvertent insertion of incompatible component types into the database. When the user wishes to add a child to an existing component, he is presented with a filtered set of candidate child component-types. This mechanism is a valuable assistance in populating the database and It requires the user to insert all infrastructure items needed to install the component, thus promoting exhaustive component coverage.

COMPONENT PORTS

The hierarchical topology of the IRMIS component database is a result of the unique parent child relationships that exist between components. In addition, components are interconnected and exchange signals in a network topology. This section describes mechanisms in the IRMIS schema to support this topology.

An extension of the basic component type definition is shown in Figure 2. The port_template association table associates a set of port-types for each component-type. The port-type resource table is a list of commercially available connectors. These port types are further elaborated with a detailed pin-out description, using the port_pin_template association table.

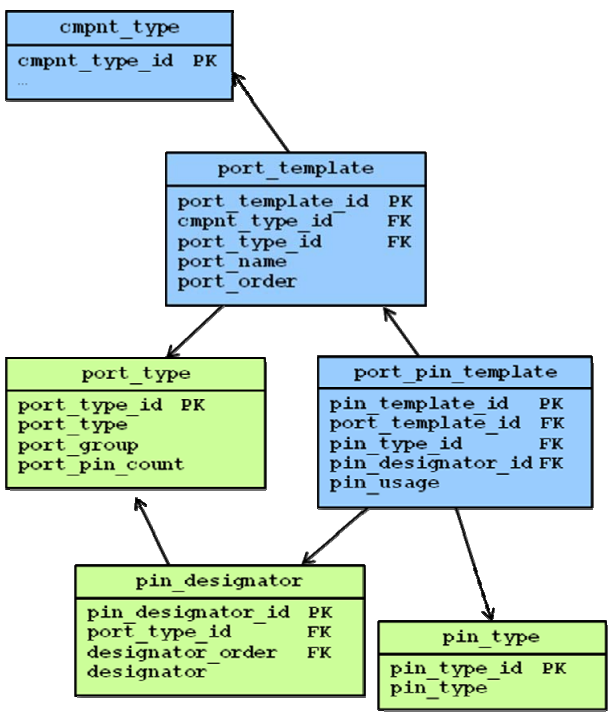

Figure 2. Component-type Port ERD.

When a component of a particular type is instantiated in the IRMIS database, a set of ports associated with the installed component is also instantiated, using the templates shown in Figure 2. All of the pins associated with the component's port set are also instantiated in the database. The installed component port database provides the mechanism for the cable databases, in which a cable connection is documented as a port-port connection.

UNIVERSAL COMPONENT TYPES

Although originally directed at capturing the APS control system component hardware and assembly, the basic IRMIS schema is applicable to the entire facility, including beam delivery components (magnets, bpms), power supplies, beam line components, IT, plant facilities, etc.

The IRMIS project at the APS has developed detailed descriptions of ~900 component-types. More than 300 port connector types have been entered into the system. The project includes definitions for a large number of commercially available modules as well as locally developed electronic modules. Also included are all the infrastructure elements (rooms, racks, chassis, enclosures) needed to fully describe the APS facility. The definitions provided are site-neutral.

To model an installed system using the IRMIS component model, a mechanism is required that would allow potential users to leverage off the extensive APS investment in developing and refining the rich component-type relational schema. Ideally, it should be possible for users to contribute to this component-type database.

SUMMARY

The IRMIS component/type schema provides an exhaustive description of the accelerator hardware. The relational model provides powerful querying capabilities to locate components and identify the control flow as well as the power feed to the component. The schema has been designed to be site-neutral, and is applicable to any complex plant or facility. .

REFERENCES

[1] D.A.Dohan. Component/Connection/Signal Modeling of Accelerator Systems, PAC'05, Knoxville, May 2005, P707