Unit Schemes in RiverWare 6.1

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This document describes a new architecture for control of the units and precision with which numeric slot values are displayed in RiverWare.

0.1 Document Status

5-25-2011: Initial writing in progress

0.2 Contents

0.3 Other Relevant Documents

 RiverWare Technical Documentation: "Units" Section.
The RiverWare 6.0 edition (11-22-2010) is available at this URL: <u>http://cadswes.colorado.edu/PDF/RiverWare/documentation/Units.pdf</u>

0.4 Special Unresolved Issue (5-24-2011)

Our initial discussions have focused on display "units" configurations. Display precision and display type ("Float". "Integer", or "Scientific") configurations are currently maintained in parallel with units configurations on slots. We need to clarify the extent to which the new display configuration architecture addresses all of these settings. In particular:

- Display Precision (fractional decimal digits) is very closely related to "unit scale" and "unit" when the "Float" display type is selected (which is the usual case).
- We should consider removing the "Integer" display type. That is redundant with configuring a "Precision" of zero, and is a source of confusion.

1.0 Overview

Currently, in RiverWare 6.0 and earlier versions of RiverWare, display units and "precision" (fractional decimal digits) with which numeric slot values are displayed are configured individually on each slot or slot column instance. Series slots for "flow" (volume per time) entities on accounts support distinct configurations for flow and volume units. There are tools within RiverWare for reassigning the display units and precision on multiple slots in a single operation.

There is a fixed "standard unit" specified for each unit type (e.g. "m3" for volume). Generally, slots on newly created objects (including supplies and exchanges) are initialized to use the standard unit for the slot's unit type -- or, if defined, to the unit specified for the slot's unit type or slot entity in the external "riverwareDB" file (see the referenced online help document). Slots on newly created accounts are initialized with the unit settings specified in the Accounting System Configuration dialog.

This document describes an alternative to this way of specifying slot display units and precision. Multiple named "Unit Schemes" will be stored within the RiverWare model, but not directly associated with slot instances. Initially,

this will be used in conjunction with the current slot / slot column instance configurations (in one of several possible ways, explored in this document). Probably, when sufficiently comprehensive capabilities are implemented with the Unit Schemes architecture, the older instance configurations mechanism will be removed.

2.0 Fundamental capabilities of the existing slot / slot column instance configuration mechanism

2.1 RiverWare Resource Database -- riverwareDB file

The initial configuration for slots and slot columns on new simulation objects (i.e. for only physical slots), including display units and precision is, defined in the optional external riverwareDB file. This effectively supports assigning a fixed set of properties based on the following slot and slot column "entity" (name) matches:

- object type .. slot name
- object type .. slot name .. column name
- unit type

Technically, at a low level, there is support for slot "instance" matches. But the RiverWare Resource Database management system isn't structured in a way that that is actually usable for slots on the users' simulation objects -- and an "instance" capability isn't described in the RiverWare Technical Documentation.

To be more specific, internally, there are, in fact, "instance based" queries to the internal (in-memory) representation of the resource database, but those are applied to only the hidden "prototype" simulation objects. After the internal resource database is loaded from the riverwareDB file (with one minor exception to support a single DMI-related attribute) all queries to the database are done for the purpose of initializing the prototype simulation objects before a RiverWare model is loaded. (In the current RiverWare 6.1 development build, 305110 queries are made to the database using 11670 unique keys, most of which are references to the full set of physical slots and slot columns on the set of prototype simulation objects).

The way in which prototype simulation objects are used in this mechanism isn't really fundamental. Those prototype object slot and slot column references are equivalent to references made to those entities on object *types*. A reimplementation of the internal resource database (in the course of the Unit Schemes architecture) should probably use only "entity based" keys, as enumerated above.

As described in the RiverWare Technical Documentation, the following slot and slot column attributes are supported (and should also be supported in the Unit Schemes architecture). (Some of these attributes are relevant only for series slots).

- display units
- display scale (floating point value)
- display format (integer, float, or scientific notation)
- precision (integer: fractional decimal digit count)
- minimum value (floating point value)
- maximum value (floating point value)
- convergence type (non, absolute, percent, unit percent)
- convergence limit (double)

• max iterations

Other than through the external "riverwareDB" file, there is currently no way to change any of the attributes on the prototype simulation objects -- i.e. for setting up slots on subsequently created simulation objects. Compare this to the support for changing analogous attributes on the prototype accounts, described in the next section.

Note that the RiverWare Resource Database mechanism doesn't support initial attributes on accounting system slots (i.e. slots on accounts, supplies or exchanges).

2.2 Prototype Account Slot Display Properties

When a new account is created, the account's slots' display properties are initialized from those set on the internal, hidden prototype accounts (which reside on the prototype simulation objects). The prototype account display properties (e.g. units, scale and precision) are not initialized through the RiverWare Resource Database (see prior section). Instead, they can be set by the user through the Accounting System Configuration GUI -- and such property edit operations can be applied to also existing user account instances (i.e. other than the internal prototype accounts).

2.3 Account Series Slot Display Properties: Primary and Alternate

Series slots on accounts support both a "primary" and "alternate" set of display properties (units, scale, precision, etc.) -- invariably for two different unit types related by a time factor (e.g. flow and volume, or power and energy). Internal accounting system computations are always done in the standard units of the "primary" unit type. For slots representing "flow" entities, generally the primary unit type is FLOW and the alternate unit type is VOLUME. But in cases where the natural way of computing the flow entity's values is a volume-based computation, the primary unit type is VOLUME and the alternate unit type is FLOW. The user interface, however, always presents these two options as "Flow" or "Volume" (e.g. in the Edit Account dialog).

Naturally, not all account series slots support an "alternate" unit type. For example, entities that fundamentally represent a volume (e.g. the "Storage" series slot on a reservoir) cannot be displayed as a flow.

There is no fundamental reason why the ability to show flow entity values in series data as either "flow" or "volume" is limited to accounting slots. Extending that capability to physical slots is desirable, but is probably outside of the scope of the initial implementation of the Unit Scheme architecture. However, the architecture design will "anticipate" that implementation.

Note that flow / volume conversions are implicitly automatic (even with physical slots) if the user chooses flow display units having a "time denominator" equal to the series timestep size, e.g. "acre-feet per day" in a daily timestep series (generally appropriate, in a daily timestep model). "Summing" several such flow values in multiple timesteps within the series does correctly represent the aggregate volume of water.

2.4 Ability to "correct" data enterred or imported with the wrong units

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