



CADSWES University of Colorado

Center for Advanced Decision Support for Water and Environmental Systems

Direct Database Connectivity

RiverWare User Group Meeting
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Direct Database Connectivity

- Provide direct connectivity between RiverWare and “industry standard” databases (DSS, HDB, SQL, Excel, etc)
- Database-neutral front end
- Multiple database-specific back ends
- All configuration is through the user interface and saved in the model file
- No more external control files or executables

Three Main Components

- Name Maps
- Datasets
- Database DMI

Name Maps

- RiverWare entities (simulation objects, accounts, supplies, slots, etc.) quite possibly have different names in the model than in the database
- Name Maps map the model names to the database names

Datasets

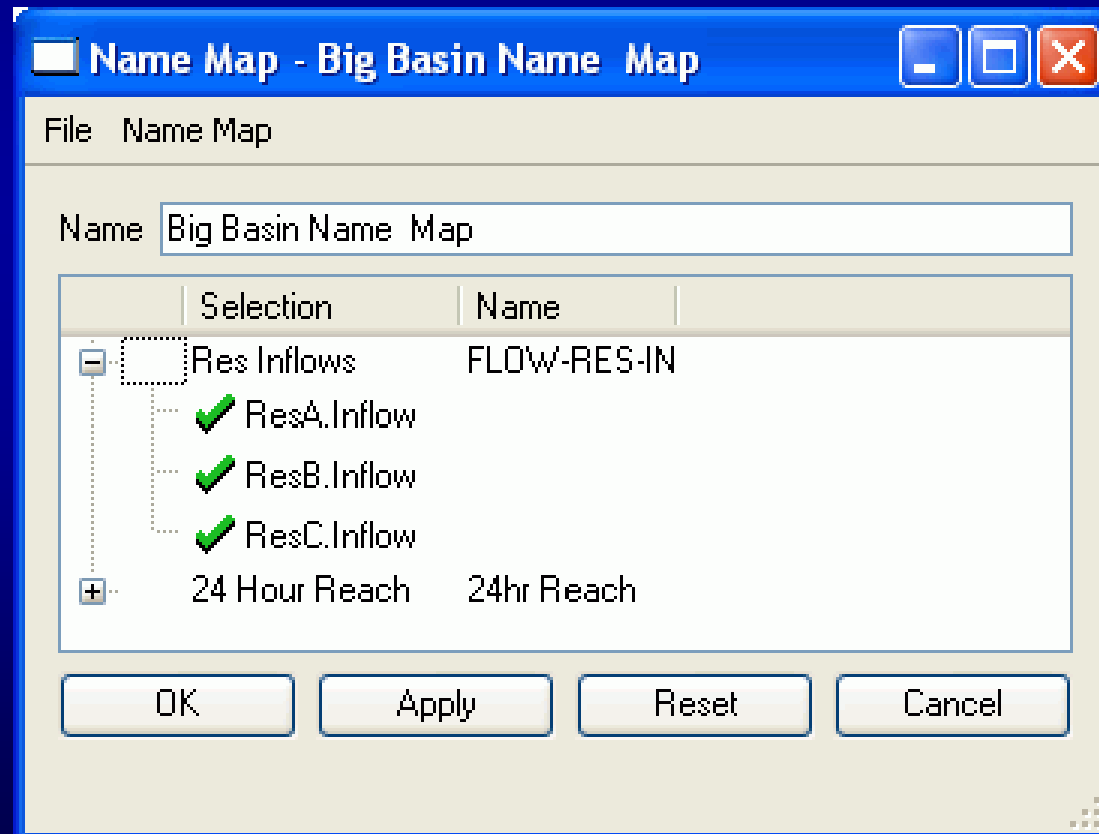
- Database specific (e.g., DSS specific)
- Encapsulate all RiverWare knowledge about the database
- Typically two types of knowledge:
 - Configuration information
 - Database interaction

Database DMI

- Specify slots and time intervals to import or export data
- Associate slot and time interval pairs with Datasets
- Import or export data

Name Map Dialog

- Reservoir “Inflow” slots mapped to “FLOW-RES-IN”
- Reach “24 Hour Reach” mapped to “24hr Reach”



Dataset Dialog

Specify:

- Name map to use
- How missing values are handled
- Database scale and unit information

DSS Dataset - Observed Flows

File

Type: DSS

Name: Observed Flows

General DSS

Name Map: Big Basin Name Map

Missing Values Are: NaN

Use Dataset Units

Units

Type	Scale	Units
Volume	1	ft3
Flow	1000	cfs

OK Apply Reset Cancel

DSS Dataset Dialog

Specify:

- DSS file
- Part information (with defaults shown in gray)
- Data type information

DSS Dataset - Observed Flows

File

Type: DSS

Name: Observed Flows

General DSS

File: C:/EIS/FlowData.dss

Part A	Part B	Part C	Part D	Part E	Part F
EIS	Mapped Object Name	Mapped Slot Name		Slot Timestep	OBS

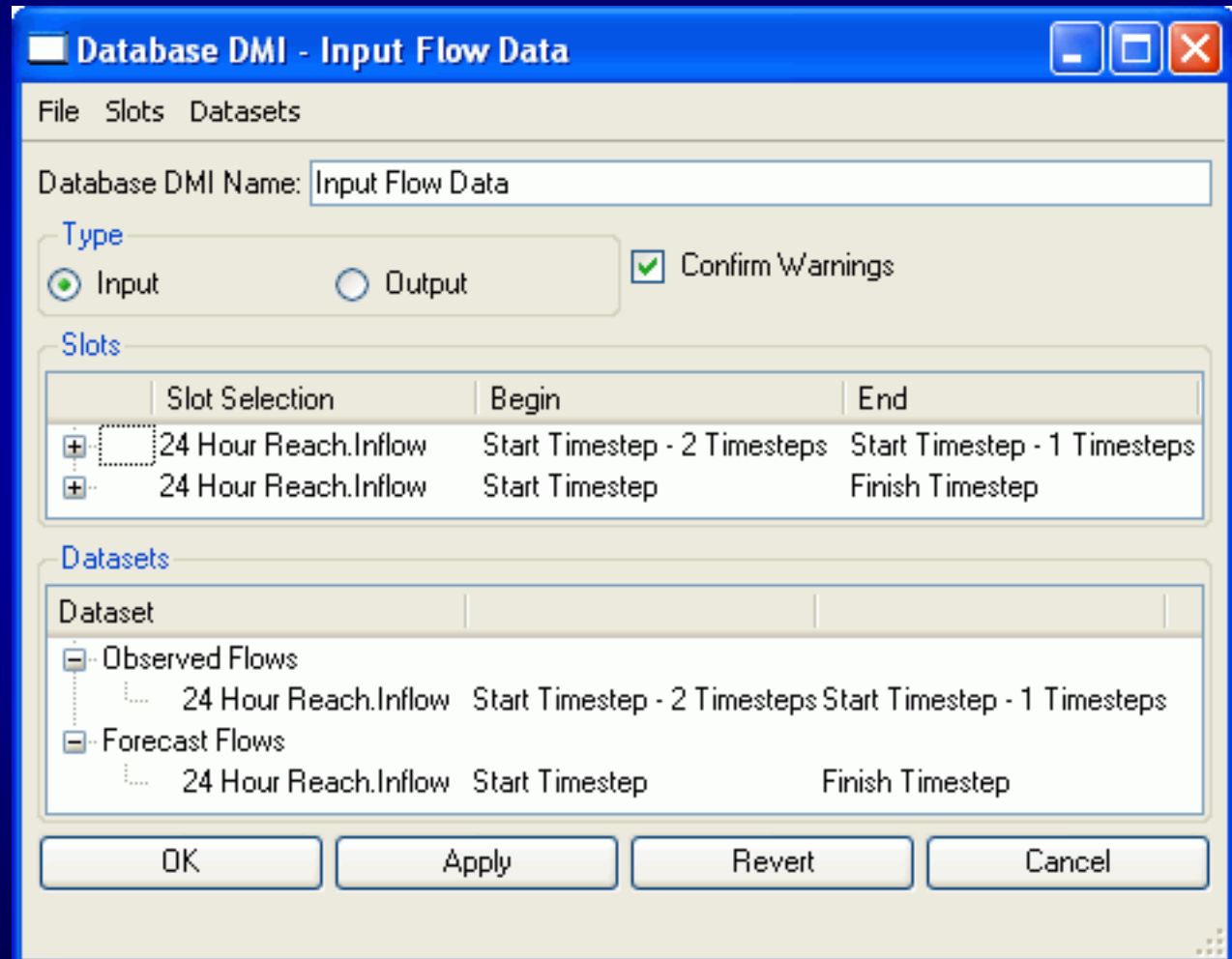
Data Types ▼

Selection	Data Type
<input type="checkbox"/>	Res Inflows INST-VAL

OK Apply Reset Cancel

Database DMI Dialog

- Specify slots and time intervals to import or export data
- Associate slot and time interval pairs with the datasets which import or export the data



Database DMI Editor Dialog

- New dialog which will combine aspects of the Name Map, Dataset and Database DMI dialogs to:
 - Provide an overview of a Database DMI
 - Provide the ability to create “simple” Database DMIs from one dialog

Database DMI Editor Dialog

- Specify the DSS file
- Specify the time interval, either for all slot selections (shown) or for each slot selection (not shown)
- Select slots
- Specify **default** part information
- See **actual** part information
- Specify **override** part information
- Specify scale and unit information (not shown)

Slot Selection	Part A	Part B	Part C	Part D	Part E	Part F
[-] Res Inflows	BigBasin	Object Name	Slot Name		Slot Timestep	Obs
ResA.Inflow	BigBasin	ResA	Inflow		1MON	Obs
ResB.Inflow	BigBasin	ResB	Inflow		1MON	Est
ResC.Inflow	BigBasin	ResC	Inflow		1MON	Obs
[-] ResC Slots	BigBasin	Object Name	Slot Name		Slot Timestep	Obs
ResC.Pool Elevation	BigBasin	ResA	Pool Elevation		1MON	Obs
ResC.Volume	BigBasin	ResB	Volume		1MON	Obs

Buttons at the bottom: OK, Apply, Reset, Cancel.

Client / Server Architecture

- To provide direct database connectivity, RiverWare makes calls into database-specific libraries; linking RiverWare with the libraries is problematic:
 - They increase RiverWare's executable size, negatively affecting performance for all users
 - The DSS Fortran libraries conflict with the C++ runtime libraries

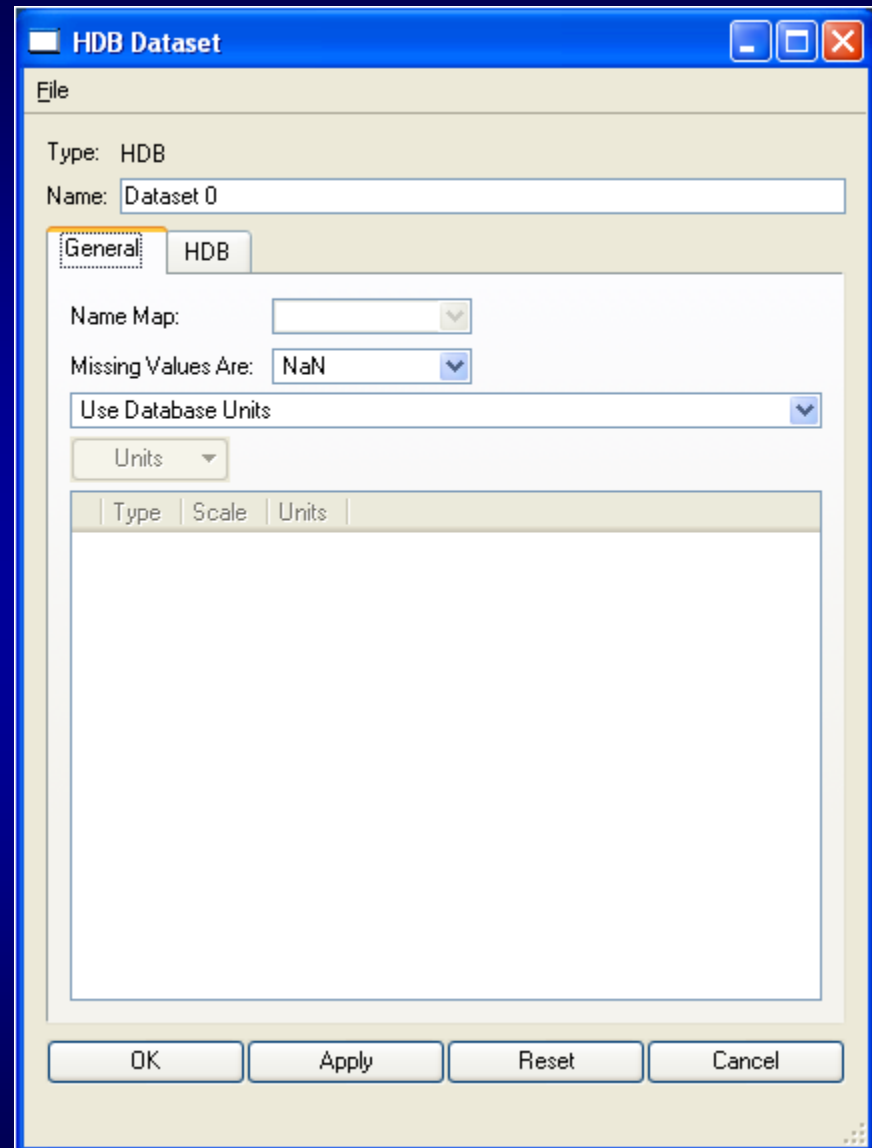
Client / Server Architecture

- Solution is a client / server architecture in which:
 - RiverWare communicates with database servers via TCP/IP connections
 - The database servers, not RiverWare, are linked with the database-specific libraries
 - Extensible architecture also being used for MODFLOW Link

HDB Direct Data Connection

- HDB is an Oracle database with a hydrologic focused schema
- Connection specifically supports transfer of data with the HDB real and model tables
- Adds an HDB dataset type with HDB configuration options
- Not a generic relational database connection

- Name mapping and units information will be contained in the database
- Missing values have option to be NaNs, unchanged, or replaced with default value



HDB Dataset GUI

HDB Dataset

File

Type: HDB
Name: Dataset 0

General | **HDB**

HDB Database: ALBHDB

Mapping ID: 3

HDB Table Type

Model
 Real

Model Run ID

Select ID when DMI run
 Select ID
4 Official Forecast from Operations Model

HDB Dataset

File

Type: HDB
Name: Dataset 0

General | **HDB**

HDB Database: ALBHDB

Mapping ID: 3

HDB Table Type

Model
 Real

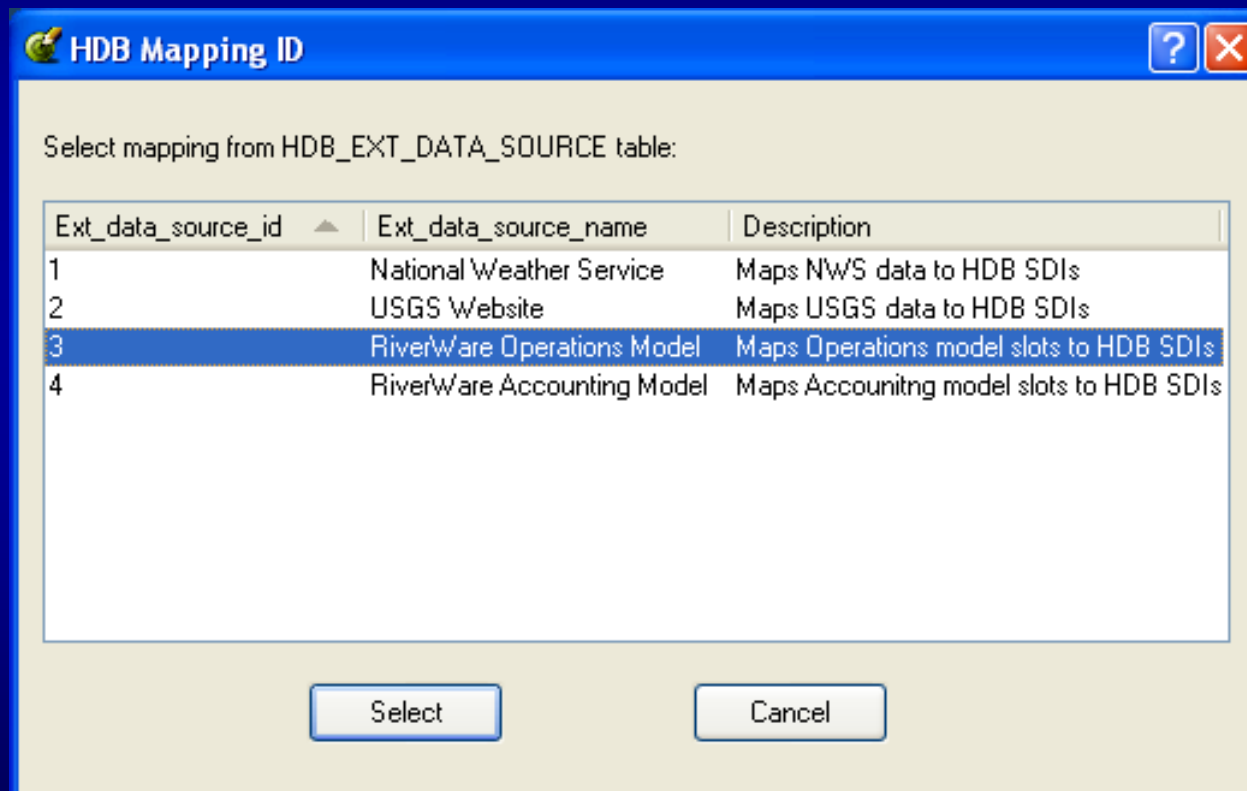
Required for Output to HDB

Agency ID: 4 Bureau of Reclamation

Collection System ID: 2 RiverWare

Use Overwrite Flag

HDB Mapping ID GUI



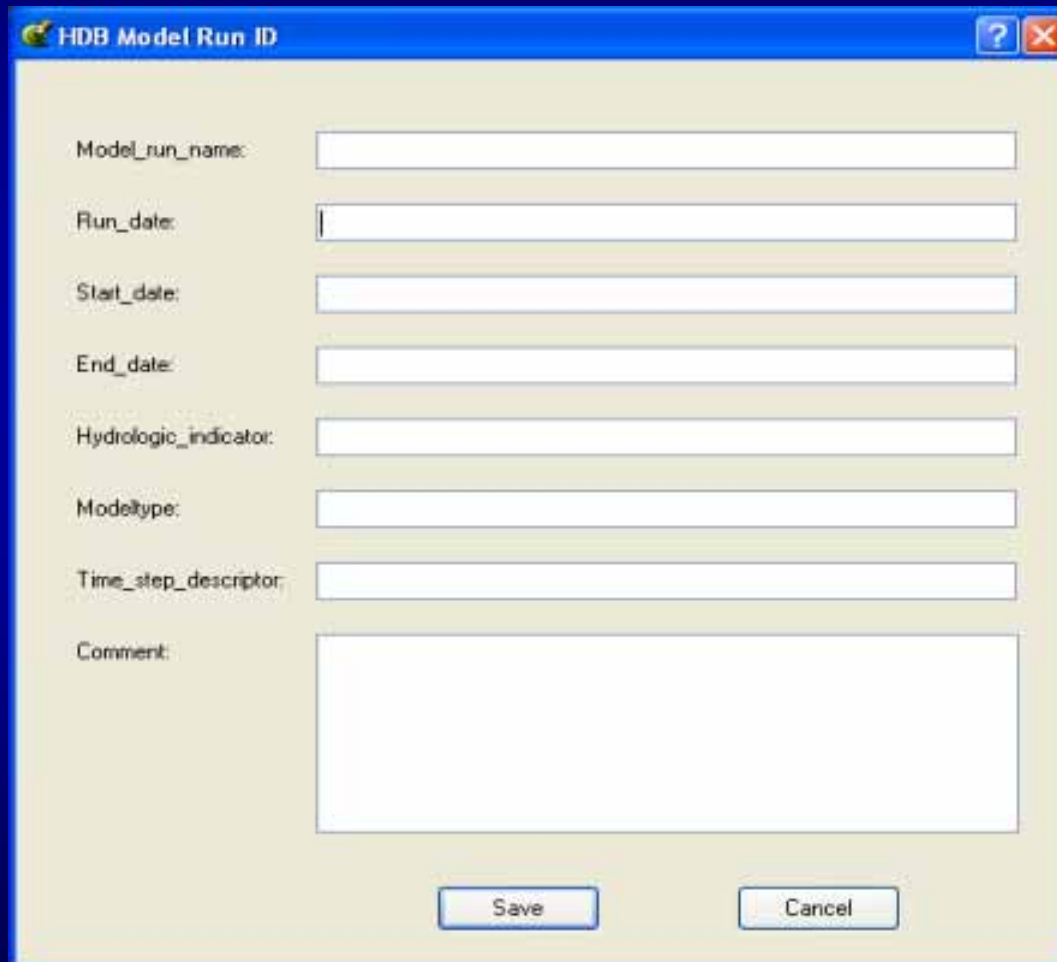
HDB Model Run ID GUI

Select model from HDB_MODEL table:

Select model run ID from REF_MODEL_RUN table:

Model_run_id	Model_run_name	Run_date	Start_date	End_date	Hydrologic_indicator	Modeltype
2	Archived Operations Model for 2005	31-DEC-05	01-DEC-05	31-DEC-05	50	F
3	Archived Operations Model for 2006	31-DEC-06	01-JAN-06	31-JAN-06	50	F
4	Official Forecast from Operations Model 26-JAN-07	01-JAN-07	01-JAN-07	31-DEC-08	50	F

HDB Model Run ID Creation



The image shows a Windows-style dialog box titled "HDB Model Run ID". The dialog box has a blue title bar with a question mark icon and a close button. The main area is light beige and contains several input fields and a text area. The fields are labeled as follows:

- Model_run_name: [text input field]
- Run_date: [text input field]
- Start_date: [text input field]
- End_date: [text input field]
- Hydrologic_indicator: [text input field]
- Modeltype: [text input field]
- Time_step_descriptor: [text input field]
- Comment: [text area]

At the bottom of the dialog box, there are two buttons: "Save" and "Cancel".

Connection Technologies

➤ Qt Database Classes

- Standard SQL interface through Oracle driver
- Data-aware widgets built on database tables
- Widget implementation changes from Qt3 to Qt4

➤ Oracle C++ Call Interface (OCI)

- Comprehensive access to Oracle database functionality
- Allows array inserts and calling procedures with arrays as parameters

Reducing Network Traffic

- Standard SQL using Qt requires a network trip to write each data value
- OCCI can write arrays of values (such as all time steps for a slot) with one network trip
- For a year's worth of data for 50 slots, using OCCI reduces network trips from 18,250 to 50
- Excessive network trips degrades application performance

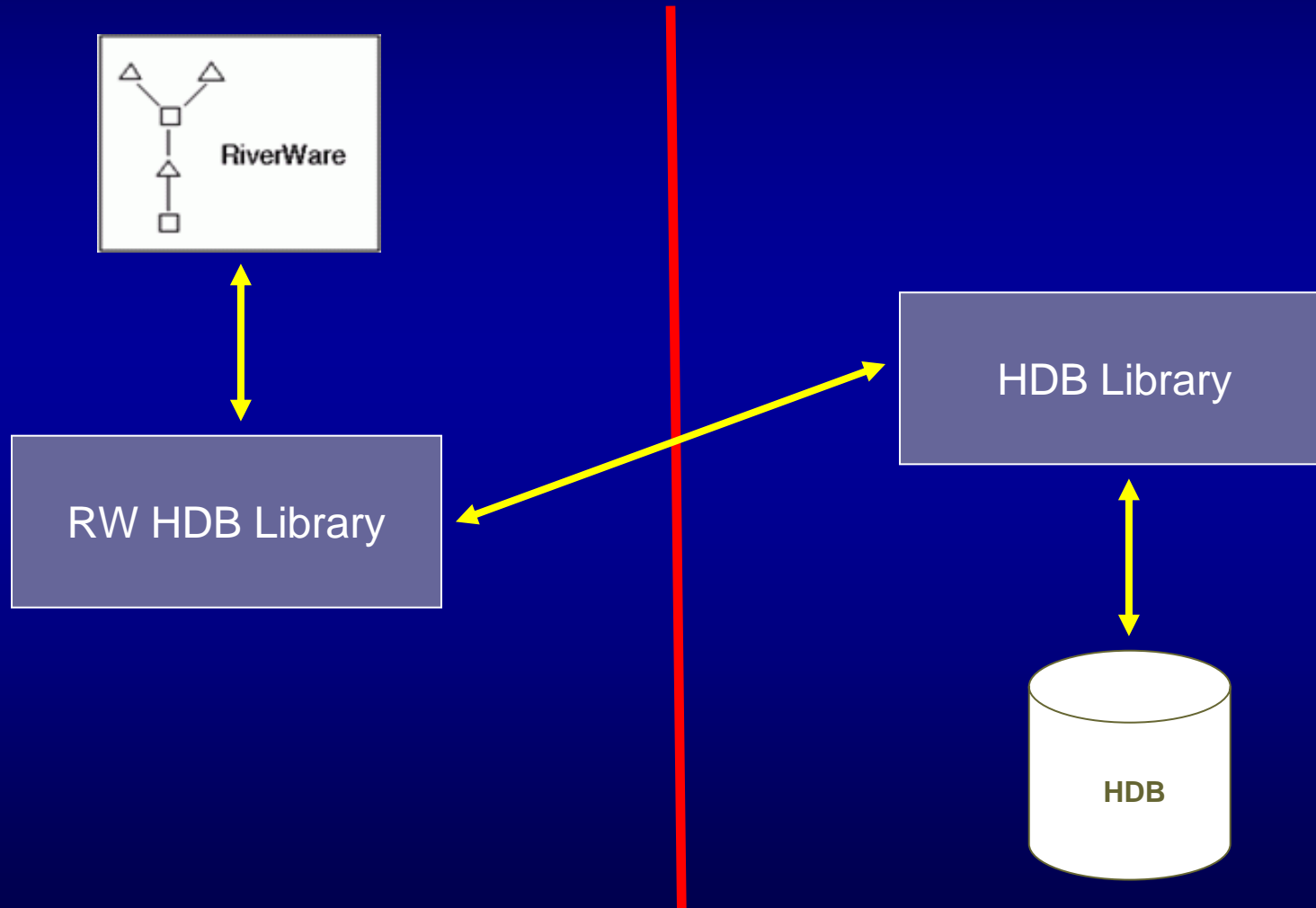
Connection Choice

- Performance has been an issue with the existing DMIs
- OCCI chosen over Qt for the likely performance advantage
- Using array parameters with procedures via OCCI will reduce network traffic and insulate RiverWare from specific knowledge of HDB schema

HDB Connectivity Architecture

- RiverWare and HDB should be loosely coupled
 - RiverWare's dependencies on HDB are well known
 - An implementation change in HDB shouldn't require an implementation change in RiverWare
 - RiverWare and HDB can continue to be independently developed and released

HDB Connectivity Architecture



HDB Connectivity Architecture

- RiverWare interacts with RW HDB Library using RiverWare concepts (e.g., slots, datasets)
- RW HDB Library translates RiverWare concepts to HDB concepts (e.g., slot names to site datatype ids)
- RW HDB Library interacts with HDB Library using HDB concepts (e.g., site datatype ids)
- HDB Library interacts with Oracle

Timeline

- Clarifying requirements on a few remaining issues
- Finalizing GUI design and the structure of the code
- Coding will start soon
- Target for initial implementation is April 30th