

LIGO Database: Status, and Demonstration of Graphical User Interface

**Peter Shawhan
Caltech**

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LIGO Database: Overview

Uses commercial software (IBM DB2) for core database functions

LDAS software entities (“APIs”) provide:

- Remote access (using Tcl sockets)
- Format translation
(standard external format is “LIGO lightweight” XML)
- Job management
- Scripting capability

Client programs communicate with managerAPI

Will have databases running at the interferometer sites as well as at Caltech (and possibly other analysis centers)

Plan to copy data from the sites to the central database at Caltech on a nightly basis

LIGO Database: Planned Usage

Database table definitions have been established to store various types of information:

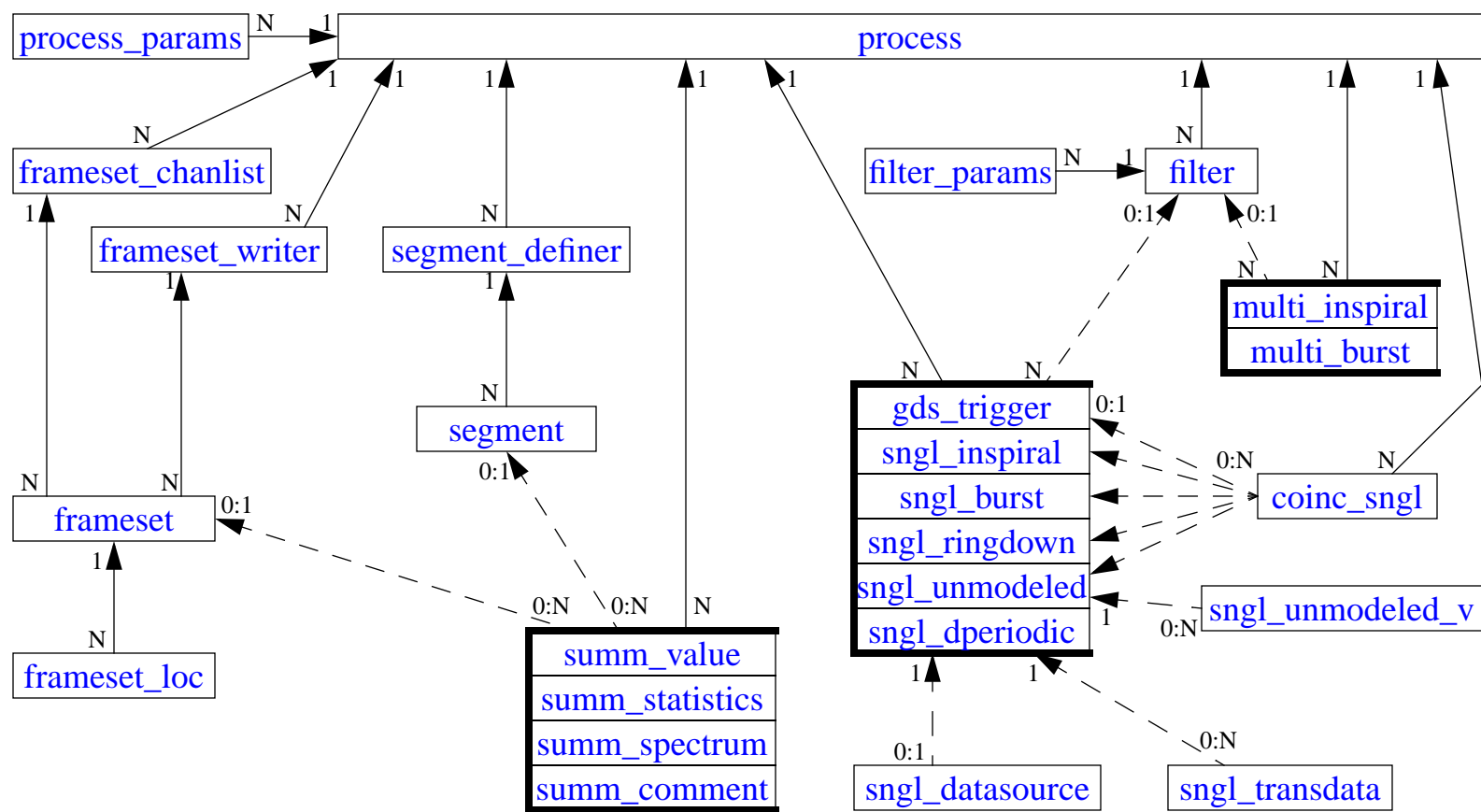
- Metadata about raw data
 - “Framesets” (catalog of data files and their contents)
 - “Segments” (time intervals of interest, e.g. when a particular interferometer was locked)
- Summary information for arbitrary time intervals
 - Scalar values (indexed by descriptive name)
 - Standard statistical quantities for a channel
 - Spectra
 - Comments
- GDS triggers
- Astrophysical event candidates of various types

Draft document with detailed definitions: LIGO-T990101-02

These table definitions are thought to fulfill most data storage needs; potential users need to write statements of proposed usage, for an approval process and for planning purposes

Once in active use, database tables can be modified in limited ways

Database Tables and Relationships



Sample Database Table Definition

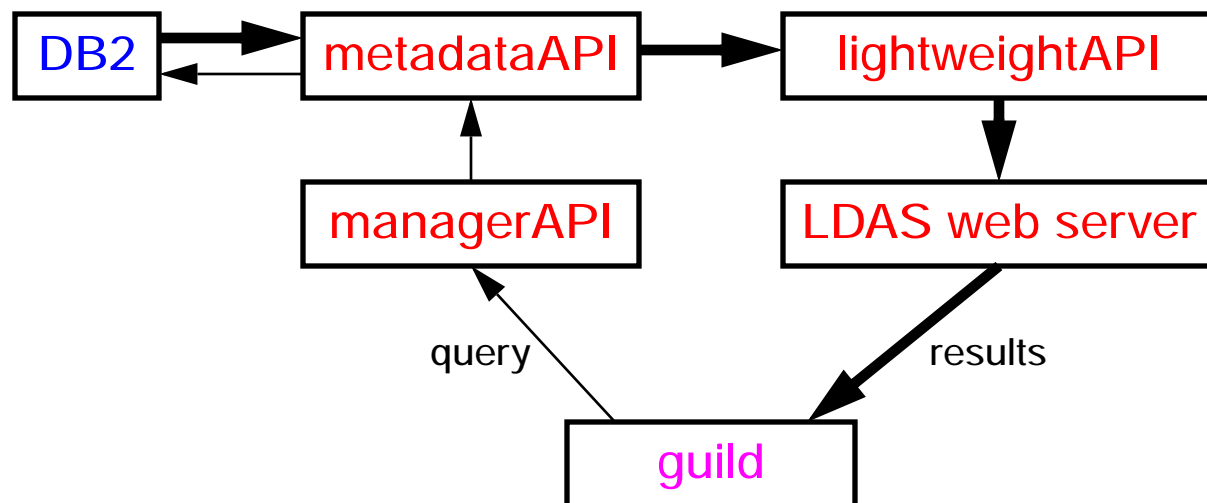
```
CREATE TABLE sngl_burst
(
-- Event table for single-interferometer burst-event search.
-- Database which created this entry
    creator_db          INTEGER NOT NULL WITH DEFAULT 1,
-- INFORMATION ABOUT THE PROCESS WHICH GENERATED THIS EVENT
-- Process which generated this event
    process_id         CHAR(13) FOR BIT DATA NOT NULL,
-- Filter identifier (indicates type of filter, plus parameters).
    filter_id          CHAR(13) FOR BIT DATA,
-- Interferometer
    ifo                 CHAR(2) NOT NULL,
-- TIME OF THE EVENT
-- The start time of this burst event (in GPS seconds and nanoseconds)
    start_time         INTEGER NOT NULL,
    start_time_ns      INTEGER NOT NULL,
-- The time duration of this burst event (seconds)
    duration            REAL NOT NULL,
-- PROPERTIES OF THE EVENT
-- Center of frequency band in which observation is made (Hz)
    central_freq       REAL,
-- Range of frequency observed (Hz)
    bandwidth          REAL,
-- Absolute signal amplitude (fractional strain)
    amplitude          REAL NOT NULL,
-- Signal to noise ratio
    snr                REAL,
-- Confidence variable
    confidence         REAL,
-- Unique identifier for this event
    event_id           CHAR(13) FOR BIT DATA NOT NULL,
)
```

Graphical User Interface to LIGO Database (“guild”)

Written as a Tcl/Tk script (requires latest version of Tcl/Tk)

Provides a point-and-click method to build database queries (in DB2's native SQL language), with various optional qualifiers

Sends query to the LDAS managerAPI, retrieves file of matching database records via http, and displays them as a scrollable table



Knows about the relationships between tables, and provides cross-reference links

Sample “guild” Windows

The screenshot displays the 'guild' graphical user interface for the LIGO Database. The main window shows a table of search results with columns: IFO, START_TIME, DUR, AMP, FREQ, Q, MASS, SNR, CONFIDENCE, and EVENT_ID. A dialog box titled 'Build query for table' is open, showing query construction options. Below it, a 'Built SQL query' window displays the generated SQL query.

Main Window Table:

| Rows | IFO | START_TIME | DUR | AMP | FREQ | Q | MASS | SNR | CONFIDENCE | EVENT_ID |
|------|------------|------------|-----|-----|------|----|------|-----|------------|----------|
| 1 | 481426+ H1 | 632183714 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | X'20000 |
| 2 | 481426+ H1 | 632183715 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | X'20000 |
| 3 | 481426+ H1 | 632183716 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | X'20000 |
| 4 | 481426+ H1 | 632183717 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | X'20000 |
| 5 | 481426+ H1 | 632183718 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | X'20000 |
| 6 | 481426+ H1 | 632183719 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | X'20000 |
| 7 | 481426+ H1 | 632183720 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | X'20000 |
| 8 | 481426+ H1 | 632183721 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | X'20000 |
| 9 | 481426+ H1 | 632183722 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | X'20000 |
| 10 | 481426+ H1 | 632183723 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | X'20000 |
| 11 | 481426+ H1 | 632183904 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | X'20000 |
| 12 | 481426+ H1 | 632183905 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | X'20000 |
| 13 | 481426+ H1 | 632183906 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | X'20000 |
| 14 | 481426+ H1 | 632183907 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | X'20000 |
| 15 | 481426+ H1 | 632183908 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | X'20000 |
| 16 | 481426+ H1 | 632183909 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | X'20000 |
| 17 | 481426+ H1 | 632183910 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | X'20000 |
| 18 | 481426+ H1 | 632183911 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | X'20000 |
| 19 | 481426+ H1 | 632183912 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | X'20000 |
| 20 | 481426+ H1 | 632183913 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | X'20000 |

Build query for table dialog:

- Columns: All
- Order by column(s): end_time
- Qualifiers:
 - interferometer is H1
 - coalescence time =
 - duration (seconds) > 30
 - time of peak filter output =
 - duration of filter (seconds) =
 - signal amplitude (fractional) =
 - mass of heavier object (solar) =
 - mass of lighter object (solar) =
 - coalescence =
 - effective distance =
 - signal-to-noise ratio =
 - confidence =
 - creator database ID =

Built SQL query window:

```
SELECT * FROM SNGL_INSPIRAL WHERE (ifo = 'H1') AND (duration > 30) ORDER BY end_time
```

Summary of Database Status

LDAS database-related software is being shaken down;
should have a constantly-running system before too long

Database table definitions need one more round of revisions before
being put into active use

Graphical User Interface is essentially ready

Need to set up automatic data replication between database sites

Still need to standardize input/output tools, e.g. LIGO_LW formatting
and parsing by user programs, and procedures for inserting data

Need data to insert!