Relational Vibroacoustic Database for VISPERS

by

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presented for

The Spacecraft and Launch Vehicle Dynamics Environments Workshop

June 28, 2001 at The Aerospace Corporation, El Segundo, CA

THE AEROSPACE CORPORATION

VISPERS Project

Vibroacoustic

Intelligent

System for

Prediction of

Environments

Reliability and

Specifications

Development Team

- The Aerospace Corporation
- Cambridge Collaborative, Inc.
- The University of Alabama

Funding

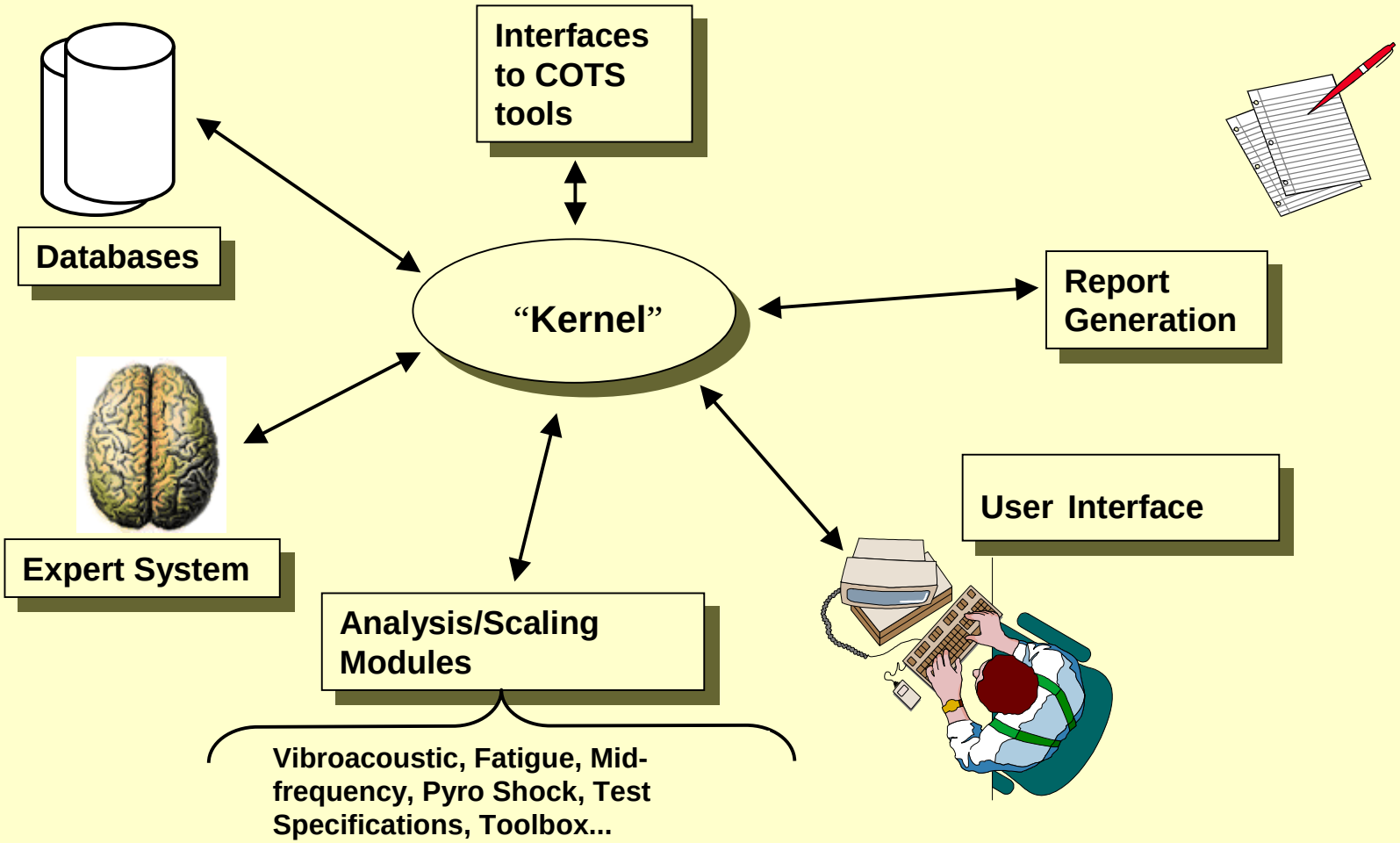
- AFRL (SBIR Program)
- Aerospace IR&D
- USAF Titan Program

Goal: To Decrease the Time and cost Required to Make Environmental Predictions, While Increasing Confidence in Those Predictions

Objectives

- A Software Package That Combines Test, Theoretical and Empirical Methods to Provide Rapid, Accurate Predictions of Vibroacoustic and Shock Environments
- “One-stop Shopping” for Data and Analysis
- Expert System Guidance to Improve the Productivity of Both Novice and Experienced Analysts Alike

VISPERS Architecture

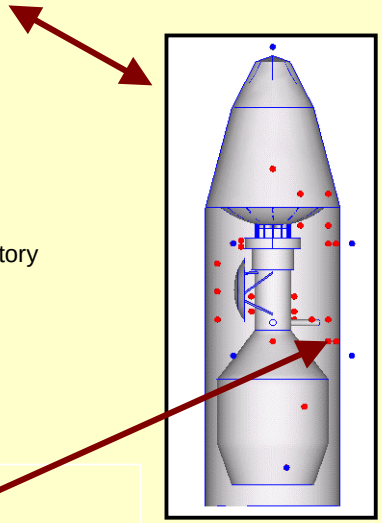


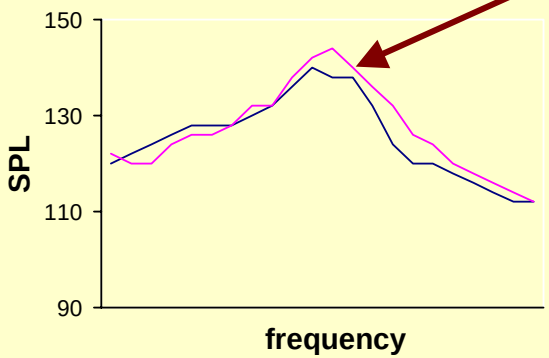
Vibroacoustic Database (overview)

- Motivation
- Challenges
- Relational Database Design
  - Solution for data organization, access and storage
- XML for Data Transfer
  - Solution for cross-platform communication across a distributed database

Motivation

Courtesy of Jet Propulsion Laboratory





- Make Archived Flight and Ground Test Data Immediately and Selectively Accessible for Vibroacoustic Analysis and Prediction Tools
  - Quickly Assemble Relevant Data From Various Sources According to Query
  - Automatically Access Information About Source and Physical Context of Data

Motivation: An Example

- For all Titan IVA/Centaur flights, gather all available acoustic spectra associated with the internal PLF environment near station 110 during lift-off.
- For all of these spectra, generate
  - an overlay plot of the spectra against the associated MPE specification
  - a graphic 3D rendering of all microphone locations
- Identify fairing size and type of acoustic blanket and percentage of coverage used for each flight
- Generate a P95/50 curve from lift-off PLF external acoustic measurements for all eastern range TIV flights

Challenges

- Efficient, yet maintainable storage of many categories of data
- Allow for many different variations and configurations of data
- Enable complex association of data of dissimilar type
- Provide necessary and relevant information in a usable form for use by analytical tools.
- Access to data stored in different locations on different database platforms
- Accommodate control of restricted and proprietary data

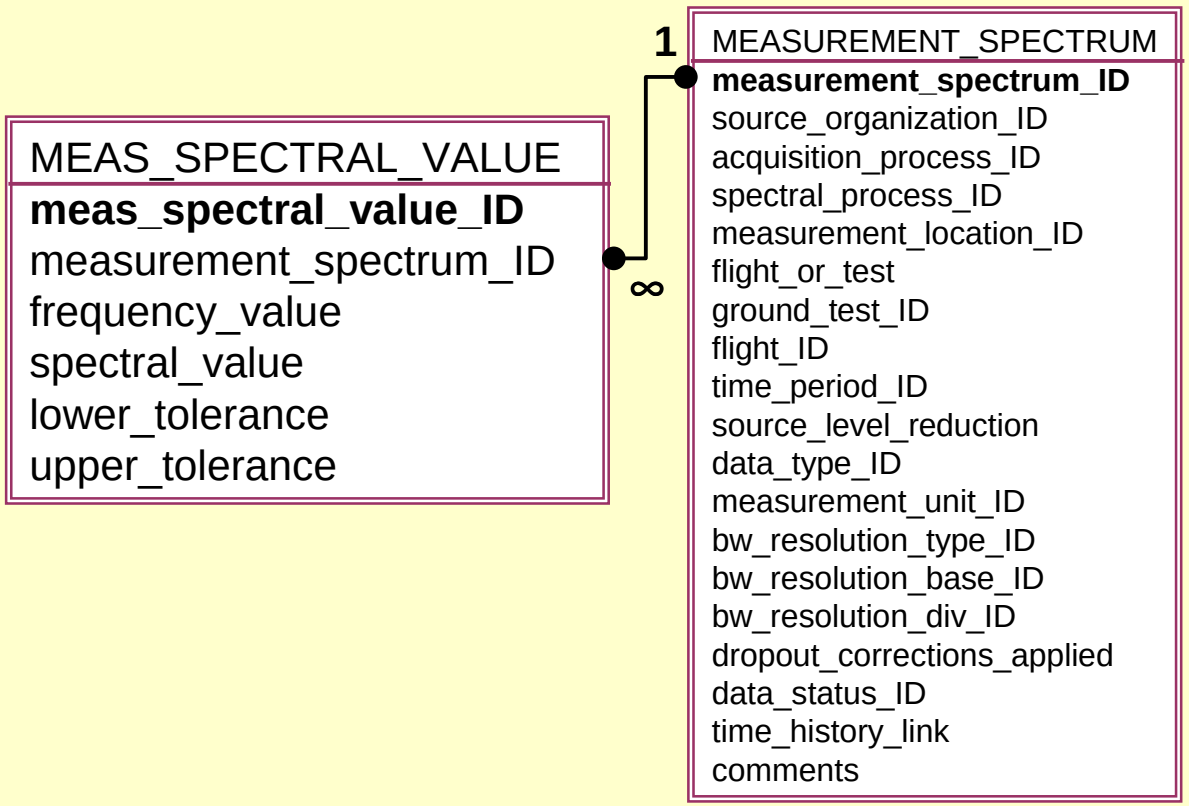
Categories of Information

- Spectra (acoustic, vibration, shock)
  - measured: flights, ground tests
  - derived: specifications, correction curves, predictions, test excitation / force limitation
  - processing parameters, data sources
- Transducer information
  - location / mounting
  - type, calibration information
  - tie location to specification zone
- Structural system configuration
  - geometry, material properties, absorption treatment
- Flight, ground test, launch facility information
- Units given explicitly for all quantitative data

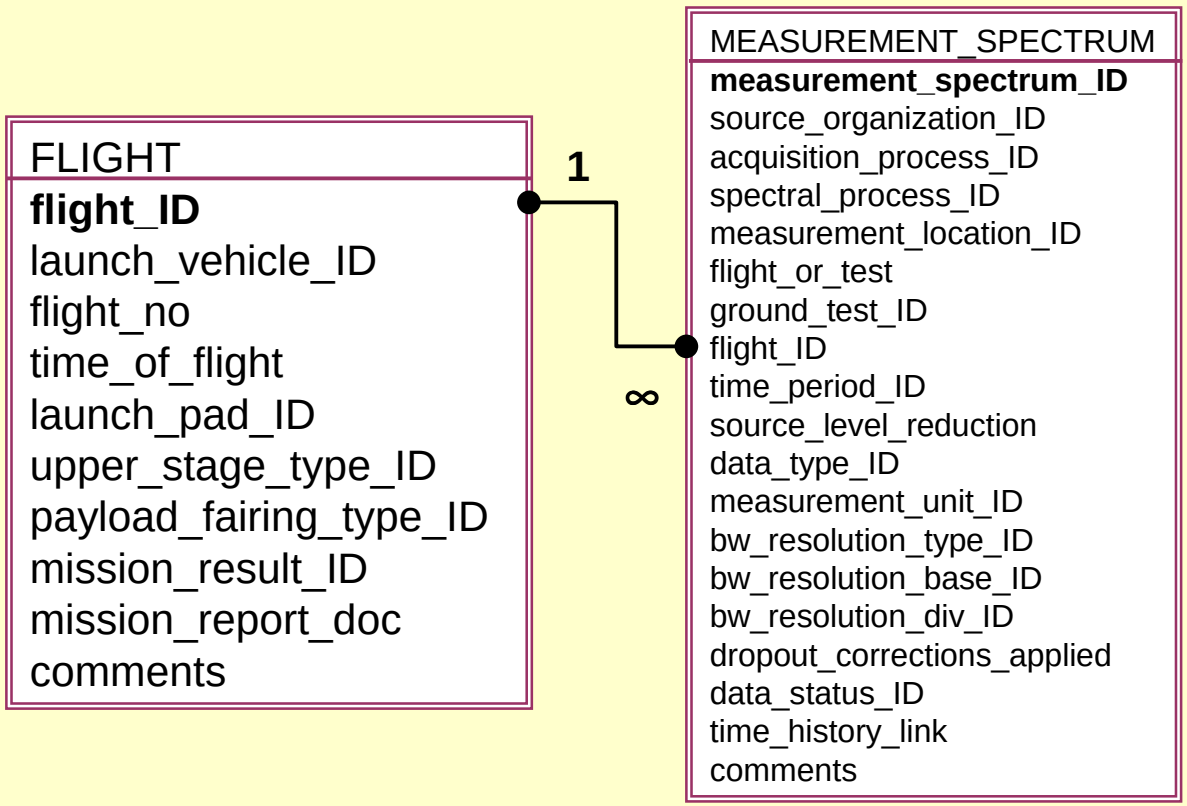
Relational Database Approach

MEASUREMENT_SPECTRUM
measurement_spectrum_ID
source_organization_ID
acquisition_process_ID
spectral_process_ID
measurement_location_ID
flight_or_test
ground_test_ID
flight_ID
time_period_ID
source_level_reduction
data_type_ID
measurement_unit_ID
bw_resolution_type_ID
bw_resolution_base_ID
bw_resolution_div_ID
dropout_corrections_applied
data_status_ID
time_history_link
comments

Relational Database Approach



Relational Database Approach



Relational Database Approach

Enumerated Type List

(user-extensible)

DATA_TYPE

data_type_ID

enum_data_type

1 acoustic

2 vibration

3 shock . . .

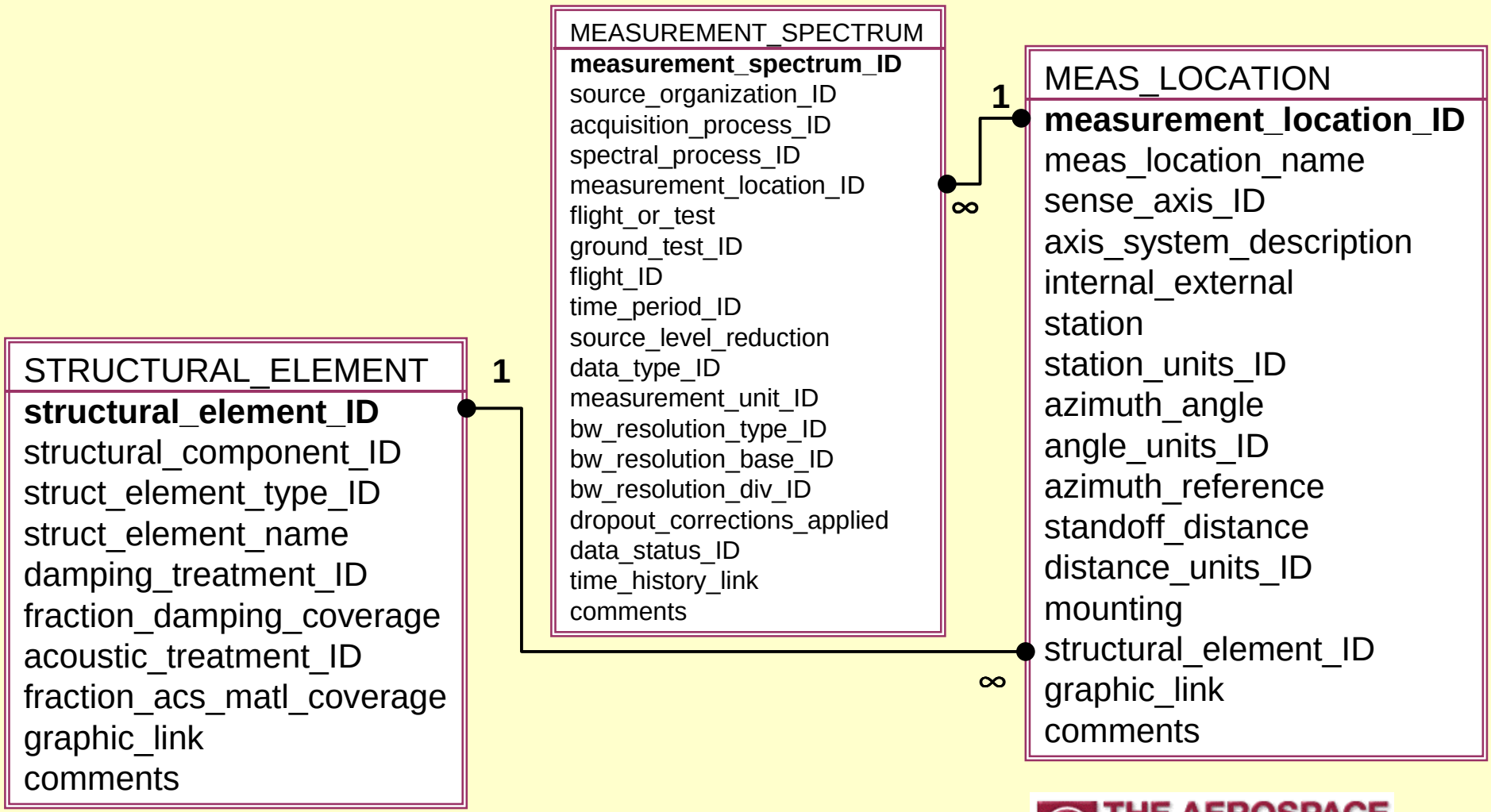
1

∞

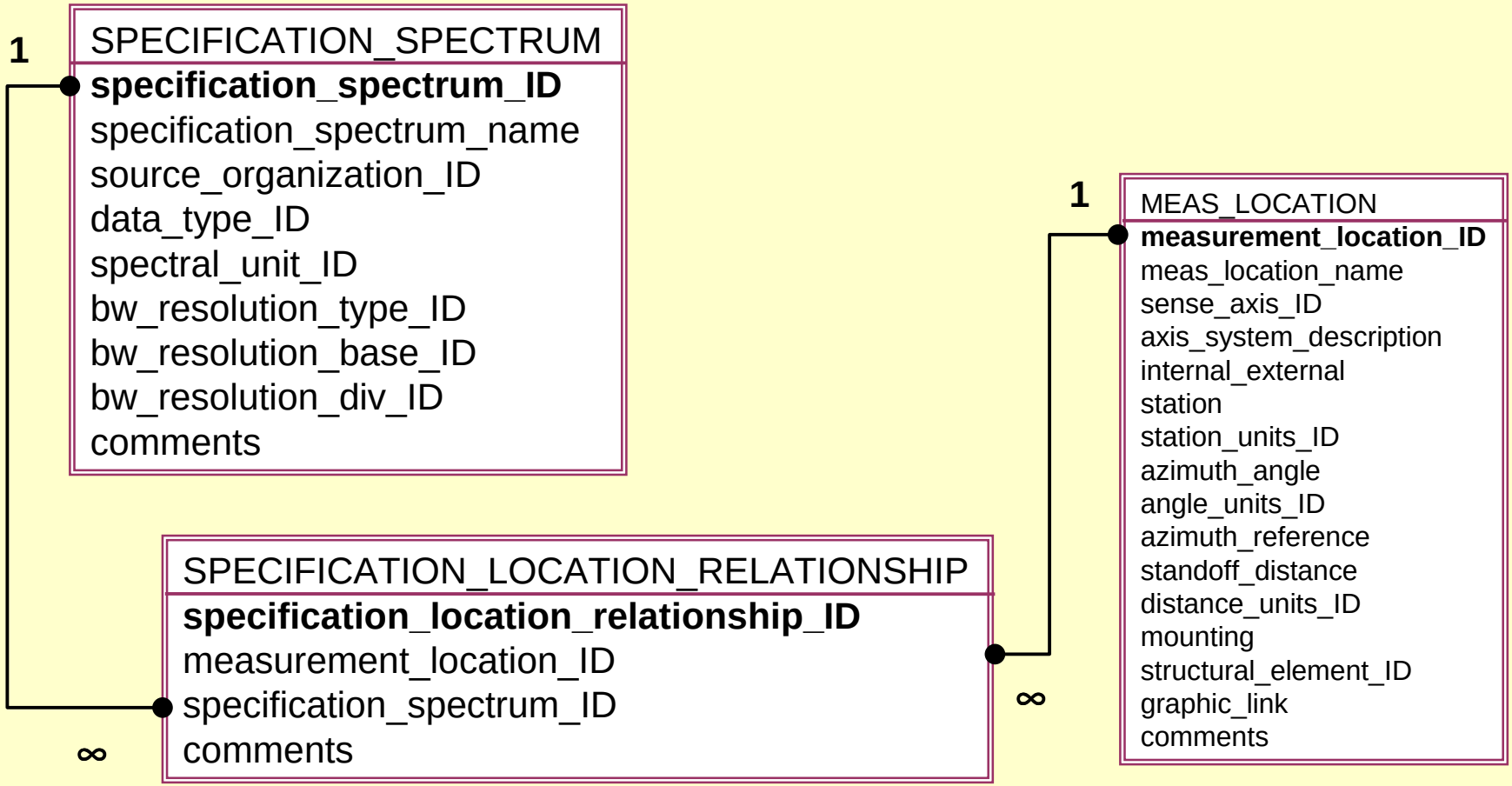
MEASUREMENT_SPECTRUM

measurement_spectrum_ID
source_organization_ID
acquisition_process_ID
spectral_process_ID
measurement_location_ID
flight_or_test
ground_test_ID
flight_ID
time_period_ID
source_level_reduction
data_type_ID
measurement_unit_ID
bw_resolution_type_ID
bw_resolution_base_ID
bw_resolution_div_ID
dropout_corrections_applied
data_status_ID
time_history_link
comments

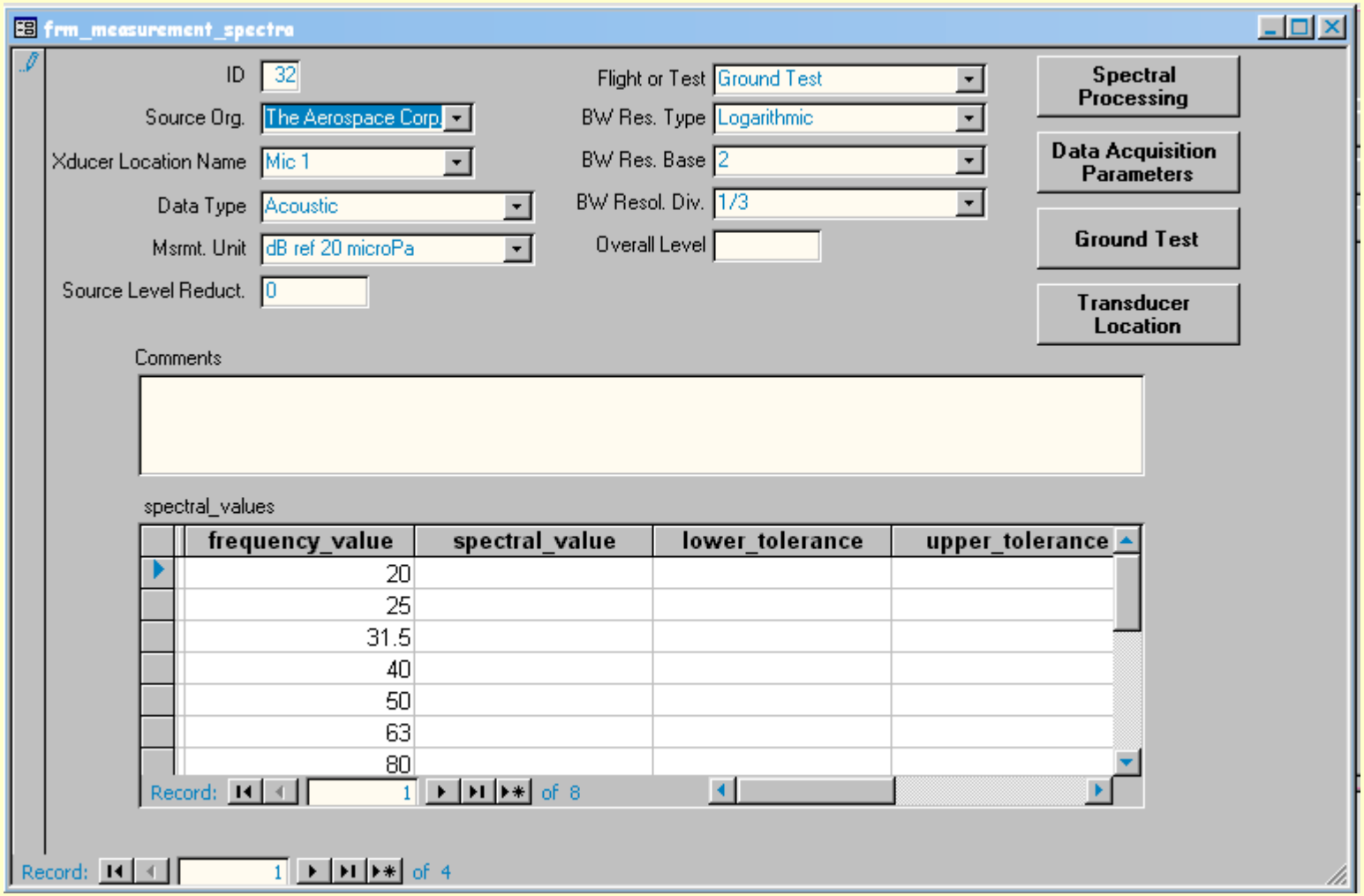
Relational Database Approach



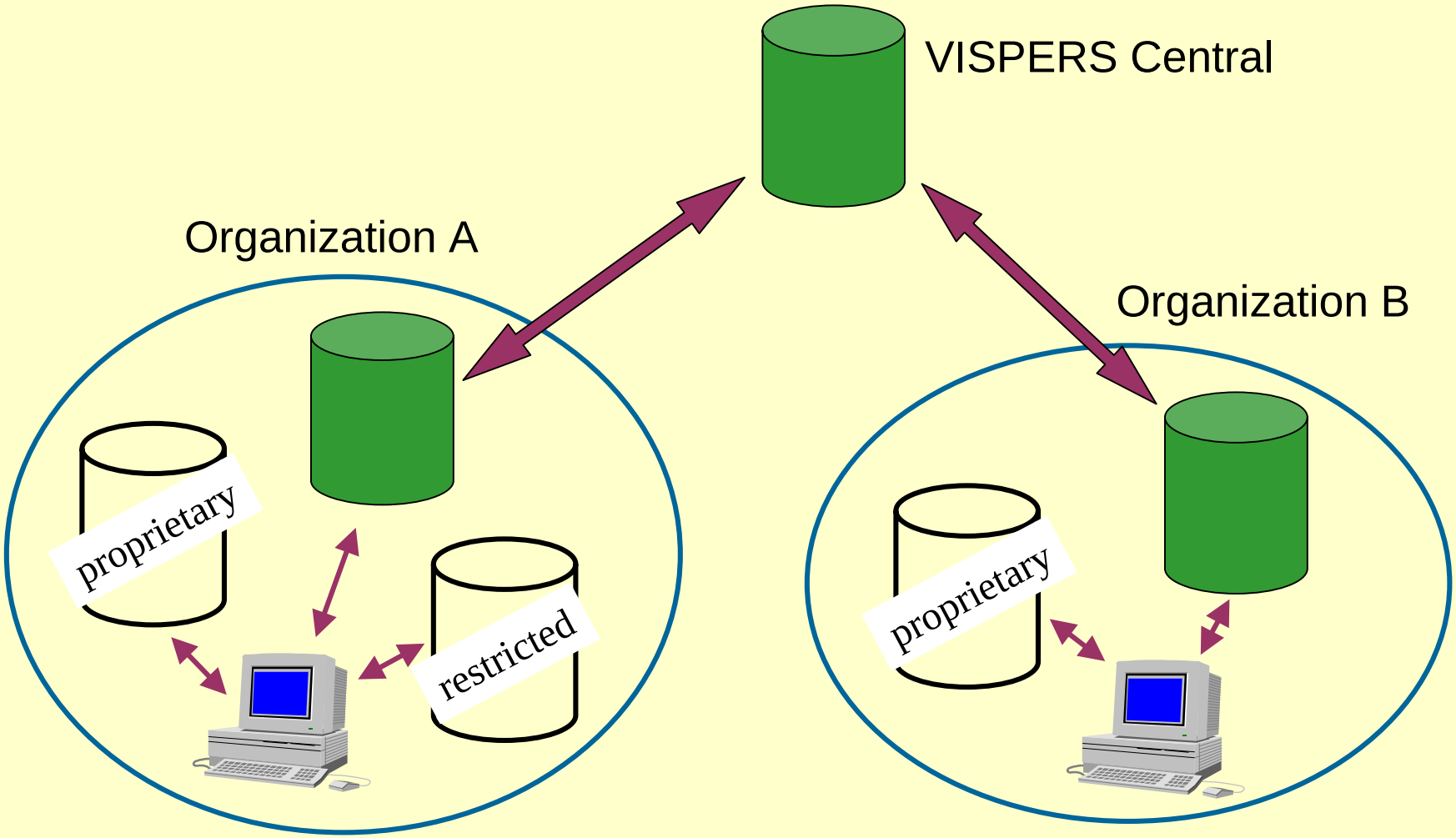
Relational Database Approach



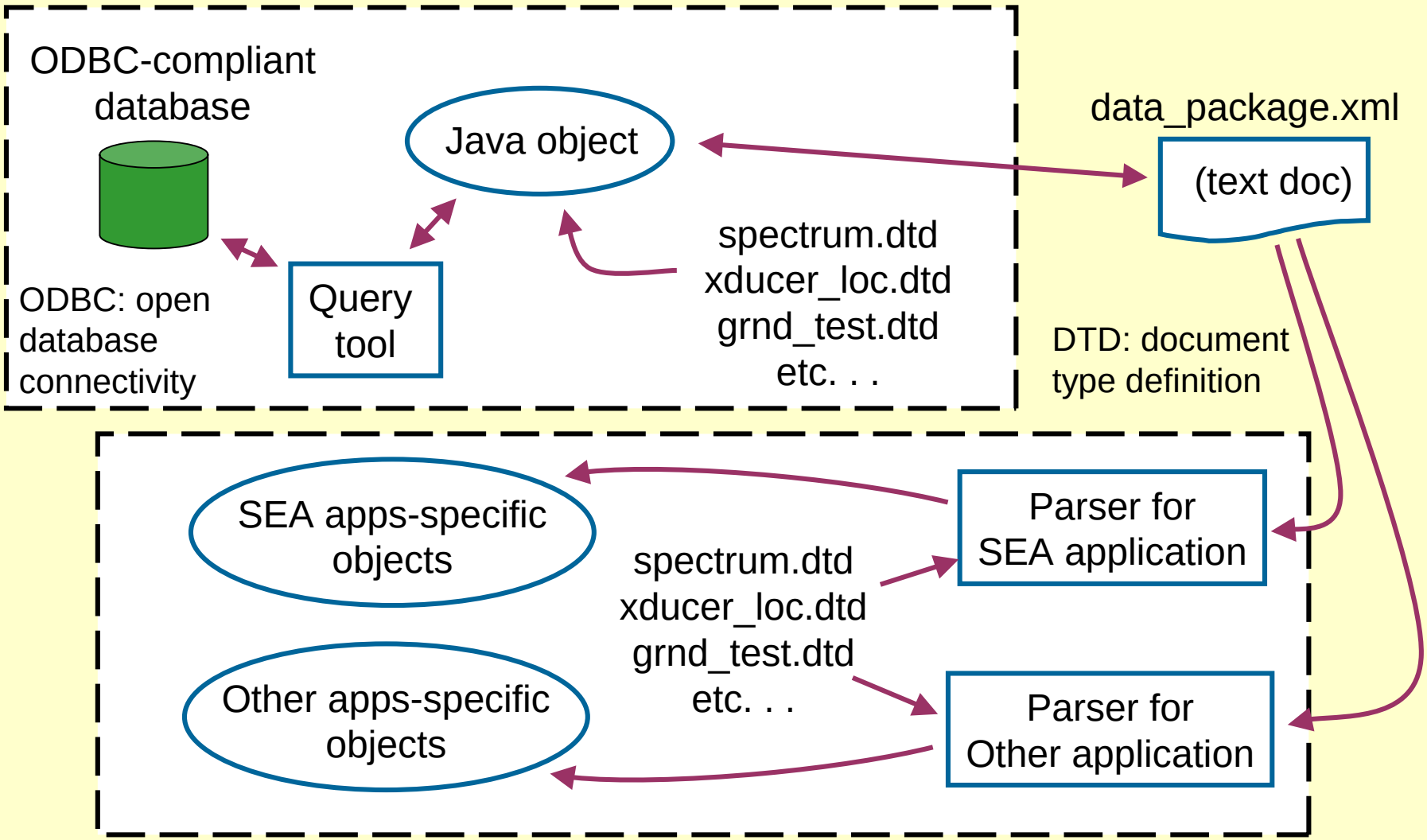
Example Input/Output Screen



Distributed Database Concept



Application of XML (eXtensible Markup Language)



Summary

- Design of a database to accommodate the VISPERS “one stop shopping” concept presents a number of challenges
- A design approach was presented which uses the structure and flexibility of a relational database to create a comprehensive and usable database
- The design uses an application of XML to provide for cross-platform connectivity of a distributed database