A Framework-Based Approach to Science Software Development

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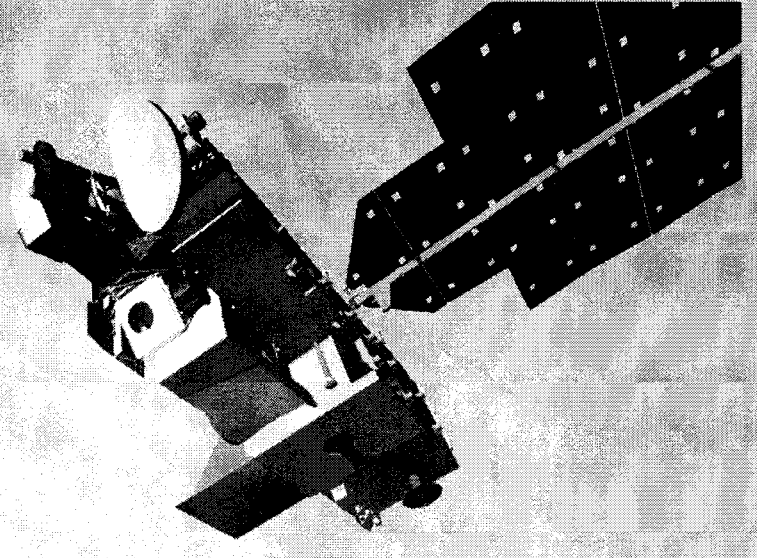
Topics

- TES Project Description
- TES Science Data Processing System
- Framework Requirements
- Framework Components
- Current Status
- Conclusion

TES Project Description

- Tropospheric Emission Spectrometer (TES)
  - Fourier Transform Spectrometer
  - One of 4 Instruments on-board EOS-CHEM Platform
  - Launch Scheduled for 12/02



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TES Project Description (cont.)

- Science Goals
  - Further understanding of long-term variations of minor gases in the troposphere
  - Understand resulting effects on climate and the biosphere.
  - Provide global maps of tropospheric ozone and its photochemical precursors.
  - Produce database of the three-dimensional distribution of gases important to tropospheric chemistry, troposphere-biosphere interactions, and troposphere-stratosphere exchange

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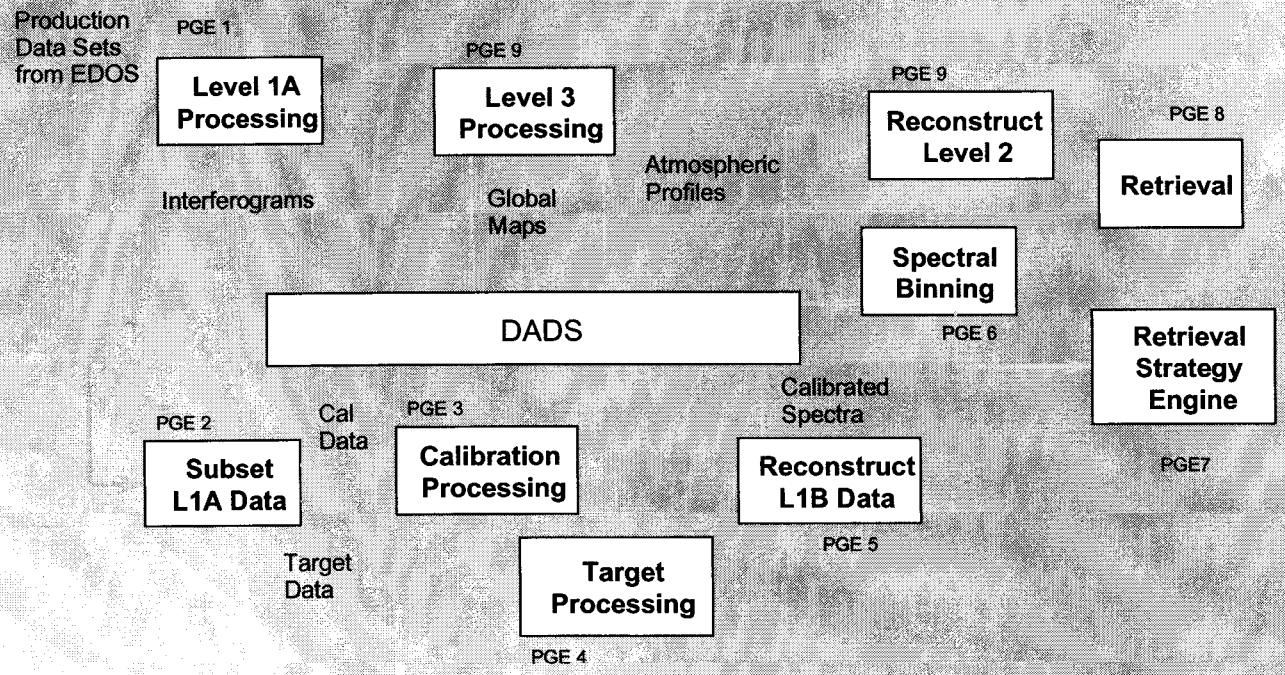
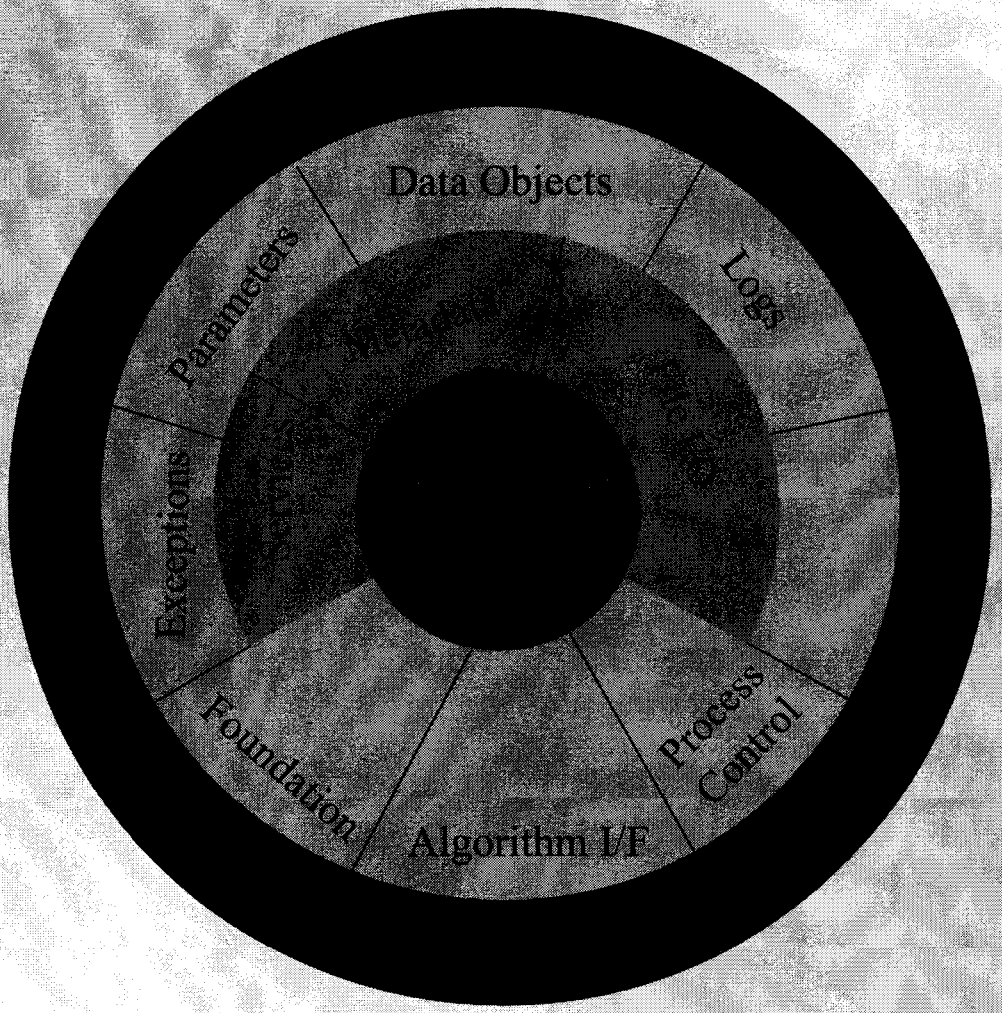
TES Science Data Processing System



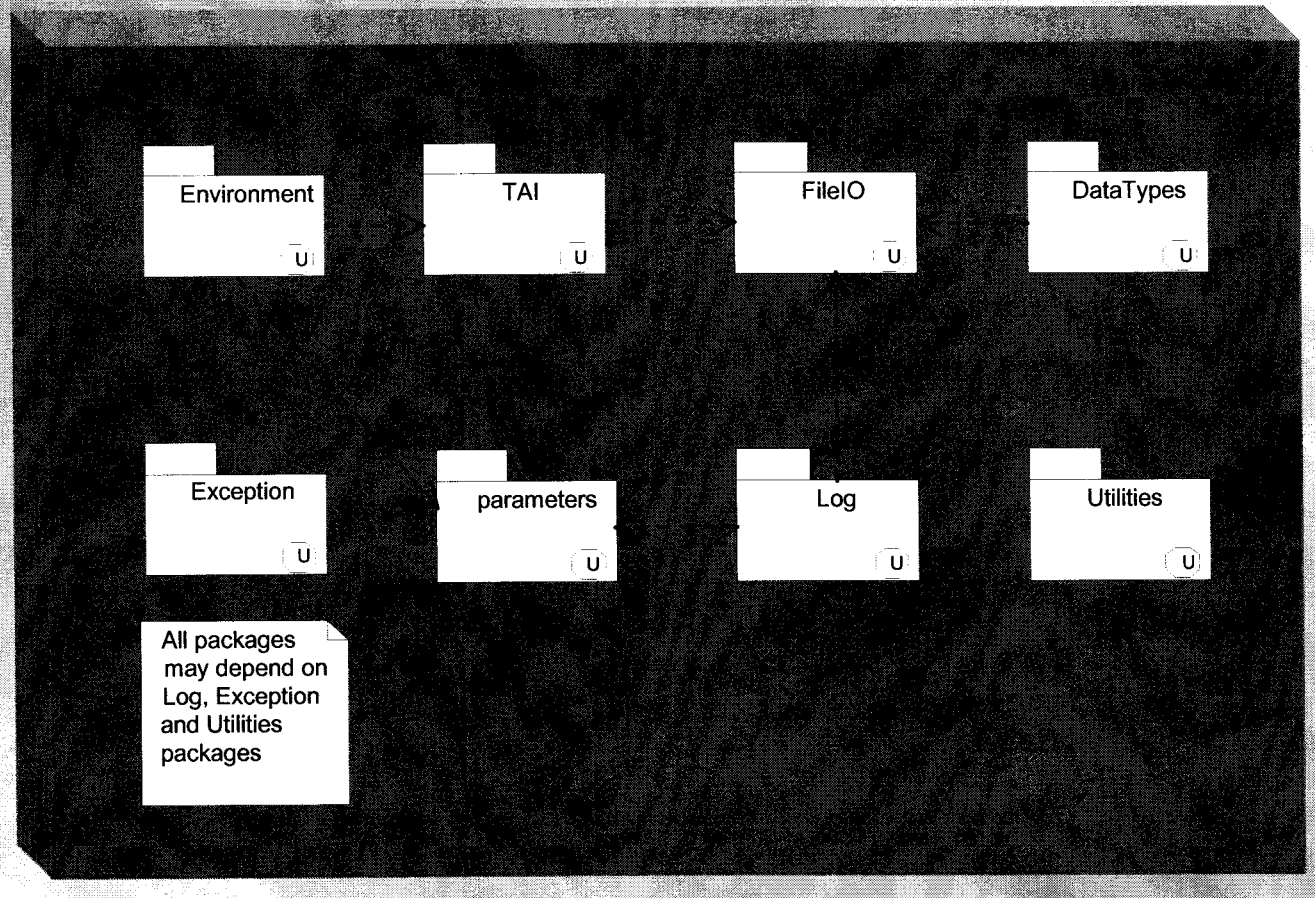
Framework Requirements

- Protect science algorithms from environment changes
- Implement common functionality
- Encapsulate utilities and 3rd-party packages
- Minimize run-time overhead due to large data volumes (>60 GB/day)
- Highest level of reliability

System Diagram



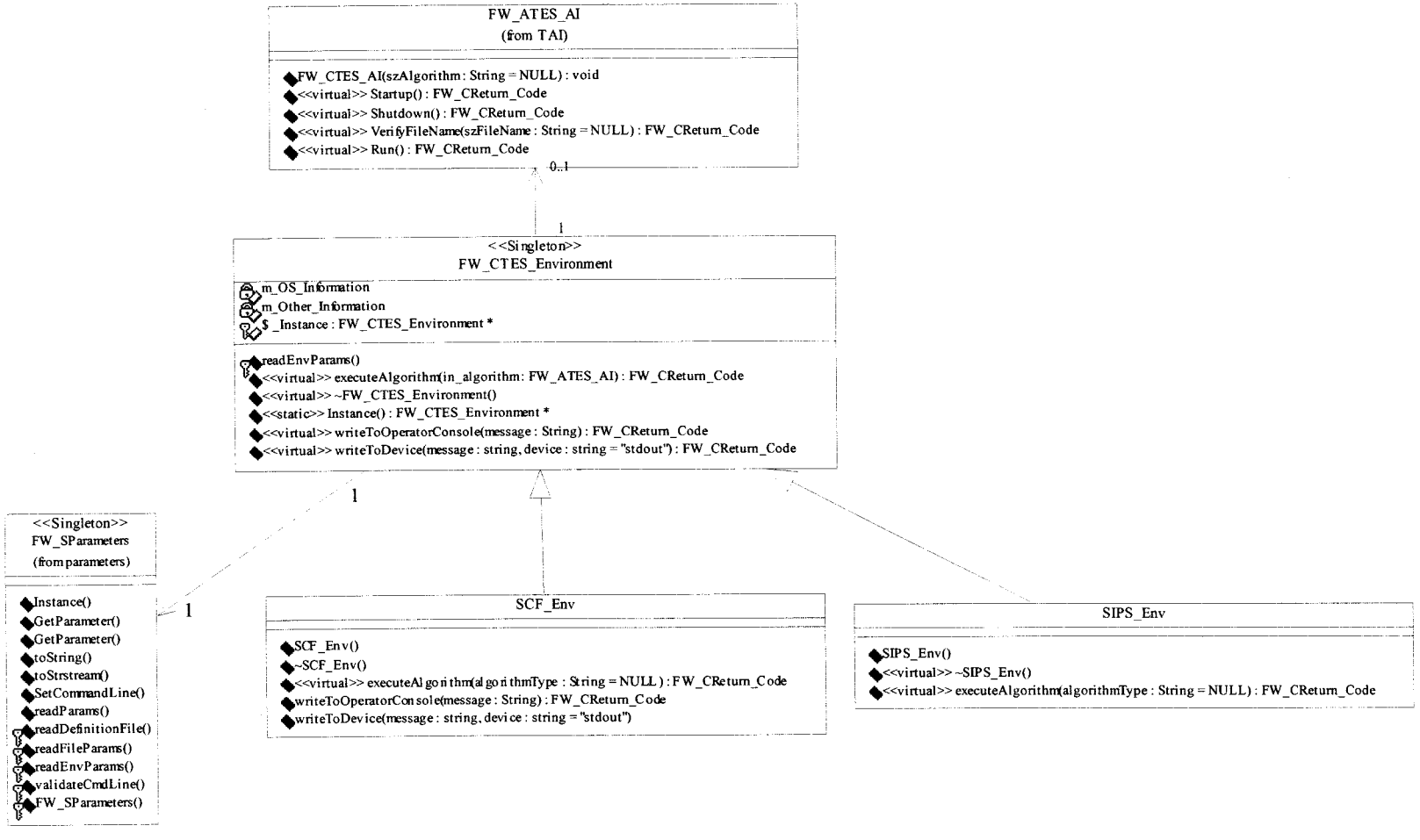
Current Packages



Environment and Algorithm Packages

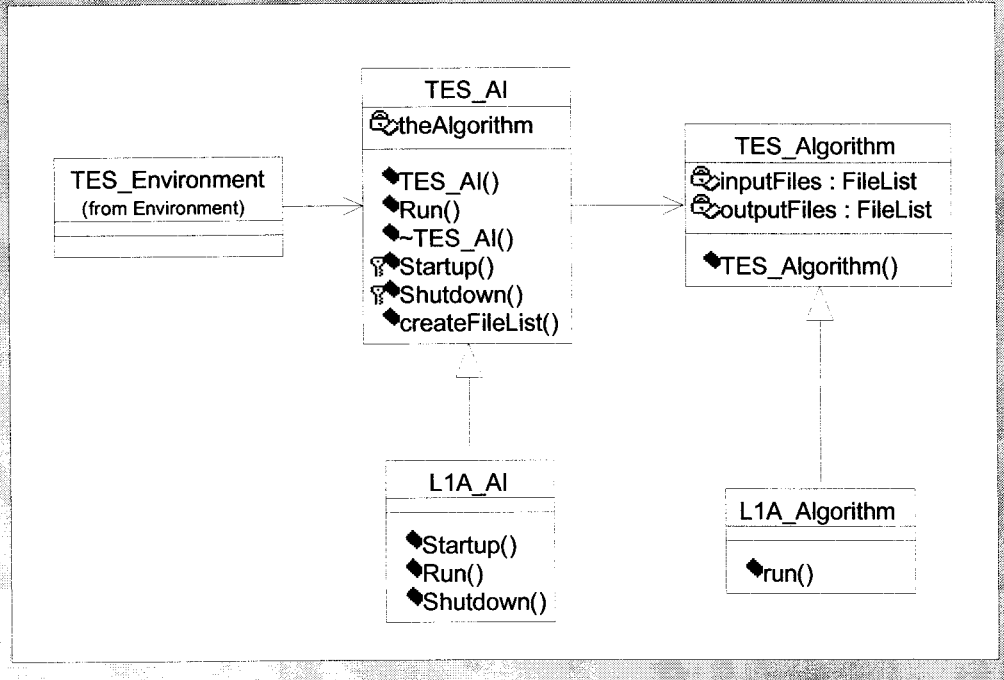
- Provide a generic processing environment interface, so the same application code can run in any of the specified environments (SIPS/DAAC/SCF).
- Provide a generic application implementation.
- Support a mechanism to build an application from the components of framework.
- Provide a generic construct which supports the derivation of level-specific algorithm implementations.

TES_Environment Design



Algorithm Interface Design

- Based on bridge design pattern
- Intent: "decouple an abstraction from its implementation so that the two can vary independently."

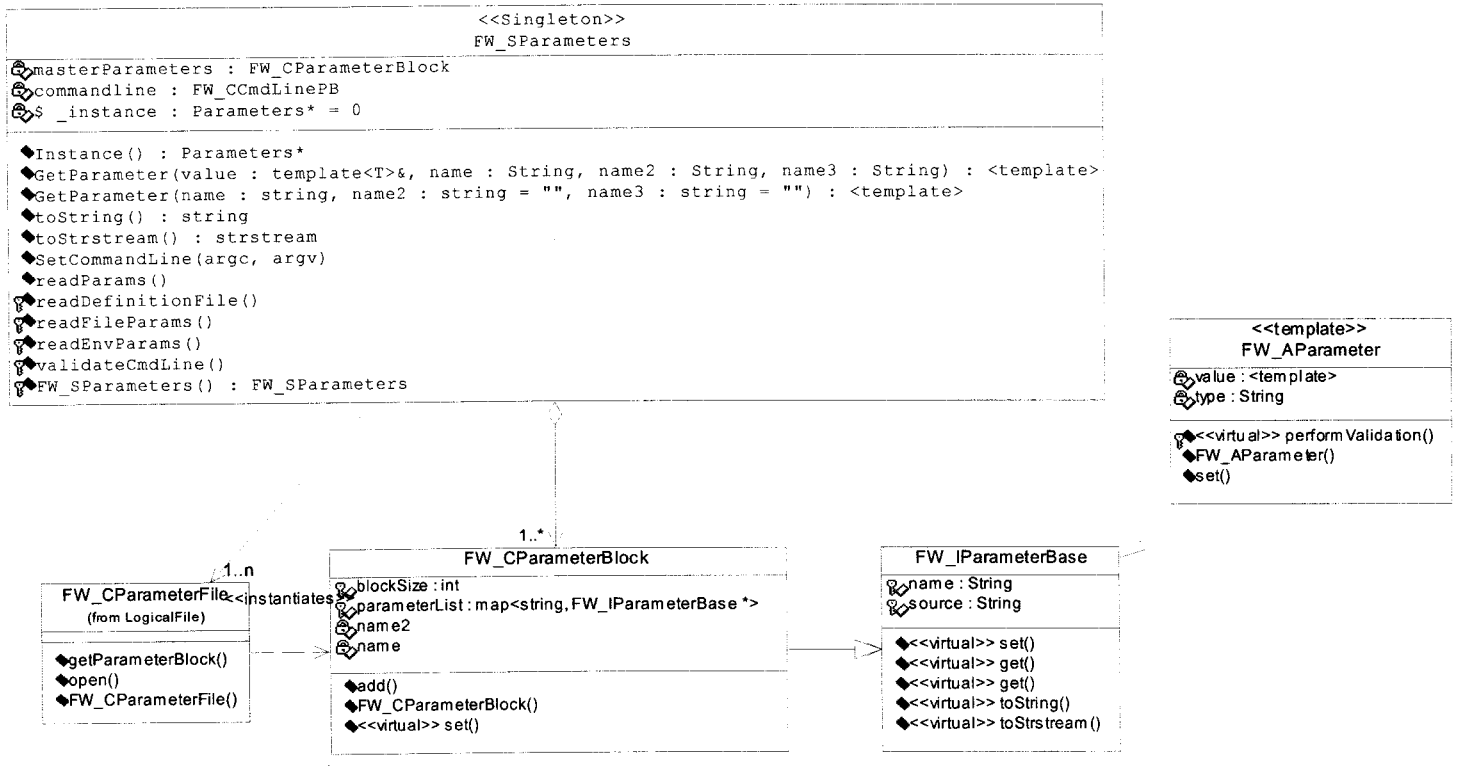


Parameter Handling Requirements

- Provide a mechanism to receive parameters from multiple sources - command line, application's parameter file, production environment's parameter file, environment variables and application default setting.
- Provide methods/functions to access input parameter values.
- Inhibit updates to parameter values during the application execution.

Parameter Handling Design

- Implemented as a singleton design pattern
  - Intent: "ensure a class only has one instance, and provide a global point of access to it."

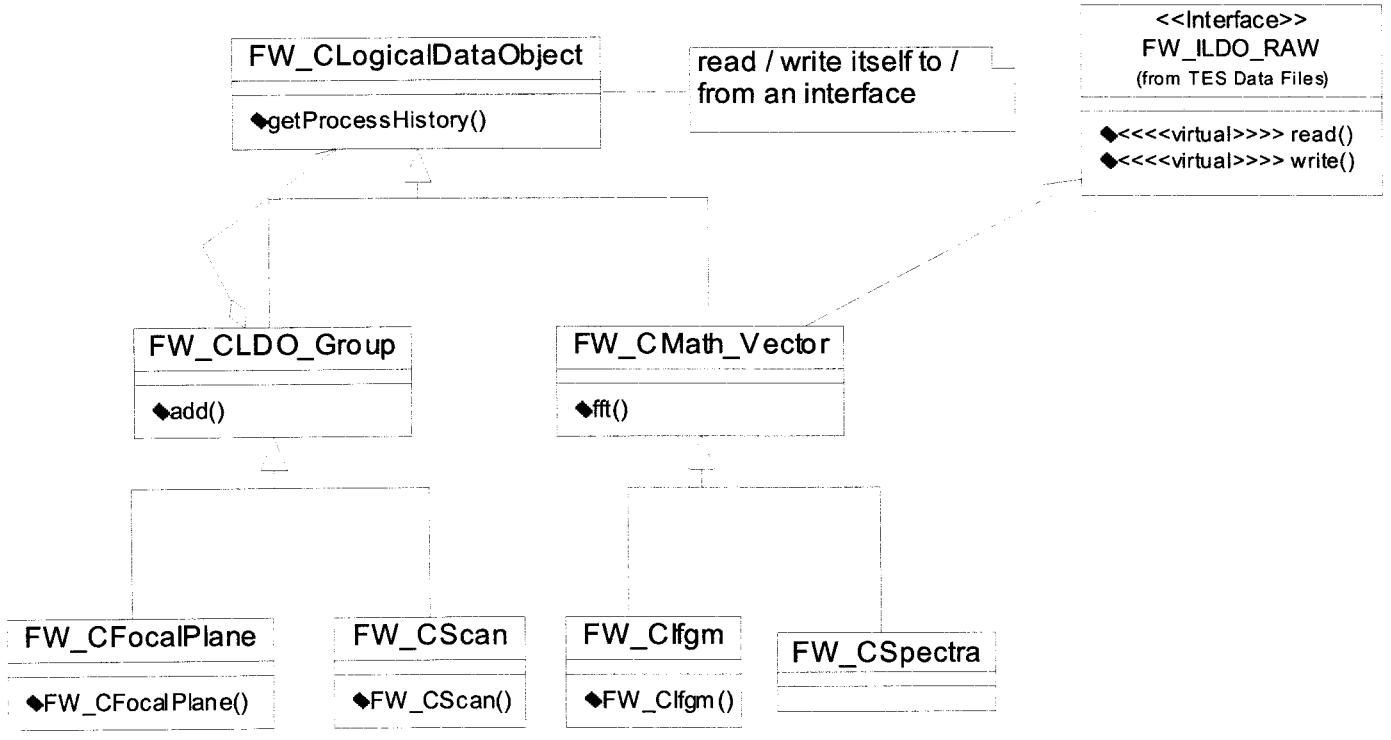


Data Handling Requirements

- Use a generic structure that will support a broad range of application data types.
- Provide TES-specific data types such as interferogram, spectra, etc.
- Provide a mechanism for applications to extend the TES-specific data types to implement application-specific high level data types.

Logical Data Objects

- Based on composite design pattern
- Intent: "compose objects into tree structures to represent part-whole hierarchies. Composite lets clients treat individual objects and compositions of objects uniformly."



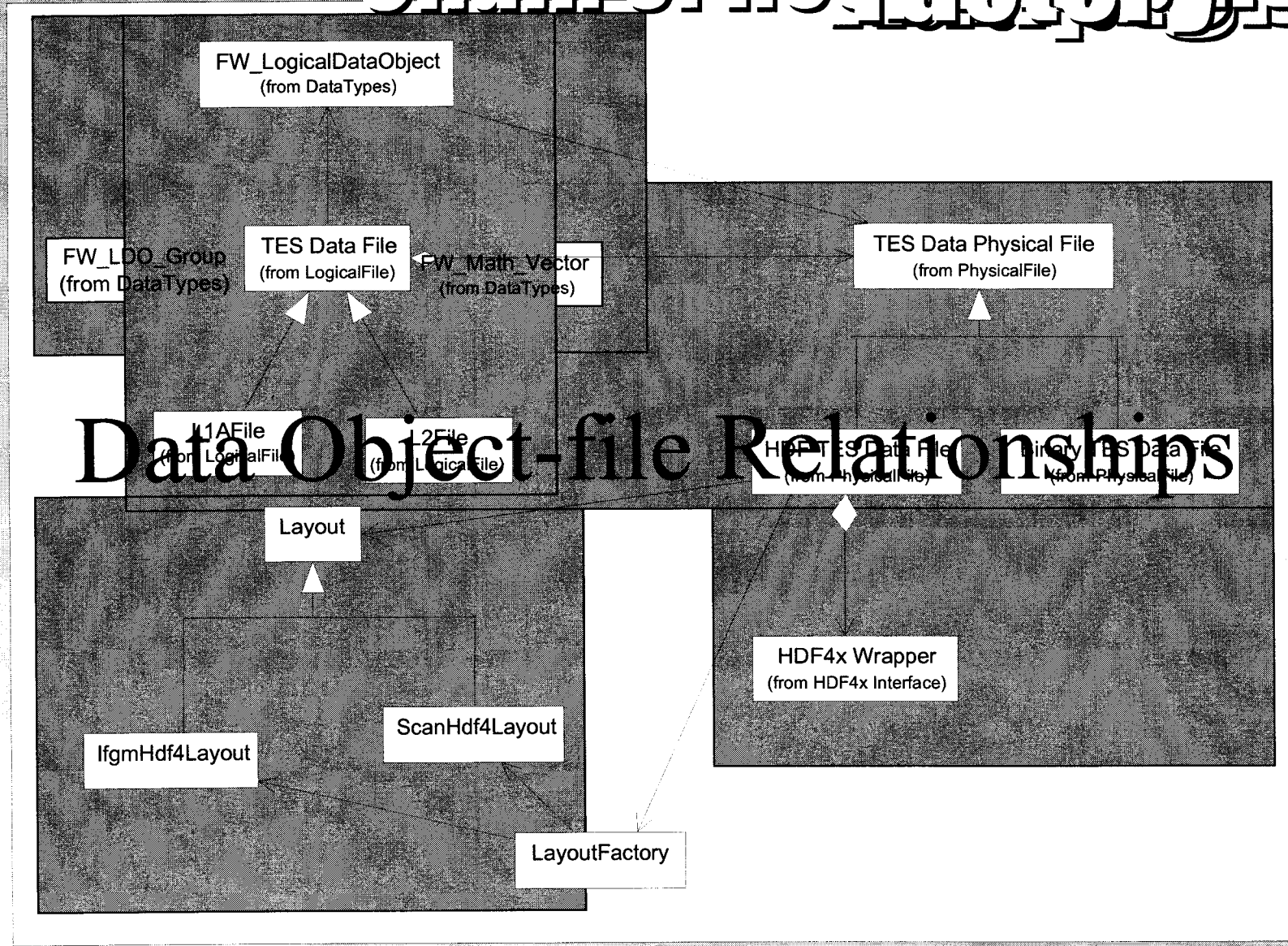
File I/O Introduction

- File handling has proven to be most complex component (so far)
- Difficult to reduce coupling with data objects to a minimum
- Multiple File Format requirement causes some difficulty

File I/O Requirements

- Provide a common interface to a file, independent of its physical format, for use from an application.
- Insulate the application programs from the underlying library (such as SDP tool kit/ HDF-EOS libraries).
- Provide a mechanism for an application to write and read data to and from :
  - HDF 5
  - HDF EOS
  - Binary
  - ASCII

Chain of Responsibility



Data Object-file Relationships

Additional Packages

- Log files
- Exception Handling
- Process Control
- Utilities
- 3rd-Party Packages

Current Status

- Architectural and High-Level Designs Complete
- Detailed Designs for Environment, AI, Parameters and File I/O under way
- Iterative Development - Additional requirements resulting from $Level_x$ subsystems result in new packages
- Initial internal delivery 00Q3, external β 01Q1

Conclusion

- High level of reusability
- Reliability is paramount
- Multi-platform support
- File handling most complex portion to date
- Complex, evolving system requirements imply iterative development approach
- Development continues until 2002 - interim results at IEEE Aeroconference 01!