Infrastructure

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Infrastructure Overview

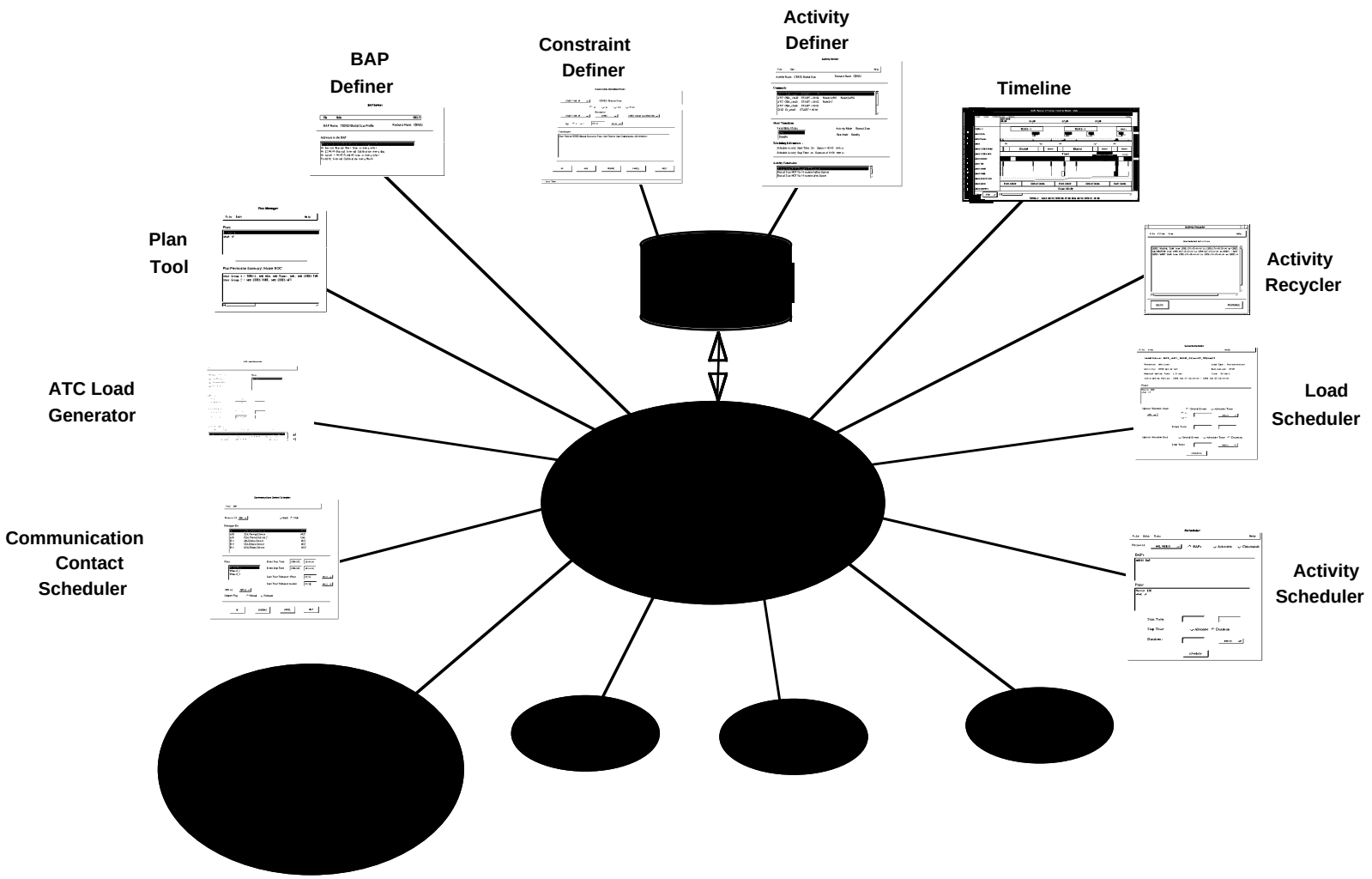
Processes Central to Planning and Scheduling System

- **Resource Model**
  - **Models components of P&S system**
- **Data Distributor**
  - **Distributes modeling data**

Includes Common Portions of P&S Processes

- **DMS Interface**
  - **Interface between P&S processes and FOS database**
- **FUI Interface**
  - **Interface between P&S GUI processes and FOS User I-F**

Infrastructure Processes



Resource Model Design

Heart of Planning and Scheduling Software

Models Resources and Their State Through Time

- e.g., MODIS instrument and its mode configurations

Performs Constraint Checking

Handles Scheduling Requests by Allocating Activities Against Resources

Acts as Server to Other P&S Client Processes

Resource Model Consists of Many Subcomponents

- Resources and states
- Activities and plans
- Schedulable resources
- Client interface and messages

Resource Model Design (cont.)

Design Based on Delphi Resource Model Design

- **Delphi COTS provides over 10,000 lines of code**

Stores and Retrieves main Scheduling Data From FOS Database

- **Resources, states, activities obtained from DB at startup**
- **Reports can be generated using DMS Report Generator**

Combines Model and Rule-based Mission Scheduling

- **Constraint modeling based on Delphi product**
  - **Completely flexible to handle any constraint**
  - **Multi-mission extensibility**
- **Rule-based temporal constraint checking added**
  - **Generically handles most constraints**

Resources and States Design

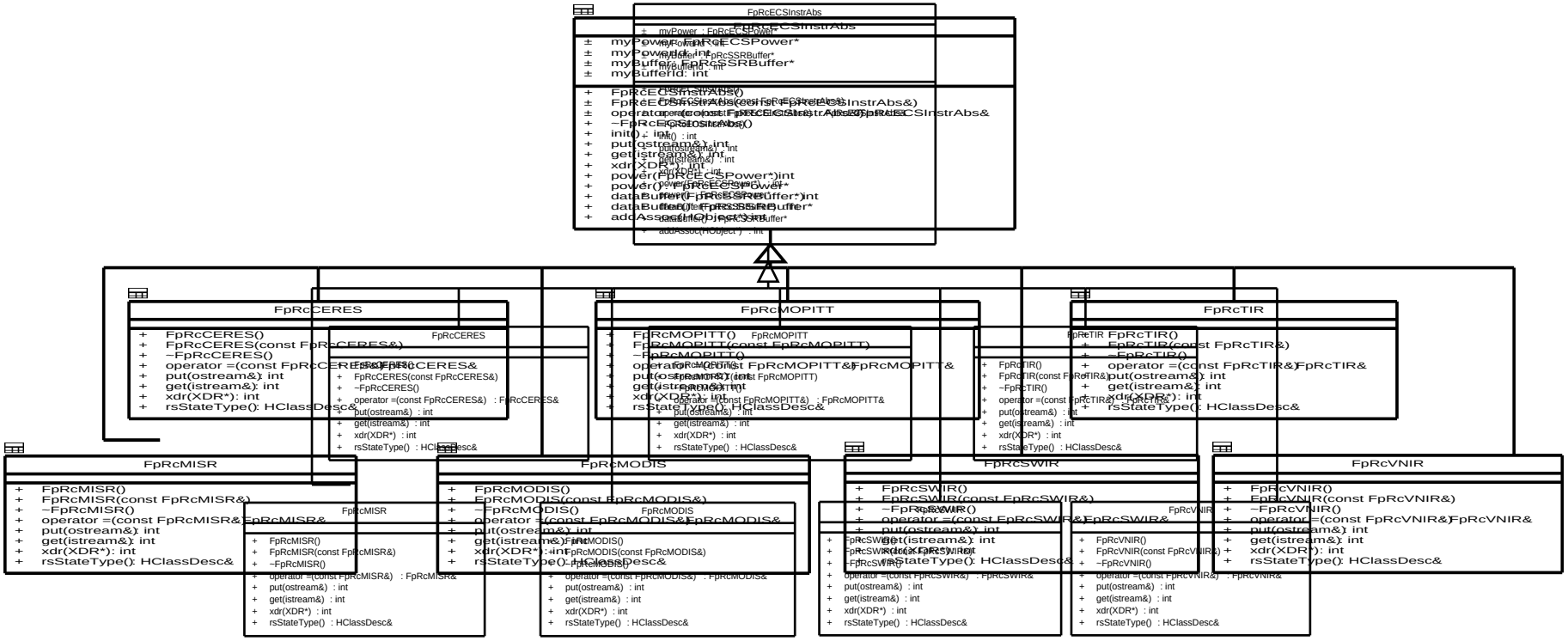
Resources Include Mission Planning Domain Modeling

- **Subscribable, e.g., CERES, MODIS, MISR, MOPITT, ASTER**
- **Consumable, e.g., power subsystem, SSR buffers**
- **Informational, e.g., TDRSS and AM1 spacecraft, WOTS, GN, DSN ground stations**

Resources Contain State Through Time

- **Instruments contain modes/configurations of operation**
- **Consumable resources contain values through time**
  - **e.g., power available, solid state recorder pointer positions**
- **EOS spacecraft contain orbit events**
- **TDRSS and ground stations contain visibility periods**
- **All resources can have constraint states, e.g. power exceeded**

Instrument Resources Object Model



Resources and States Design (cont.)

Derived ECS Specific Resource Classes Contain Added Behavior

- **Inter-resource associations**
  - **Instruments with S/C subsystems (power, SSR buffers)**
- **High gain antenna slew rate determination algorithms**
- **Solid state recorder (SSR) buffer size and pointer position limits**
- **Power subsystem wattage usage limits**

Considerable Amount of Resource and State Code Obtained From Delphi

Activities and Plans

Activities are Resource Configurations for a Specified Time Period

- **e.g., MODIS will perform a night imaging activity for 2 hours**

Activities Have Associated Activity Definitions Specifying the Commands that Caused the Configuration

Within the Resource Model

- **Scheduling activities cause resource state changes**
- **Constraint violations are identified during activity scheduling**

Resource Model manages pool of activities

Plans are Objects Representing a Collection of Activities Scheduled Against Resources Over Time

Multiple Plans Exist Simultaneously in Resource Model

Schedulable Resources

Certain Resources in Resource Model can be Scheduled

- Instruments: CERES, MODIS, MISR, MOPITT, ASTER
- High gain antenna, Omni, Direct Access System for communication contact scheduling

Activities Scheduled Against Schedulable Resources

Non-schedulableResources Provide Needed State Information

- AM1 S/C - orbit events, TDRSS S/C - availability

Design Includes Schedulable Resource Objects Containing Behavior for

- Determining constraint violations
- Creating resource states as a result of activity allocation

Extensible to Handle Resource Specific Constraint Checking

- High gain antenna slew rate constraint check

Client Interface and Messages Design

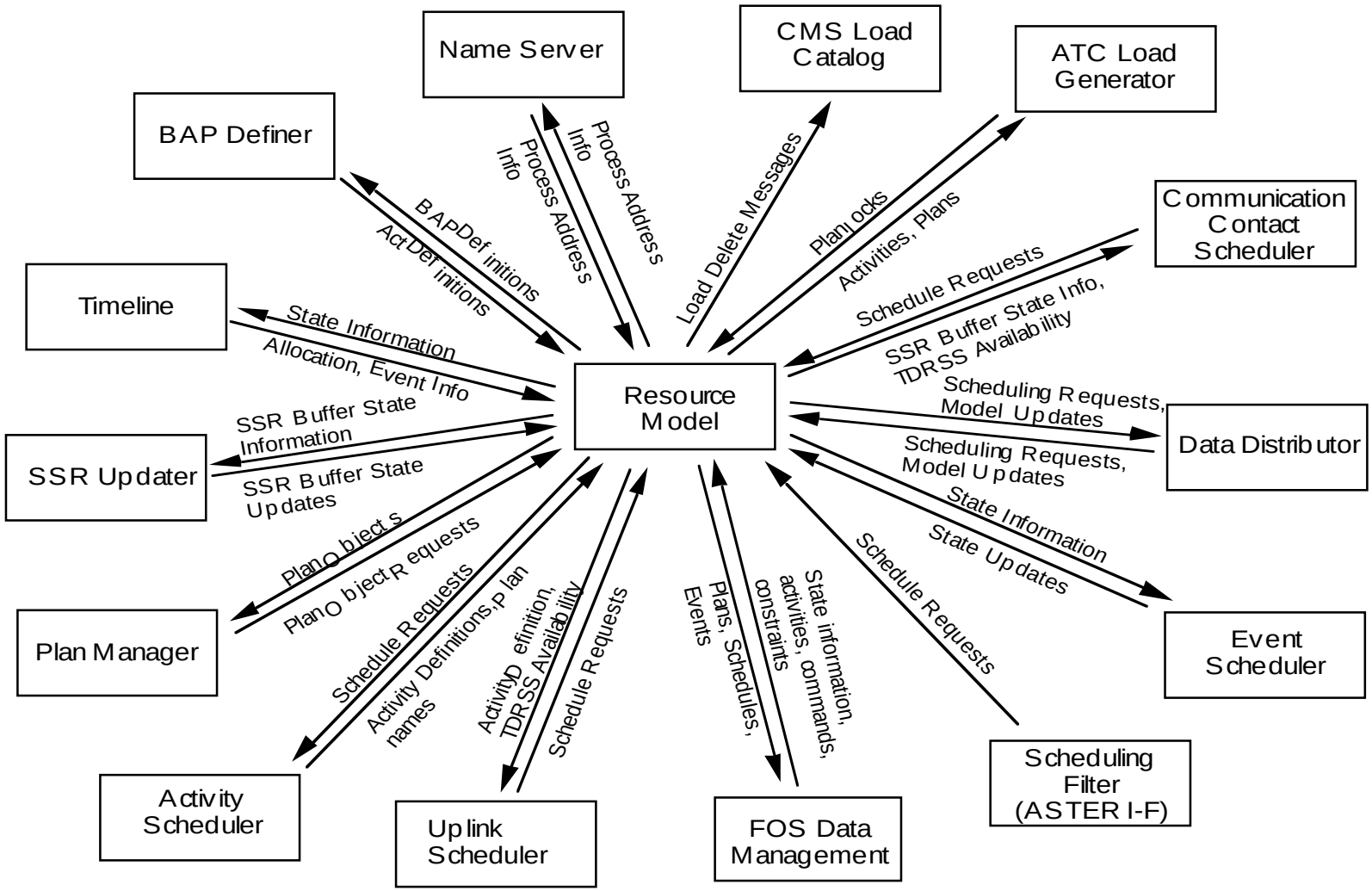
Interface Handles Messages From Resource Model Clients

- **Clients include all P&S tools except activity, BAP and constraint definer configuration Tools**

Resource Model Server Interface Consists of Client Requests For

- **Data from Resource Model (resources, activities etc.)**
- **Modeling data modification**
  - **Plan creates, deletes, access updates**
  - **Activity scheduling, unscheduling, resource state update**
- **Data storage and retrieval from FOS database**
  - **Opening, saving plans**
- **Notification when modeling data changes**
  - **Timeline request for state updates for display**

Resource Model Clients



Client Interface and Messages Design (cont.)

Design Consists of a Server Object, Client Object and Messages Passed

- **Large portion of interface obtained from Delphi**

Resource Model Client Catalog Keeps Track of Clients

- **Allows any number of client processes**
- **Keeps track of clients interested in model updates**

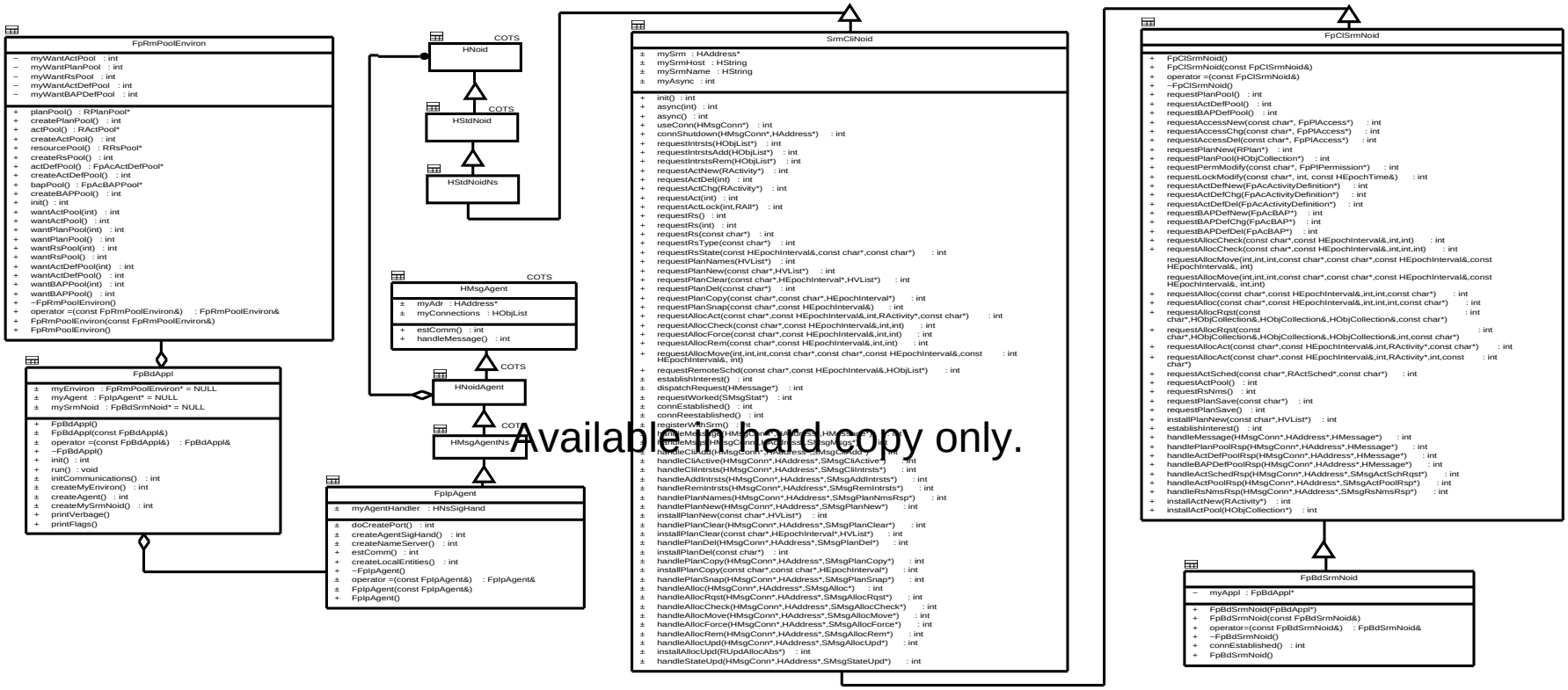
Client Interface Object Reused Among all Client Tools

- **Single “plug-in” object to interface with the resource model**

Messages Containing Client Request Passed via IPC

- **Resource Model receives message, processes it, dispatches Response back to client**

Sample Resource Model Client Object Model



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Data Distributor Design

Process to Distribute Resource Model Updates Throughout the System

- **Sending scheduling data between Resource Models**
- **Geographically distributed IST's and ICC's**
- **Heterogeneous network of major UNIX platforms (SUN, DEC, SGI, HP, IBM)**

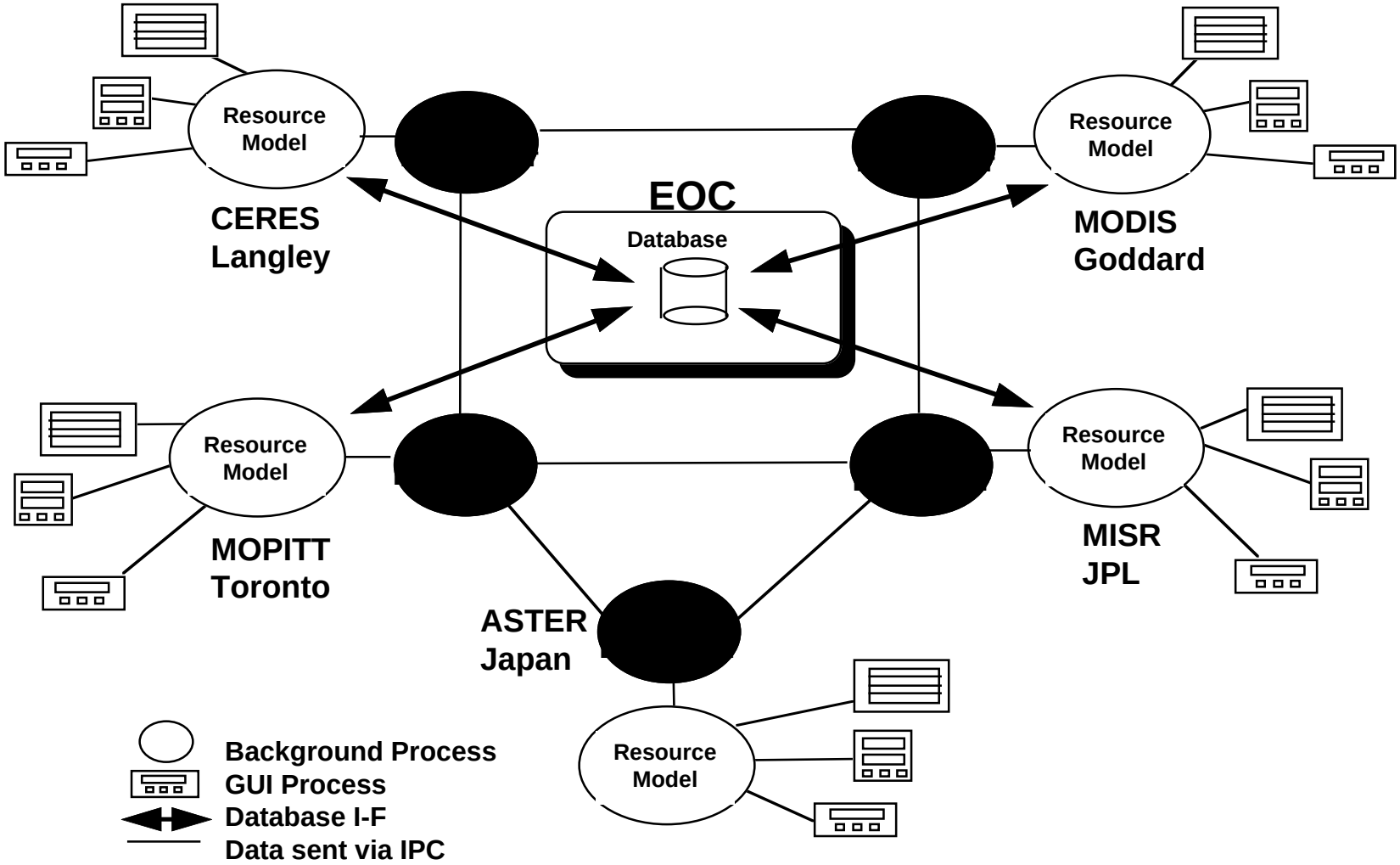
P&S Session Will Run Resource Model and Companion Data Distributor

- **Resource Model saves to database propagated by Data Distributor**
  - **Examples include plan saves, new BAP definitions**

Resource Model Gets Initial Data From FOS Database

Resource Models Kept Concurrent by Updates From Data Distributors

Data Distribution Diagram



Data Distributor Design (cont.)

Based on Heritage Design Used on Other Project

- **DOD program had 60-100 users**

Improvement Over previous Designs

- **Previous design caused performance problem**

Resource Model free from Distribution Duties to Other Resource Models

- **Client tool processes get quicker response**

Unrestricted Sistribution Architecture

- **Extensible to many users**

DMS Interface

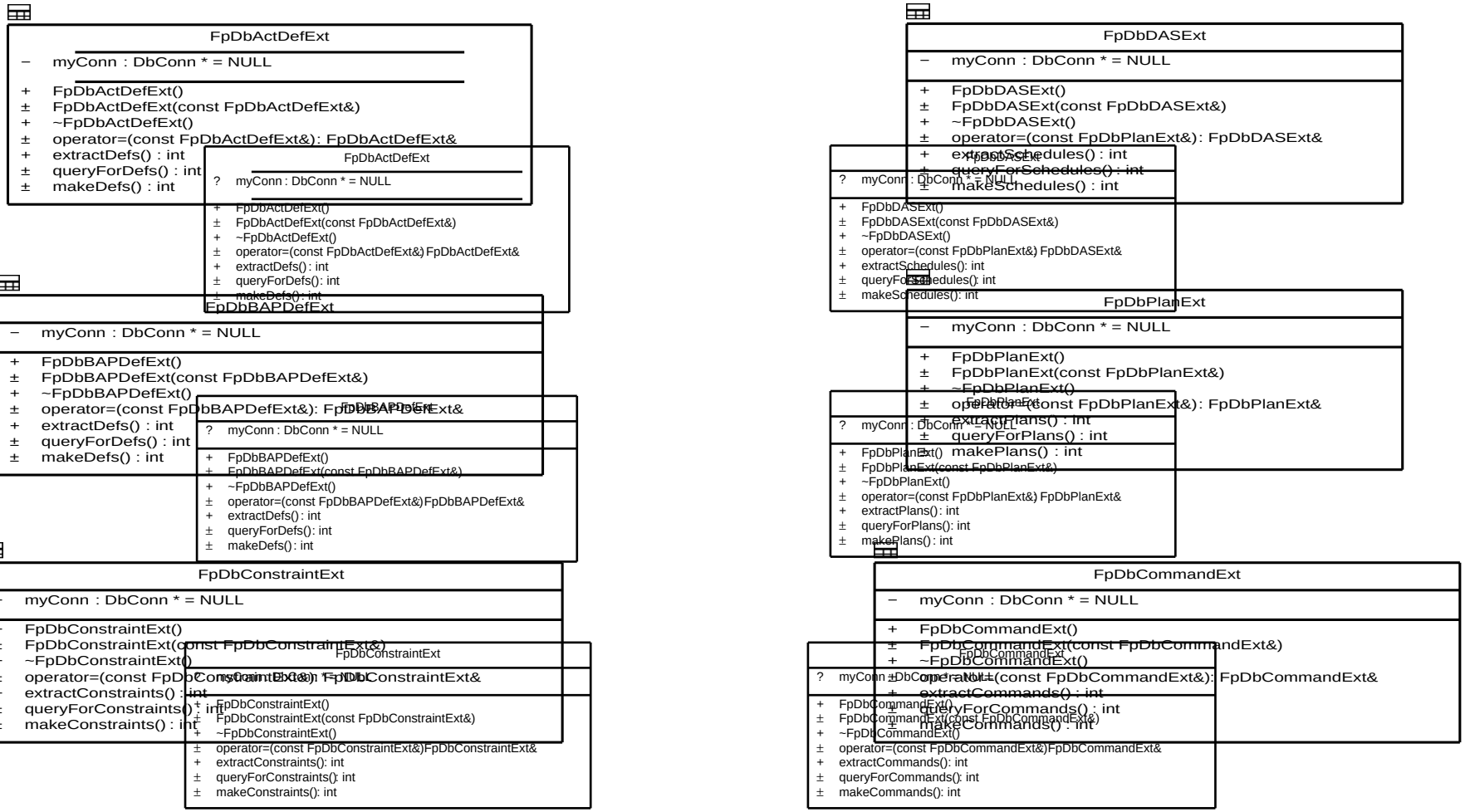
Interface Between P&S Processes and Database Management Subsystem

- **Allows P&S processes to store, retrieve, modify persistent data**
- **Data stored in configuration files and tabular format**

Design Includes

- **Configuration file interface inherited from Delphi base class**
  - **Delphi layer provides basic file open, setup, parsing**
- **Table data access using extractor and updater objects**
  - **P&S processes choose extractors and updaters needed**
  - **Provides modularity**
- **Basic database connection and access using *DBTools* COTS**

DMS Interface Object Model



FUI Interface

Interface Between P&S GUI Processes and FOS User Interface

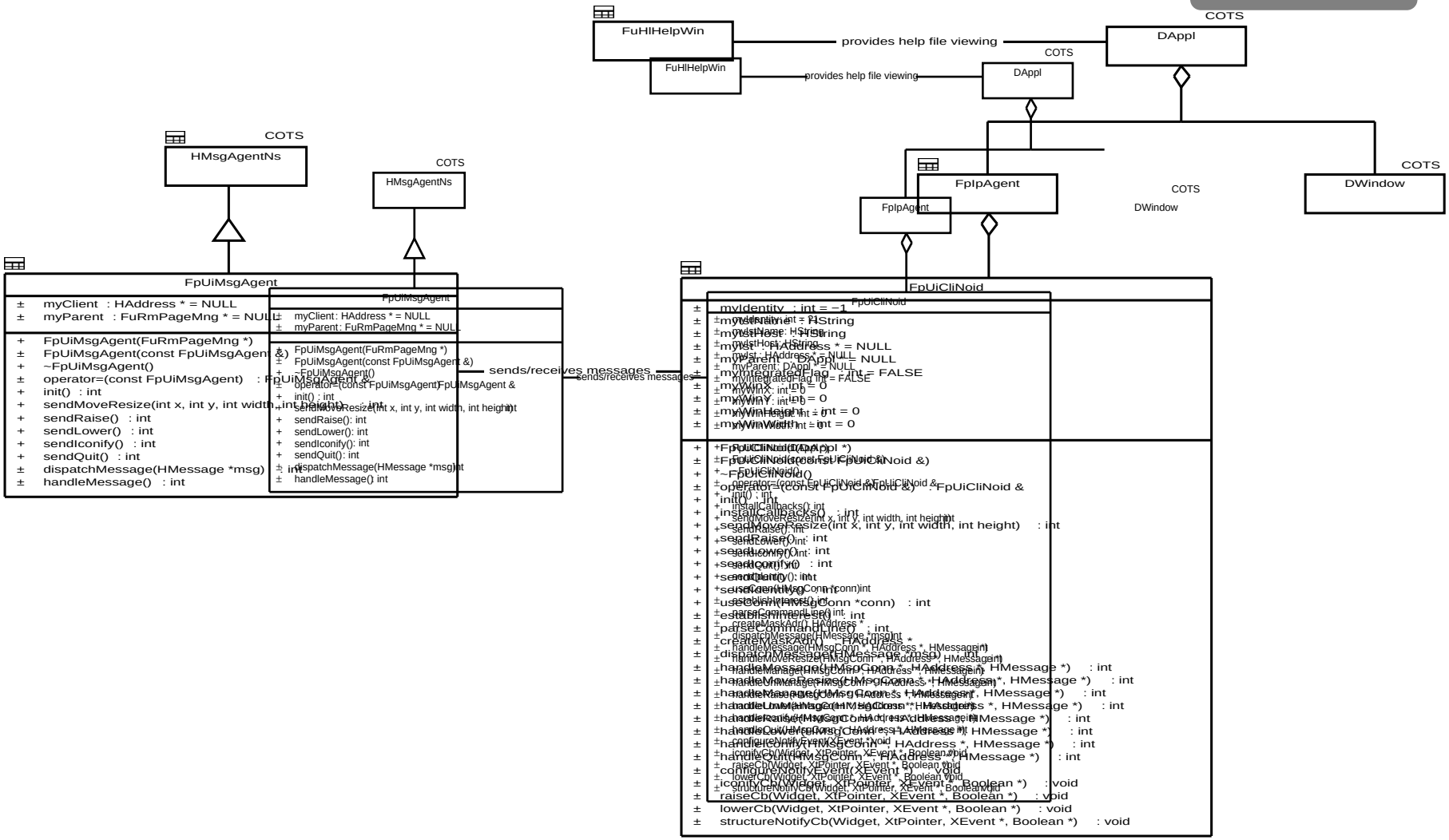
Allows Integration of P&S Tools Into FUI Toolkit

P&S Tools Behave Similarly to All FOS Tools

- Handles toolkit room and window tiling capability

From User Perspective Integration is Seamless

Simple, Single Class Interface Added to P&S Processes

- Plugging in one class will integrate P&S tools

FUI Interface Object Model