The GNU Enterprise Application Server

A Whitepaper
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1 Introduction

1.1 Purpose

In 2-tier systems, the application logic lies either in the front end or in the database (via triggers and stored procedures). The main purpose of the Application Server is to pull the application logic out of both of them and serve as a middle layer that abstracts the logic (called *business rules*) from the user interface as well as from the database backend.

1.2 Additional goals

Apart from (of course) fulfilling the purpose, we have defined several additional, ethical as well as technical, goals. The following list is sorted by priority:

Freedom GNUe Appserver must be GPL and must be built with truly free tools.

Stability GNUe Appserver must be reasonably stable. For a mission-critical application in a business environment, reasonably stable means very stable.

Security GNUe Appserver must be reasonably secure.

Maintainability
The code base of GNUe Appserver itself must be and remain maintainable by the development team, and the code must be clear enough to allow interested programmers to adapt it, fix bugs, or even take over maintenance of a part of Appserver.

Configurability
GNUe Appserver must be configurable and reconfigurable dynamically, centrally, without programming skills, without downtime, and in separate "layers" for various levels of specification.

Performance
GNUe Appserver must perform reasonably well with large quantities of users and/or data.

Database Independence
GNUe Appserver must be able to use a number of database systems as backend.

Portability
GNUe Appserver must run on multiple operating systems and architectures.

Communication Independence
GNUe Appserver must be able to use a number of communication means to communicate with the front end (CORBA, XML-RPC...).

Language Independence
GNUe Appserver must be able to deal with business methods written in different languages.

2 Features

(Note that not all features are yet implemented)

2.1 Business Objects

GNUe Appserver allows definition of data entities (for example, name and address of a customer) and of program code to perform on such entities (for example, how to build the address line from country, zipcode, and city).

The combination of a data entity with all code functions that can be performed on the entity is called a *business object*.

Appserver lets the user define *classes* of business objects. The class definitions describe both the data elements (called *properties*) and the available functions (called *procedures*) of the business object.

Procedures may also be bound to a specific event, that is, they are called automatically as soon as the event happens. These procedures are called *bound procedures*.

2.2 Properties

GNUe Appserver will provide the following property types:

Basic property
: contain most of the actual information, in the basic property types *string*, *number*, *datetime*, and *boolean*. Examples could contain customer name, item price, invoice date, and invoice payment status.

Compound properties
: are a means for combining properties that logically belong together and appear repeatedly in the same combination. Compound properties can be built from properties of any type, not only of basic properties. An example could be a monetary value consisting of the amount and the currency.

Reference properties
: point to another object and declare a relation between two objects. The value of a reference property is another object. Examples include the customer of an invoice or the preferred vendor of an item.

List properties
: point to lists of objects and declare a relation between these objects. The value of a list properties is a list of objects of a defined class, where all objects in the list will be of the same class. Lists are actually nothing more than a shortcut for frequently used filters. Examples include all line items of an invoice, or all line items of all invoices containing a specific stock item, or all invoices of a customer.

Calculated properties
: contain information that is generated by Appserver out of other properties. Calculated properties are generally read-only. An example could be the total value of an invoice item (calculated from price * pieces) or the total value of an invoice (calculated from all total item values).

2.3 Procedures

A procedure is code performed on an object. Procedures can have parameters of any attribute type (string, number, reference, etc.). Every method is passed a parameter, *self*, that identifies the object to operate on.

2.4 Modules

Modules define namespaces for classes, properties, and procedures. When module A defines a class with various properties and procedures, module B can extend the class with new properties. Another module, C, can independently extend the same class, without fear of conflicting with module B. All modules have their own namespace.

2.5 Qualified class, property and procedure names

Class, property, and procedure names can be preceded by a module name to override the current module context. In this case, the module name is separated by an underscore (_). This results in the rule that neither a module name nor a class, property or procedure name may contain an underscore.

Property and procedure names are separated from the object references by a dot (.).

Example:

Module "cust" defines a class "customer". Module "sales" defines a class "invoiceHead" and a class "invoiceItem". Module "base" defines a class "item".

Then, `cust_customer` is the fully referenced class name for the customer class, and `sales_invoiceHead` is the fully referenced class name for the invoiceHead class.

Now, let module "cust" define the properties "name" and "address" for the customer class, where address is a compound property consisting of "street" and "city".

The following are now valid property references of a customer object:

`name` or `cust_name` is a base property.

`address` or `cust_address` is a compound property.

`address.street` or `cust_address.street` is a compound member property.

Now, the module "sales" extends the customer class by a property "lastInvoice" which is a reference to an invoiceHead object.

`sales_lastInvoice` is a reference containing an invoice_head object.

If module "sales" defines the attribute "number" and "items" in "invoiceHeader", then

`sales_lastInvoice.number` is the number of the last invoice of the customer. We could call that an *indirect property*.

`sales_lastInvoice.items` is an indirect list property.

And if yet another module, "acct", extends the invoice_header class by a property "paid", then

`sales_lastInvoice.acct_paid` could be a boolean property that tells you whether the customer has paid his last invoice or not, and you would access it just as easy as the "name" attribute. However, this attribute would only be available if all three modules "cust", "sales", and "acct" are installed.

2.6 Bound Procedures

Bound procedures are procedures that are automatically called upon occurance of defined *events*; for example, on every change of a specific property or before a commit of a changed object.

Bound procedures are always procedures of the object where the event occurs. Because every module can extend any class with a procedure of arbitary name, calling of bound procedures could be automated by method name.

Example:

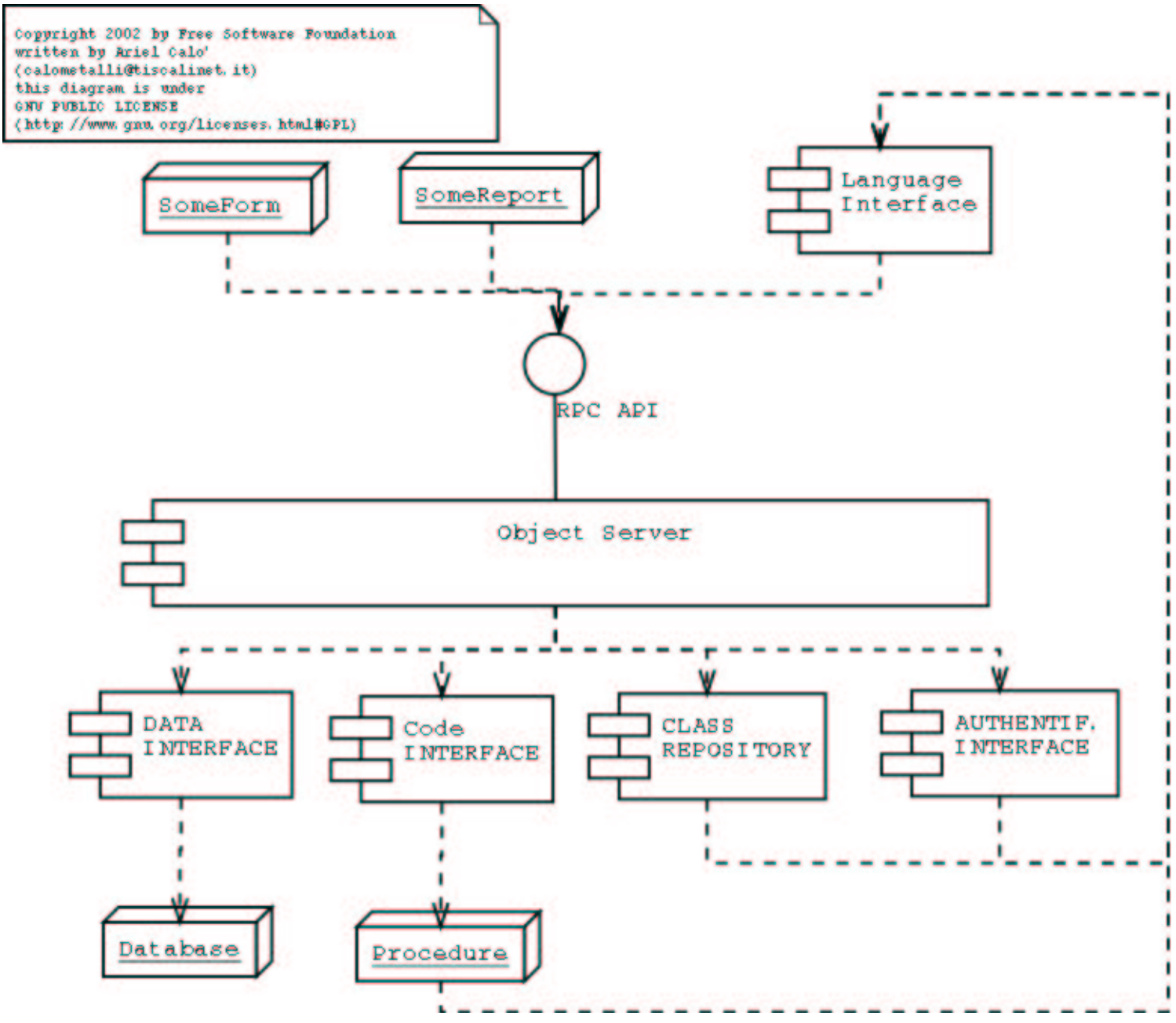
The cust module, which defines the customer class, defines a procedure "OnChange-Name", whose fully qualified name is of course `cust_OnChangeName`.

The sales module could extend the customer class by a procedure and also call this it "OnChangeName", because the fully qualified name of this procedure will be `sales_OnChangeName` and therefore different from the other procedure.

If the property "Name" is changed in a customer object, Appserver would call both procedures because both are named "OnChangeName". The order of the calls would be unpredictable.

3 Architecture

3.1 Overview



Data Interface:
: abstracts database access from a specific database API and from SQL.

Code Interface:
: abstracts calls to methods from the language and the specific API.

Class Repository:
: holds and provides the definition of classes.

Authentication Interface:
: provides a way to authenticate a user and define his access rights.

Object Server:
: translates all requests to the business objects into appropriate database transactions and method calls, by using the other building blocks.

Remote Protocol Interface:
: provides the Appserver API to a remote client via various RPC mechanisms.

Language Interface:
: provides easy access to business objects for procedure code and for internal use by Appserver

3.2 Theory of Operation

For easy understanding, here is the basic way the Application Server will provide data:

1. The client requests an object from the app server through the Remote Protocol Interface.
2. The Object Server checks if the requested class name is valid by looking up the class definition in the Object Repository.
3. If the class name is valid, then the Object Server uses the Authentication Interface to check whether the connected user may access this class.
4. If both are OK, the Object Server translates the class name into a table name. This will include adding a prefix to enable different application modules to have their own namespace.
5. Then the Object Server passes the database request to the Data Interface to actually get the data.

3.3 Data Interface

The Data Interface provides an API that allows creation and extension of tables, reading of data and updating, adding and deleting of records in a table, all without SQL.

Eventually, the Data Interface will support creating and extending tables "on the fly", which means that reading a recordset with attributes that don't exist in the database will automagically add the missing columns to the table. This will, of course, be an optional feature that can be turned off.

The Data Interface operates strictly on a table/row interface and doesn't know anything about objects, properties and procedures.

The Data Interface used in GNUe Appserver is part of GNUe Common.

3.4 Code Interface

The Code Adapter will abstract the calls to business methods written in the different languages.

Python will be the only language supported for the near future.

The Code Adapter, or at least parts of it, will reside in GNUe Common.

3.5 Class Repository

The Class Repository will hold all the business object definitions: what properties the object consists of, what procedures exist, which bound procedures should be called on what event, and so on.

The class definitions will be stored in the database and be accessible like normal business objects. Consequently, the Class Repository will access the definitions via the Python Language Interface.

3.6 Authentication Interface

The Authentication Interface will provide a means to authenticate a user on connection to the Appserver, and to check access rights for an already connected user.

For the sake of flexibility and independence from operating system and database backend, access rights per user will probably be stored in the database and be accessible via system business objects.

3.7 Object Server

This is the central part of the Application Server.

The Object Server uses the Data Interface and the Code Interface to fulfill requests directed at business objects, after it has checked the validity of the request against the Class Repository and the Authentication Interface.

Security implementation will also select or reject based on the users authorizations to any regular query.

Example: if the division president uses a form to request all sales orders, Appserver will query the database and return only the object data that represents the divisions sales orders.

Form level (view) security will not be enforced by Appserver.

The Object Server will also provide object transparency. Meaning that there will not necessarily be a direct relationship between business objects and tables.

While accessing data from the database via the Data Interface, the Object Server will also automagically check for defined bound procedures, and call them via the Code Interface.

3.8 Remote Protocol Interface

The Remote Protocol Interface is used to export the functionality of the Application Server over the net, using a variety of RPC mechanisms.

3.9 Language Interface

The Language Interface will make business objects easily accessible for code written in supported languages. Each language will have it's own Language Interface.

For example, the Python Language Interface (which will be the first one implemented) lets you access business objects as if they are normal Python objects. Procedures written in Python will use this interface to access business objects in a rather straightforward way. Other parts of the Application Server also use the Language Interface to access system objects like the ones defining classes or access rights.

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