A Tutorial on CORBA

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Summary

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Justification and History (=blah, blah)

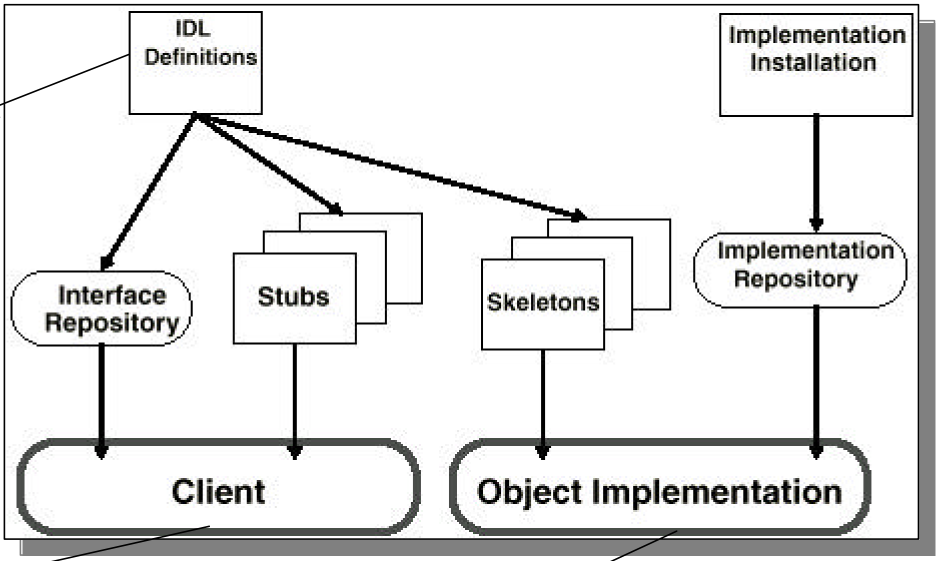
- Distributed Applications are heterogeneous
  - layers, applications, libraries glued together
  - can all components really work together?
- Two key rules
  - build platform-independent models and abstraction
  - hide as much low-level complexity without sacrificing too much performance
- CORBA provides a well thought **balanced** set of abstractions and concrete services
  - Object Services
  - Domain Interfaces
  - Application Interfaces
- Object Management Group (OMG) since 1989 - now over 800 members

What is CORBA (Executive summary)

- ORB: Object Request Broker = manages remote access to objects
- CORBA: Common ORB Architecture = software bus for distributed objects
- CORBA provides a framework for distributed OO programming
  - remote objects are (nearly) transparently accessible from the local program
  - uses the client-server paradigm
  - platform and language independent
- “an OO version of RPC”
  - but a framework rather than a technology => lot of theory

How does CORBA work (Programmer summary)

```
Interface PS {
        attribute double current;
        readonly attribute Ulong status;
        octet on(in octet value);
        void test(out long result) ;
}
```



```
try {
   PS aPS = PSHelper.bind(ORB,“PS1”);
   if ( ! aPS.on(1) ) return;
   aPS.set_current(3.1415);
   print (aPS.status());
} catch (CORBAexception) {…}
```

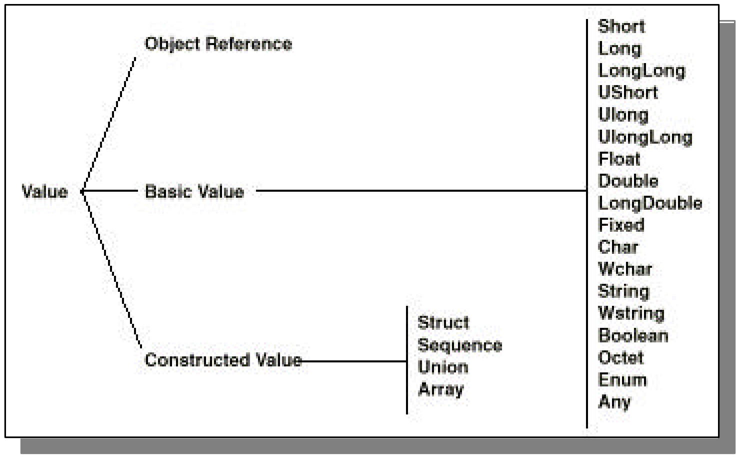
```
class PSimp extends PSImplBase{…};
…
PS thisPS = new PSimp(“PS1”) ;
BOA.obj_is_ready(thisPS);
BOA.impl_is_ready();
```

CORBA Features

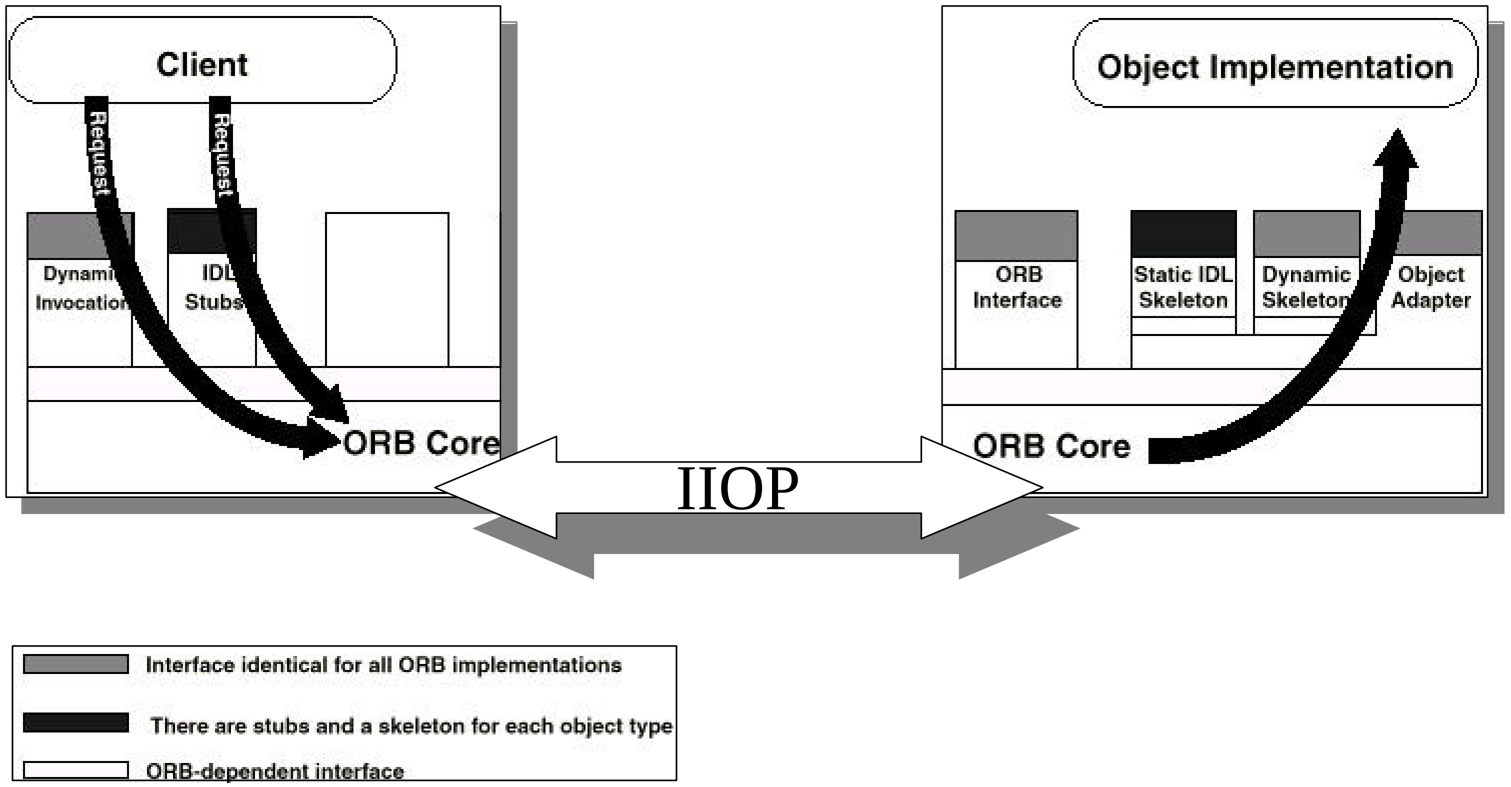
- Don’t worry about unique terminology - these are just words!
  - CORBA object
  - request, target object, object reference
  - client, server, servant
- Features
  - Interface Definition Language (IDL)
  - language mapping
    - official: C, C++, Samlltalk, COBOL, Ada, Java
    - also: Eiffel, Modula 3, Perl, **Tcl**, Objective-C, Python
  - Operation invocation and dispatch facilities
    - static (known at compile-time)
    - dynamic (determined at run-time)
  - Object adapters
    - Design pattern: adapt CORBA object interface to servant
  - Inter-ORB Protocol

What are Objects in CORBA

- Objects are abstract: not realized by any particular technology
  - An object system is a collection of objects that isolates the requestor of services (clients) from the providers of services by a well-defined **encapsulating interface**
- Objects "talk" through requests: operation, target object, zero or more parameters, optional request context
- Objects are described with interfaces
  - operations (methods)
  - attributes (properties)
  - Standard data types are supported
    - object references
    - Any



Data Flow in CORBA



Some Definitions

- ORB:
  - find the object implementation for the request, prepare the object implementation to receive the request and communicate the data making up the request.
  - ORB throws exceptions
  - ORB implementation is not defined in CORBA
- Object Adapter (POA, BOA, …)
  - provides ORB services to particular groups of object implementations
  - generation and interpretation of object references, method invocation, security of interactions, object and implementation activation and deactivation, mapping object references to implementations, and registration of implementations.
- IIOP: Internet Inter-ORB Protocol
  - ORB's of different vendors can talk
  - TCP/IP implementation of GIOP

More Definitions

- IDL: Interface Definition Language
  - IDL is the means by which a particular object implementation tells its potential clients what operations are available and how they should be invoked.
- Language mapping: recipe how to generate stubs&skeletons from IDL
  - Clients see objects and ORB interfaces through the perspective of a language mapping, bringing the object right up to the programmer’s level.
- Interface Repository: where all interfaces are stored network-wide
  - provides information on interfaces at run-time
- DII: Dynamic Invocation Interface
  - construct a remote method call at run-time without the use of stubs

Request Invocation

This is transparently handled by the ORB

- Locate target object
- activate server application if not yet running
- transmit any arguments
- activate a servant if necessary
- wait for request to complete
- return any out/inout parameters and return value
- return exception if call fails

Object References

- Several references to one object
- Can point to nowhere (death undetected)
- Are strongly typed (at compile&run time)
- Support late binding
- Implemented by proxies

- But how do you get a reference?
  - Bootstrap
    - via well known entry point (Naming service)
    - via reference-to-string (known URL, filename)
  - from a Object method call

The Portable Object Adapter (POA)

- Provides object creation, servant registration and mapping, request dispatching
- Intended for scalable, high-performance applications
  - different POAs for 1 object or millions of objects
- Is a locally-constrained object, multiple may exist
- Policies
  - Object life span: persistent/transient
  - Object Id: system_ID/user_ID
  - Mapping objects to servants: unique_ID/multiple_ID
  - Object activation: implicit/no_implicit
  - Matching requests to servants: object_map/default_servant/manager
  - Object to servant association: retain/non_retain
  - allocation of threads: ORB_control/single_thread

CORBA Services

- Some 20+ defined services
- check vendor for implementation and limitations !
- Some interesting services
  - Naming Service
    - “directory-based”
    - single or federated
  - Event Service
    - decouples suppliers from consumers
    - push or pull models
    - uses Any for event data
    - Notification Service ?
    - Messaging Service ?

More About CORBA

- Other features of CORBA
  - **vendor specific implementations - check performance you need !**
  - Gateways to DCOM and OLE automation exist
  - CORBA Components (futureware)
- Some buzzwords to know (and use)
  - thin client
  - three tier architecture
  - legacy systems
- Alternatives to CORBA:

– sockets	low level, used by CORBA
– RPC	not OO
– RMI	language dependent
– DCOM	maybe someday

Meta IDL - MIDL

```
#parameter P<type>|<type>{
  #accessors{#sync, #async, #history};
  #monitorable;
  #static{default_value, graph_min, graph_max, min_step,
   resolution|pattern, description|string, format|string, units|string};
};
#parameter RW<type>|<type>: P<<type>>{
  #eventable{Alarm<<type>>};
  #mutators{#sync, #async, #nonblocking, #step};
  #static{min_value, max_value};
};

#device PowerSupply{
  #actions{on, off, reset, start_ramp(in CBRamp cb, in RampData data)};
  #methods{double sync_method_test(in double input, out double output);};
  #parameters{current|RW<double>, readback|RO<double>, status|ROpattern};
  #static{model|PowerSupplyModel};
};
```

Callbacks in BACI: device.property.get(CB)

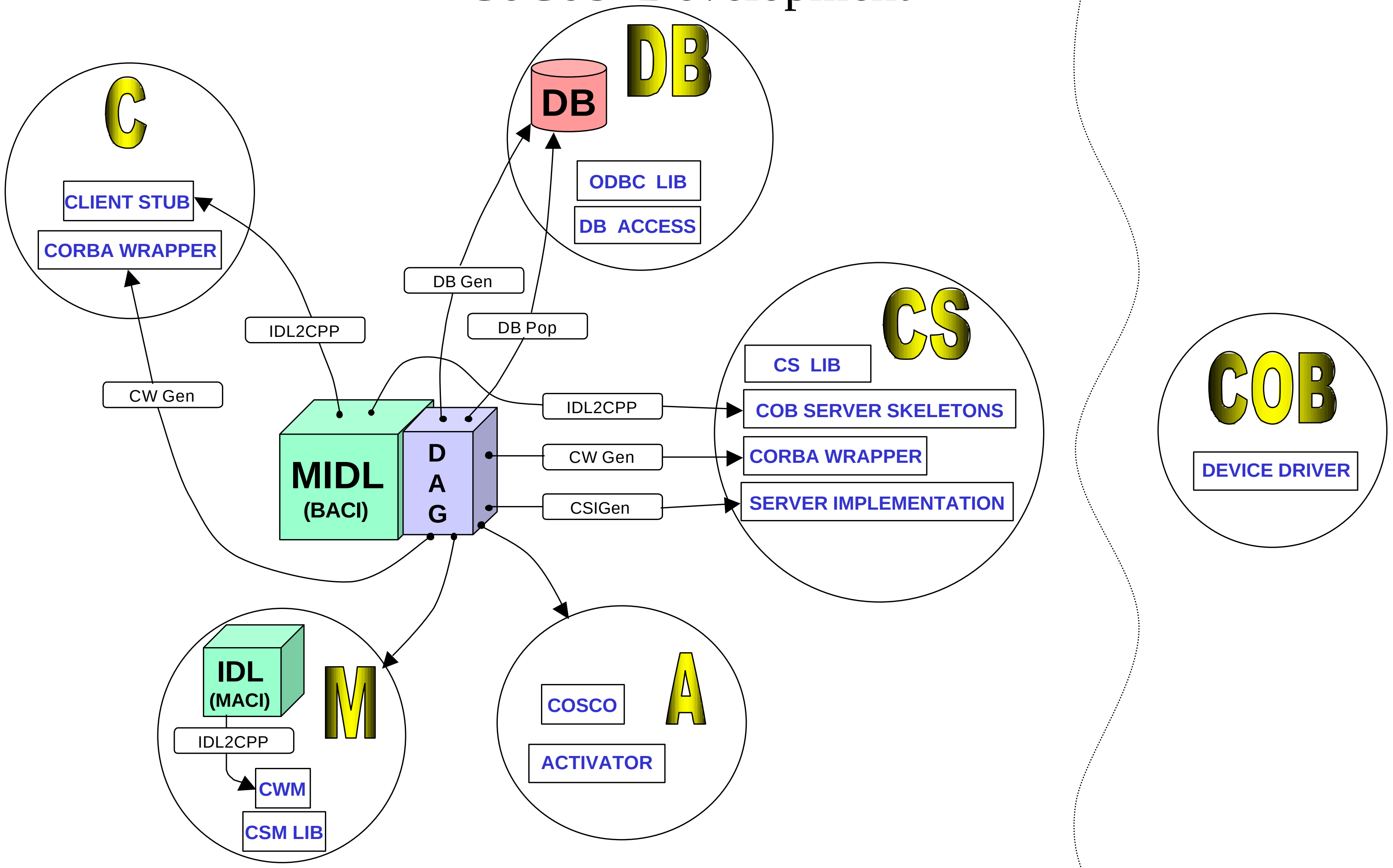
- Asynchronous completion notification

```
interface CB<type> : CB {
    oneway void execute(in <type> value, in Completion c, in CBDescOut desc);
    oneway void cb_done(in <type> value, in Completion c, in CBDescOut desc);
};
```

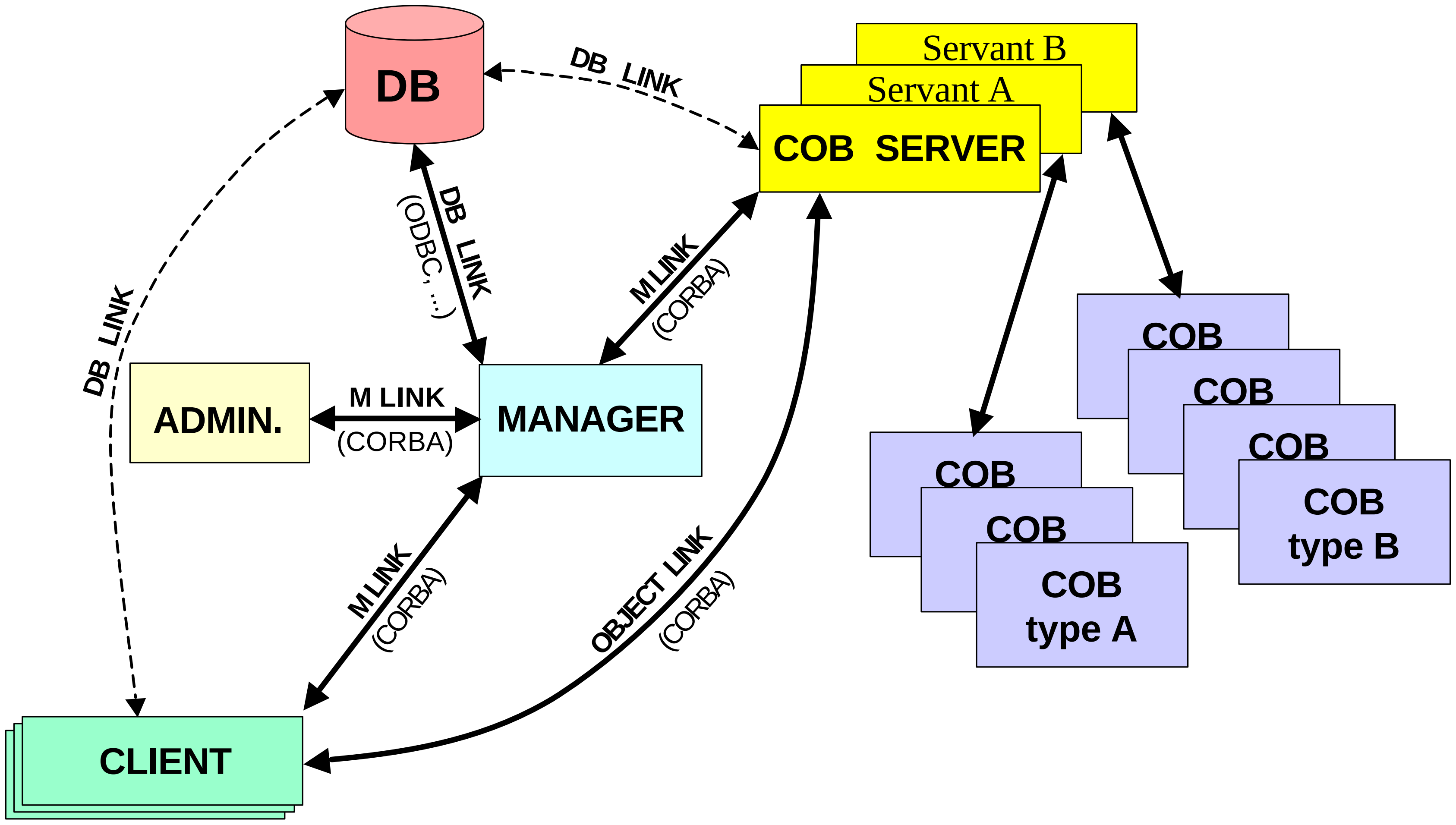
- monitoring
- events

```
interface CB<event_set_name> : CB {
   oneway void <event_1_name>(..., in CBDescOut desc);
   oneway void <event_2_name>(..., in CBDescOut desc);
   ...
}
...
void subscribe_<event_set_name>(in CB<event_set_name> cb, in CBDescIn desc);
void unsubscribe_<event_set_name>(in CB<event_set_name> cb);
```

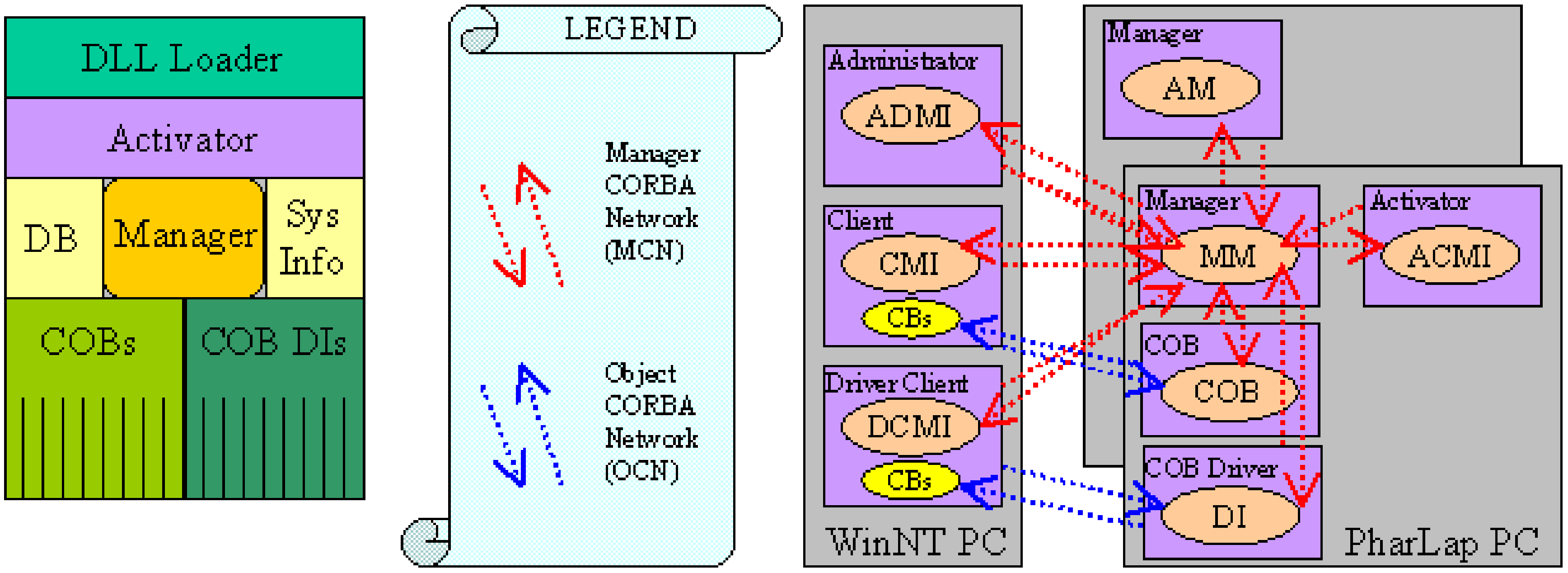
CoCoS Development



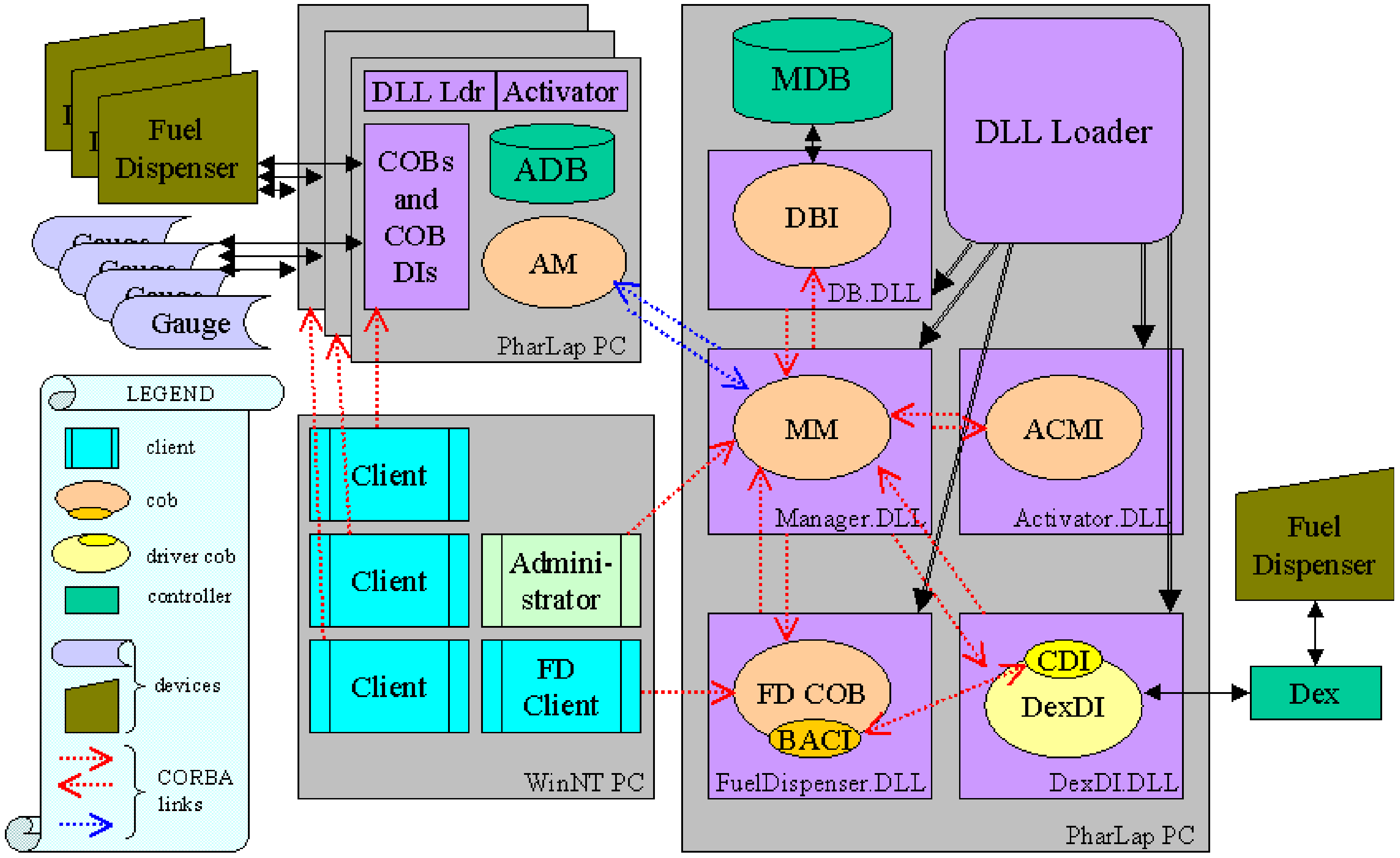
CoCoS Runtime



CoCoS Startup and Management



CoCoS on Pharlap/TNT Real-Time Operating System


Fuel Dispenser
Gauge
DLL Ldr
Activator
COBs and COB DIs
ADB
AM
PharLap PC
LEGEND
client
cob
driver cob
controller
devices
CORBA links
Client
Client
Admini-strator
Client
FD Client
WinNT PC
MDB
DLL Loader
DBI
DB.DLL
MM
ACMI
Manager.DLL
Activator.DLL
FD COB
BACI
FuelDispenser.DLL
CDI
DexDI
DexDI.DLL
PharLap PC
Fuel Dispenser
Dex