FINDAS
Development Plans
FIRST-EMS-CON002

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Change Log

Date	Version	Change
09MAR98	Draft	Original
15APR98	Draft	Many changes following comments from K. King, P. Roelfsema, O. Bauer and P. Estaria

Contents

List of Figures

1 Introduction

From the description of the ground segment configurations given in [1], an analysis of the features that FINDAS provides during the first phases of the project is performed.

2 Framework

The framework in which the development, mission and archive activities take place for the FIRST project is of *separation of centres of interests*. Each centre of activity develops and supports its own environment within a common infrastructure as well as common operations such that the transition between the different phases of the project are smooth and to maintain consistency across the centres.

The noticeable elements for the concept which drive the design activities towards the production of a system are:

- The *Instrument Stations* should remain invariant throughout the various phases.
- FINDAS is accessible during the lifetime of the project and holds all the elements that together form the FIRST observatory.

3 FINDAS system

We can separate the concerns of a system as FINDAS in two broad categories:

- Non domain aspects: the management of the system and the facilities which are shared by all actors.
- Domain aspects: Instrument, science and operations of the spacecraft facilities.

Most of the development activity of *FINDAS is concentrated on the non domain aspects*, while the ICC'S, MOC and FSC concentrate their development on the domain related software components. The domain independent software includes the central mechanisms for (main topics and not exhaustive list):

- Data aspects:
  - Persistence
  - Storage management
  - Object distribution
  - Object evolution
  - Configuration control
- Process aspects:
  - Process management
  - Session management
  - Common look and feel
- Networking aspects:
  - Transaction
  - Messaging
  - Event handling

The domain dependant aspects which FINDAS supports are:

- Process model:
  - Observation submission
  - Uplink
  - Downlink
  - Data collection
- User interface model:

– Template definition

– Dynamic web page generation

Which we could also present as:

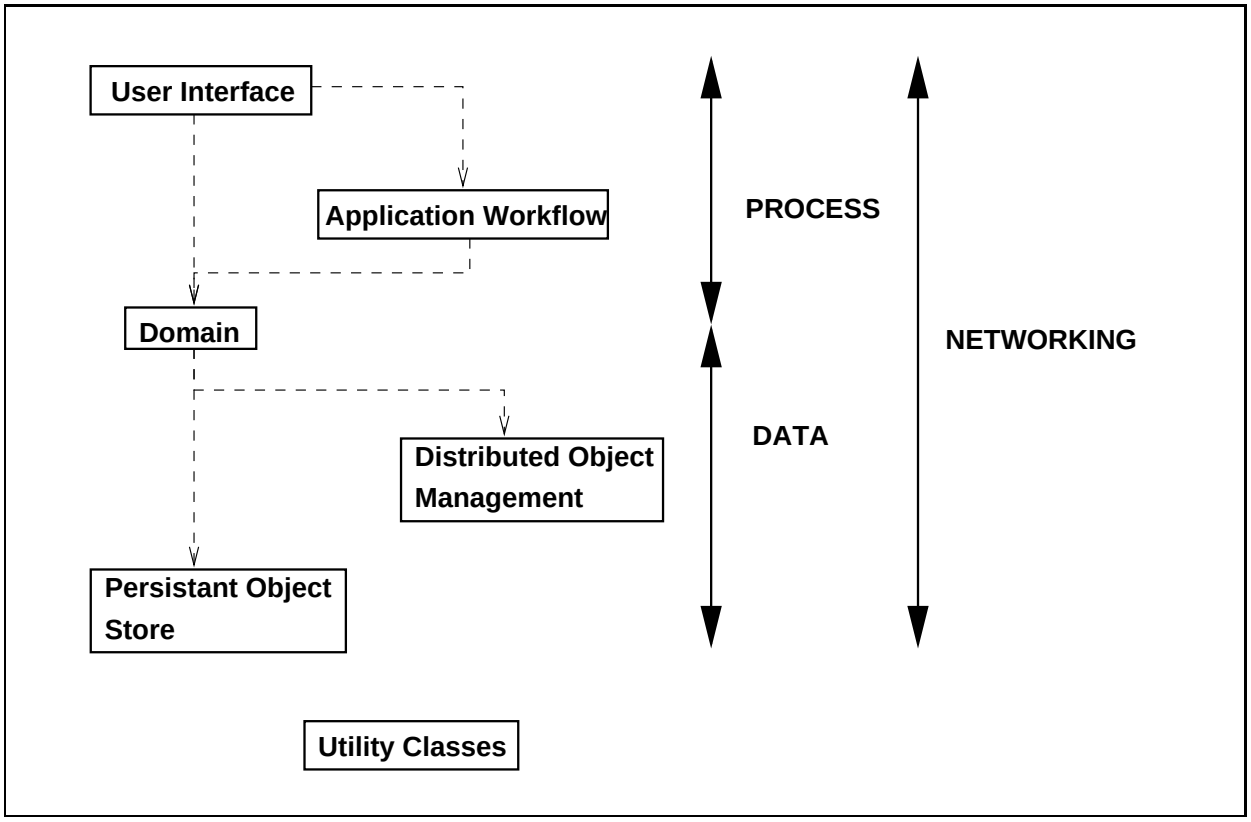

Figure 1: Top level architecture

To provide these aspects and the necessary integration in a computing environment, the following elements ought to be part of the definition of FINDAS (actual items are given as examples only):

– Operating system: Unix based.

– Networking: public network and dedicated lines, TCP/IP protocol.

– Persistent object store: Object oriented database and hierarchical file storage system.

– Distributed object management: possibly based on CORBA software.

– Domain independent framework: make, RCS, languages, process model, ...

– GUI environment: Web page composition, graphics tools, ...

4 Pre-ILT phase

This phase starts in June '99 after the prototype delivery to ESA (SSD/SA) and corresponds to the work of preparing FINDAS for the ILT phase. The prototype of FINDAS will possibly be the preliminary version used as a starting point for this phase.

4.1 Characteristics

The main characteristics of this phase are:

- Aspects related to science data, mission planning, proposal handling, proposal generation process, pipeline processing, interaction with scientific community and associated processes are not important.
- Overall infrastructure for the ground segment informatics support is defined: for instance replication mechanism, necessary hardware/software components at each centre, communication lines, ...
- Define and develop the low level interface between the instrument test equipment and FINDAS. This interface supports the core of the final interface used at check-out and commisionning phases.

4.2 Activities

The main activities in this period are the definition of the interfaces and the definition and production of generic components of FINDAS.

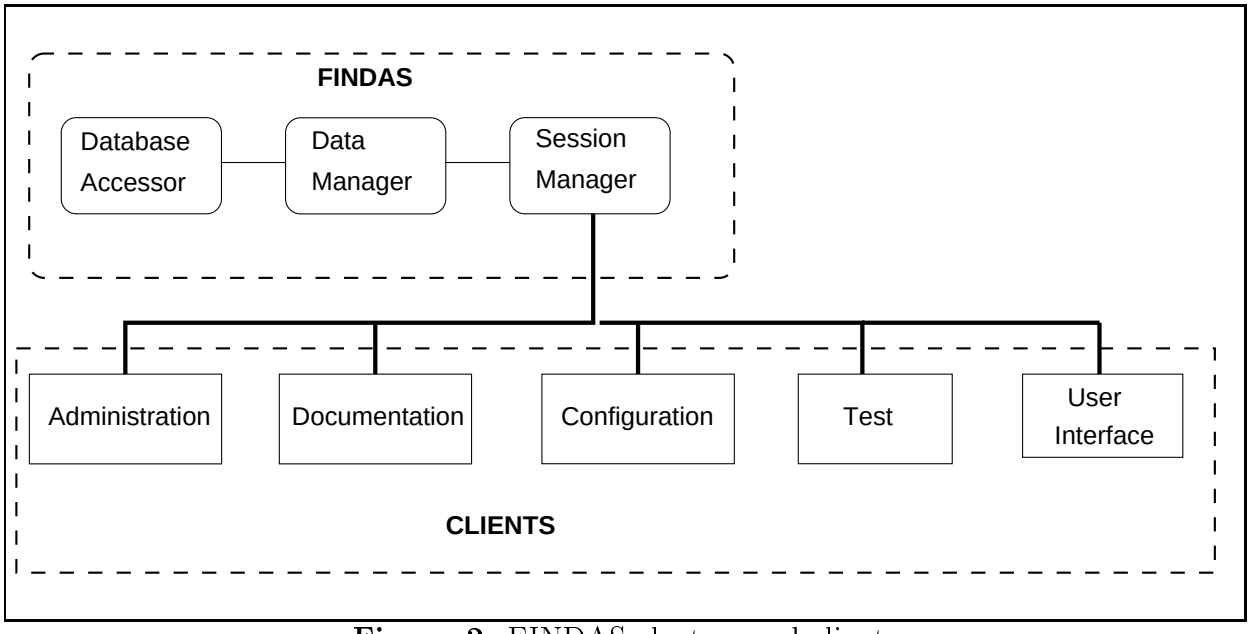

Figure 2: FINDAS clusters and clients

FINDAS at this stage is a set of three clusters (a cluster is a group of classes which contribute to one clearly defined goal), which are:

Database Accessor	provides a uniform access to the items stored in the databases which are holding all the project data. It hides the low level data structure and data location from the calling clusters.
Data Manager	holds the information of structural nature bound to the domain (astronomical database), it also hold the information relating to its management such as the configuration control and access rights.
Session Manager	holds all the information relating to the particular session and is the server aspect of the client application (the session manager is a form of temporary database for the client -it could eventually be implemented as a temporary database area-).

The five clients are:

Administration	creation of users and groups thereof, privileges management.
Documentation	insertion of documents, creation of document trees, basic search.
Configuration	insertion and extraction of software and data, process model of acceptance of inserted items, evolution of the class model at global and 'local' levels, propagation of updates.
Test	extraction of necessary items, controlled execution and storing results. Part of the controlled execution consists in providing telemetry to FINDAS and from FINDAS to a 'Real-Time Telemetry client'.
User Interface	Establish a session via login, makes available a common core of commands and information, present links to other clients.

4.3 Environment

Once the initial version of FINDAS is operating, we have two possible mode of operations for its use: either FINDAS is replicated at each centre, or only client software is operating at each centre. Both approaches have their pros and cons:

1. Central system requires no extra resources at the centres (FSC and ICC) to host the replicated database. By resource is meant computer facility, software licenses and operations (backup for instance).

2. Central system access on the network is possibly slower than intra-muros network for daily activity. When the database is replicated the Internet is used mostly for updates.
3. Central system, being the only repository always guarantee the most up to date item.
4. Both systems are equivalent in enforcing the use of project structures (classes and processes), since the result of development is 'integrated' within FINDAS.
5. Central system allows an early verification of the real-time telemetry flow: telemetry from the test equipment is sent to the central FINDAS (as MOC would do during the mission), and FINDAS would replicate it to any 'Real-Time Telemetry client' at the ICC [1].
6. Would encourage developers to use FINDAS as a baseline repository as opposed to a 'store and forget' repository.

4.4 FINDAS Development

The clusters mentioned in the preceding section will not be complete at the end of the pre-ILT phase. The following functionality should be operating though:

- Data accessor: essentially completed, except for the aspects of access to a hierarchical data management sub-system. Of importance are:
  - Access to multiple databases operating at different centres, and possibly of different nature (RDBM and OODB).
  - Reconciliation of database schema (i.e. the collection of the changes and their distribution).
  - Data security (backup and restore).
- Data Manager:
  - Configuration control implemented (i.e. versionning and access rights).
  - Documentation handling (forms to insert new documents, to browse and view documents, hooks to DMS).
  - High level science structure (uplink, downlink, schedule, real-time process, test procedures) [2].
- Session Manager:
  - Definition of transaction model.

[1] This is conditioned by the availability of communication lines at 128Kbs or better.

[2] There are possibly common classes and processes which ought to be in place at ILT such as to provide a seamless transition between phases.

5 ILT

The goal of the ILT is the delivery of calibrated instruments.

5.1 Characteristics

The main characteristics of this phase are:

- Little inter ICC communication.
- The centres in which activities take place are geographically separated.
- High frequency of changes (rapid turn-around).
- FINDAS is a common shared resource: FINDAS receives all the relevant inputs to the mission which the ICC generate.
- FINDAS installed at ESTEC and moves to Vilspa later.
- Structure of the information is changing both in the ICC and in FINDAS (by structure is meant the class organization as much as their relations and contents).
- Data exchange between FINDAS and the ICC is moderate both in volume and in frequency [3].

5.2 Activities

The following activities take place during the ILT at the ICC'S:

- Produce documents: User manuals, documents related to hardware and software development, test documents, minutes of meetings, electronic mail, flight operations procedures, etc...
- Define the telecommands and the structure and contents of the telemetry packets. Create the instrument database which contains the location and description of all housekeeping parameters, their limits and how they are affected by the telecommands and the location and description of the scientific data.
- Develop the instrument hardware.
- Specify and develop the various simulators, time estimators.
- Specify and implement the AOT'S as well as the software to use them.

[3] There is no contradiction between the rapid turn-around and low data exchange, since it is expected that mostly elements which form a baseline would be stored in FINDAS (i.e. FINDAS is not a temporary storage).

– Specify the test procedures and the flight procedures.

– Specify the calibration procedures, their processing software.

– Characterize the instrument using the calibration procedures.

A major factor during this phase and all other phases prior to the mission is that the time between the production of the telemetry and its availability at the *Instrument Station* is in the order of seconds (typically 1 second).

5.3 Environment

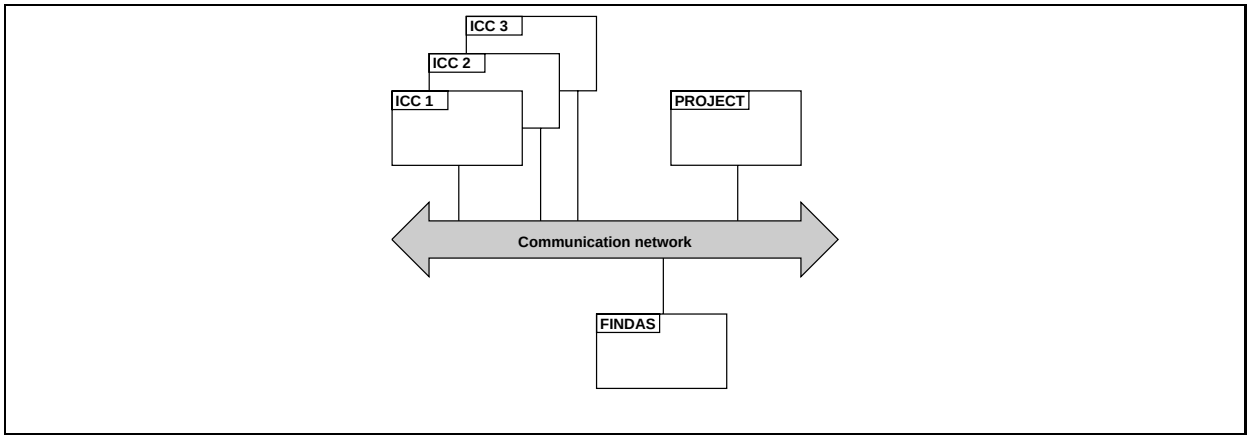

Figure 3: ILT overview

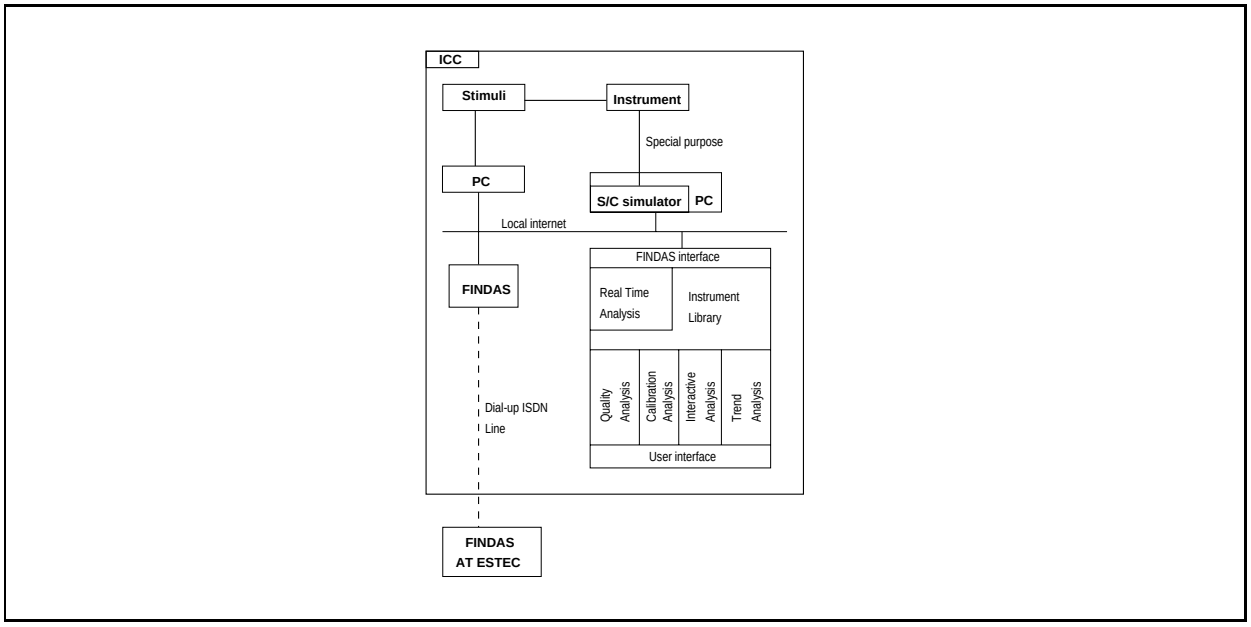

Figure 4: Instrument Control Centre

Explanations of figure 4:

1. The PC with an embedded spacecraft simulator operates with packets for both commands towards the instrument as for telemetry towards the *Instrument Station* (IS).

2. Likewise the *FINDAS interface* in the IS transfers packets[4].

3. FINDAS at the ICC may be a local database, or a client which accepts telemetry packets and forward them to other clients such as FINDAS and the IS.

4. The real time aspect of the telemetry must be carefully assessed, there are two possible scenarii:

   (a) TM from the spacecraft simulator is sent to FINDAS (either client or local database), which provides it to any client such as the IS and the FINDAS at ESTEC.

   (b) TM from the spacecraft simulator is sent simultaneously to both the IS and FINDAS, FINDAS forwards it to the FINDAS at ESTEC.

5. A communication line linking ESTEC hosting the central FINDAS and the ICC is necessary to support the telemetry feed. This line can be a dial-up ISDN line with sufficient capacity.

Scenario of a test at the ICC:

1. User selects a test to run from the list provided by the test client connected to FINDAS.

2. Data for the test is exported from FINDAS into the local environment.

3. Test setup procedure is executed mapping local names to marked up data in the test procedures [5], and performing other operations defined by the ICC for the test.

4. Test procedure is run:

   (a) Telemetry is collected by the FINDAS client.

   (b) Telemetry is read from IS client.

5. Post processing procedure is run (for instance calibration data generation software).

6. Data is sent by the test client to FINDAS to be saved with the test.

[4]This *may* imply that the PC driving the stimuli equipment also works with packets, but it may have its own communication protocol with the IS

[5]This implies that the test driver procedure is in an appropriate language such as perl or tcl

5.4 FINDAS development

The aspects that will be refined during the ILT are:

- Configuration control.
- Documentation librarian.
- Collection and distribution of schema modifications.
- High level classes for the organization and processing of instrument data (See 4.4).
- High level classes for the organization and processing of the test procedures (as exemplified in paragraph 5.3).
- Acquisition, forwarding and storage of telemetry.

6 Check-out

During check-out several integration and system level tests are performed. The phase ends with the launch campaign activities for the flight model.

6.1 Characteristics

The main characteristics of this phase are:

- Equipment moves from the ICC to the test centre.
- Large amount of data is collected.

6.2 Activities

The following activities take place:

- Equipment integration.
- System level tests.
- Ground calibration.

6.3 Environment

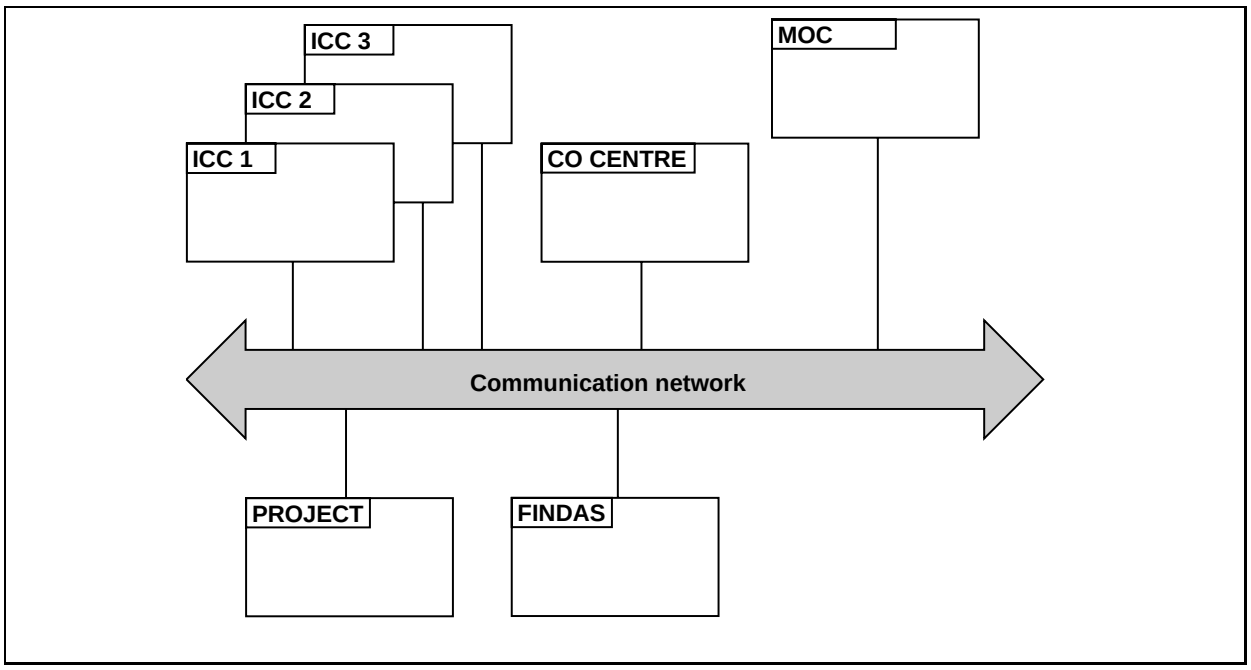

Figure 5: Check-out overview

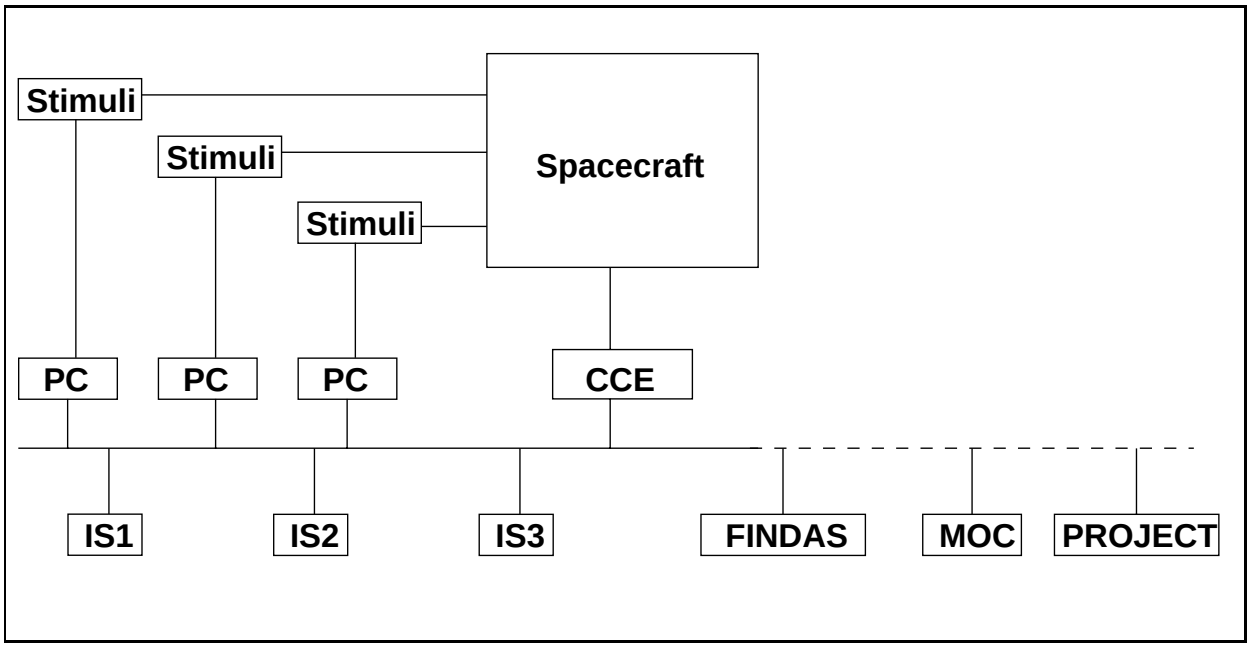

Figure 6: Check-out centre

During the check-out phase:

1. The CCE replaces (for the ICC) the spacecraft simulator.
2. The instrument station, the PC and the stimuli equipment remain unchanged.
3. The MOC is brought in as part of the ground segment component.

The connection between FINDAS, MOC and CCE is in dashed line, since there are two possible ways to achieve it:

1. FINDAS and MOC are colocated at the check-out centre, the connection uses the internal network.
2. Both systems are outside and the connection is provided via dedicated lines.

An end-to end test of the ground segment should foresee the second option in which the MOC receives the telemetry from the CCE, forwards it to FINDAS which in turn provides it to the instrument stations at the ICC.

6.4 FINDAS development

With respect to instrument development, there should be little changes between the ILT and CO phases. Instrument related aspects should be completed at the end of the ILT. Most of the work in FINDAS during this phase will be like for an instrument of integration and system level testing.

7 Development activities

The following table indicates which aspects are developed in FINDAS (or enriched) during the first phases of development.

Aspect	PRE-ILT	ILT	CO[a]	COM[b]
Database management	√			
Administration	√			
Configuration control	√			
Process model	√	√		
Session model	√			
Documentation	√			
Science data model	√	√		
Test environment		√		
Instrument DB...		√		
Observer support		√	√	
Calibration		√	√	√

[a] Check-out
[b] Commissioning

References

[1] J.J. Mathieu. FINDAS Preliminary Conceptual Model. Technical Report FIRST-EMS-CON001 V1, ESA/ESTEC/TOS-EMS, July 1997.