5.2 Operational Ground Segment (OGS) Description

The OGS is composed by the following elements:

- ground stations (including LEOP Ground Stations)
- Mission Operations Centre located at ESOC, Darmstadt
- Communications within the OGS and between OGS and SGS

5.2.1 Ground Stations

The ground stations, (reference Figure 5.2-1), establish and maintain the communications between the space segment and ground segment whenever the satellite is visible.
Space to Ground link budgets based on documented station performance are given in RD 14.

The main ground station functions are:

- acquisition and maintenance of the RF link with the satellite.
- Demodulation and pre-processing of telemetry received from the satellite
- Modulation and uplink of telecommand packets received from MOC
- Determination of range and range rate of the satellite and provision of measurement results to MOC for orbit reconstitution. (Note: according to the present baseline, range and range rate measurements are not provided from the DSN Station of Goldstone).

Acquisition of the RF link is performed at the Ground Station according to a station utilisation schedule pre-defined by MOC.

Pre-processing of telemetry at the ground station consists of the following steps:

- RF carrier demodulation and telemetry bit-conditioning
- Telemetry Frame Synchronisation and convolutional/Reed Solomon (concatenated) decoding.
- Extraction from the satellite telemetry master channel of the individual Virtual Channels (VC0 HK and VC 7 Science TM).
- UTC time stamping of each VC0 and VC7 telemetry frame with the time of reception at the ground station.
- Routing of VC0 and VC7 frames to MOC for further processing.

The VC0 and VC7 frames, and the “bad” frames (recognised as such in the telemetry decoding process, i.e., frames for which the decoding process could not be completed) are also stored at the Ground Station and can be re-called off-line from the MOC.

On the uplink side, the telecommand packets from MOC are uplinked in the VC established by MOC.

For INTEGRAL, two VCs are used to distinguish between the two redundant on-board telecommand decoders.

Two modes of telecommand operation are foreseen:

- The AD mode in which a protocol (COP 1) is established at the ground station between TC and TM in order to verify the acceptance of the TC by the on-board decoder. In the case of non-acceptance of the TC by the on-board decoder, retransmission of the TC is performed. The parameters of this protocol (number of retransmissions, etc) are set from the MOC; the protocol itself, for INTEGRAL, is contained within the ground station.

- The BD mode in which the TCs are directly uplinked to the spacecraft without being conditioned to the protocol described above.

Range and range-rate determination is performed autonomously at the ground station on request by MOC. The pre-requisite for those measurements is that the on-board transponders be configured in coherent mode.

The Integral mission will be supported in its nominal baseline Proton Orbit by the ESA Redu and the DSN Goldstone stations. In the case of Ariane 5 launch (back-up), Integral LEOP will be supported by the ESA Kourou and Redu stations, and routine operations by Redu only.

Kourou is nominally used for XMM, however in the case of LEOP operations with a backup launch, Ariane 5, Integral will be given priority.

The ESA ground station (Redu) will be a remotely controlled station, configured and operated from MOC; station operation (maintenance) personnel will only be available during working hours.

The Redu station configuration for Integral support will be obtained by upgrading the presently available station configuration, which was designed originally for Cluster support. The main upgrades are planned in the areas of Telemetry Processor (the TMP 4 will be adopted), Telecommand Encoder and PSS (Integral is based on packet commanding while Cluster commanding was PCM) and Station Monitor and Control System (the STC 1installed for Cluster, is not maintainable till the end of the Integral mission and will be replaced by the newly developed STC II).

Replacement of MPTS and modem subsystems with the IFMS (Intermediate Frequency Modem Subsystem) presently under development is being considered. It is assumed that the funding for IFMS procurement and installation will be borne by D/TOS investment budget (TBC).

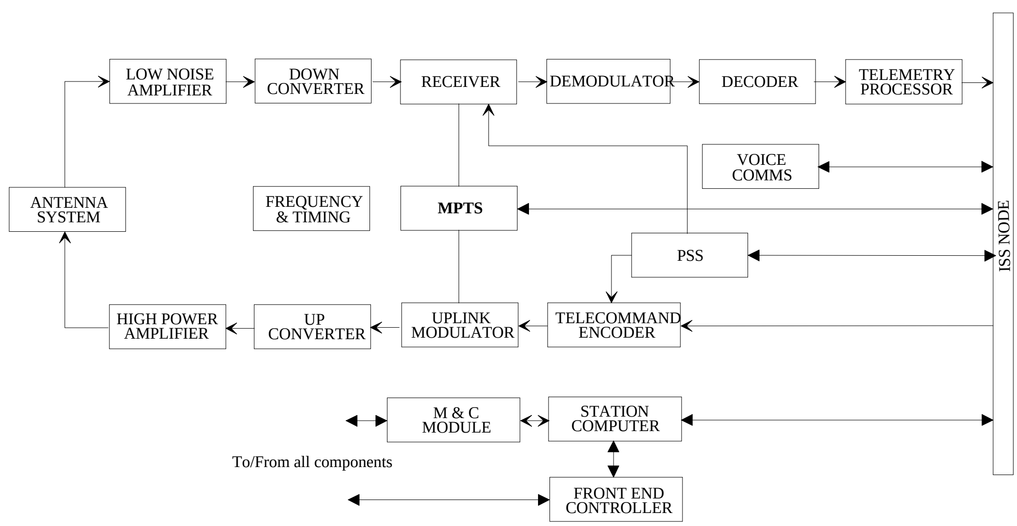

Fig. 5.2-1: Ground Station Basic Configuration

One extra operational component of the REDU station, as well as other ESA owned support ground stations, is the Portable Satellite Simulator, PSS. This is a PC based system capable of telemetry generation and command reception. The PSS will be used in support of

INTEGRAL Operations Validation Tests (OVT), Mission Readiness Tests (MRT) and Data Flow Test (DFT) and in the routine phase of operations for pre AOS system configuration confirmation checks.

At the MOC side data routing to and from the ground stations is via the Network Controller and Telemetry Router System (NCTRS). This system, (reference figure 5.2-2), is the network management and ground station interface part of the IMCS system. The NCTRS is capable of telemetry reception from the ground station; telecommand transmission to the ground station; reception of tracking and ranging data from the ground station and management of network of ground stations.

The DSN station (Goldstone) will be operated by JPL personnel. Station configuration and operations will be performed by station operators under voice control from the MOC.

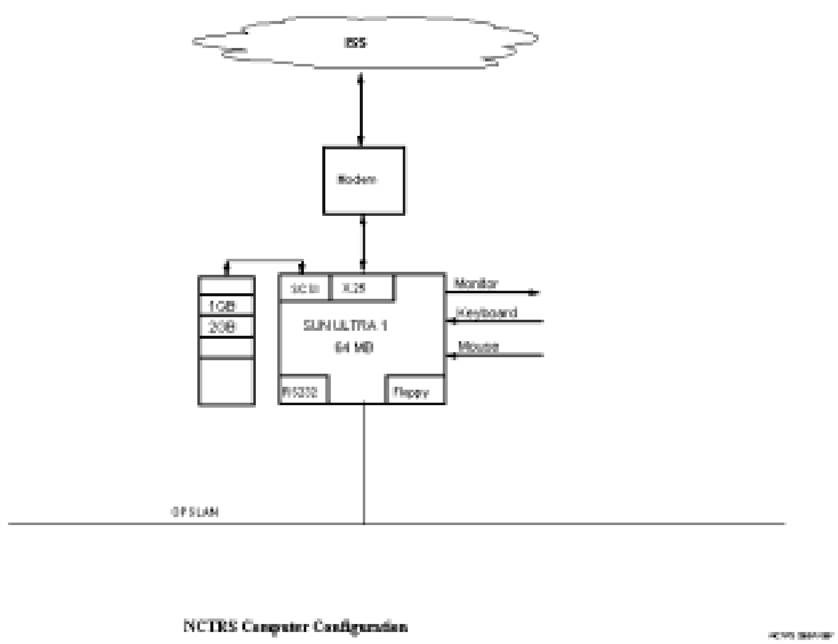

Fig. 5.2-2: NCTRS Computer Configuration

The baseline connectivity between the IMCS and Ground station in Goldstone is via the Space Link Extension (SLE).
The SLE development is planned in 2 phases:

- First Phase: adaptation to SLE of NCTR and simulator and development of an SLE Gateway for adaptation of ESA/NASA communications network
- Second Phase: adaptation of ESA stations interface to SLE.

Integral nominal mission support will be based on the first phase development, i.e. MOC will operate via the ESA stations through the standard ESA interface and via the DSN station at Goldstone through the SLE interface.

Such mixed configuration implies (minor) changes in the Integral Mission Control SW.
The ICD between D/TOS (ESA) and TMOD (JPL), RD 17, in agreement with the Integral MRR, RD (18) foresees primary Integral support from Goldstone via SLE, still maintaining NDIU as back-up solution.

As an alternative, should SLE not be ready in time for the Integral launch, the 26M subnet of the DSN station at Goldstone will be interfaced to MOC via an Network Data Interface Unit, NDIU, (reference figure 5.2-3) below, which consists in essence of a selection of ESA station baseband equipment (TC encoder + subcarrier modulator, TM decoding and pre-processing subsystem, PSS) and provides to MOC an interface compatible with the ones of any other ESA stations.

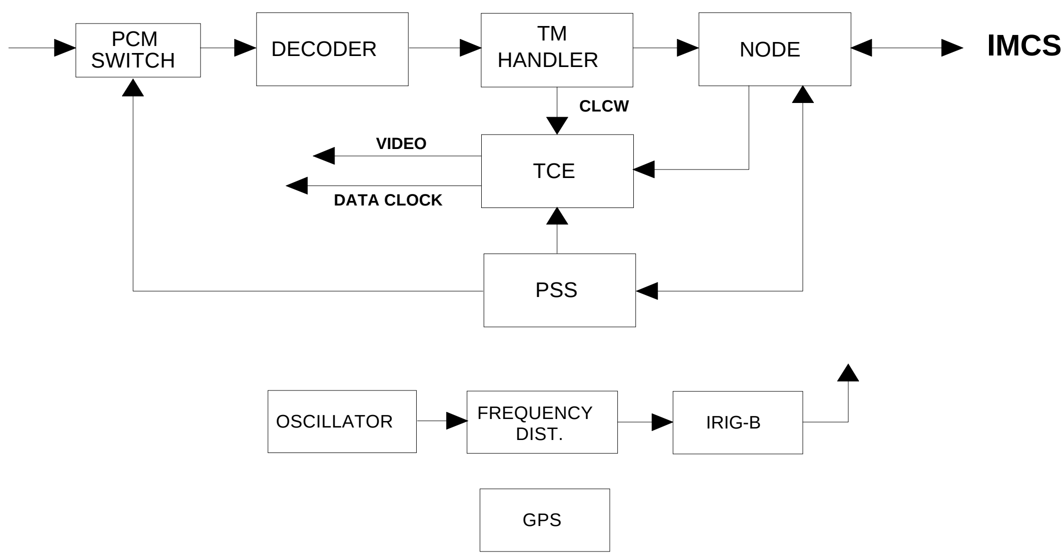

Fig. 5.2-3: NDIU Configuration

The NDIU will, in any case, be used to interface the satellite EGSE to MOC to support the System Validation Tests (SVTs) during the ground segment development testing and during pre-launch testing/operations from the launch side.

NOTE: Integral is currently exploring the possibility to reuse the NDIU Lite system concept currently under development by the CLUSTER Project which consists in the re-utilisation of the SIMSAT ground station models to interface on one side with the NCTRS at the MOC, and on the other side, the satellite EGSE via a TCP/IP protocol. This system is composed of two workstations, as opposed to four 19-inch racks of the normal NDIU.

5.2.2 Mission Operations Centre

5.2.2.1 Mission Operations Centre Functionalities

The Mission Operations Centre (MOC), (reference figure 5.2-5), is located at ESOC, Darmstadt and consists of the following elements:

- INTEGRAL Monitoring and Control System (IMCS) including OBSM.

- Flight Dynamics System (FDS)
- Mission Archive
- Offline Evaluation System (PAS)
- On-Board Software Maintenance System (OBSMS)
- INTEGRAL Overall Simulator (IOS)
- INTEGRAL Security Distribution System (ISDS)

MOC is responsible for the operation of the INTEGRAL Satellite and for the provision of data to ISDC, allowing the latter to extract the scientific products of the mission.

All INTEGRAL operations are pre-planned and executed in real-time by MOC. Real-time changes to the operations timeline are limited to contingency recovery. No real-time interactions between the various centres (MOC-ISOC-ISDC) are required/planned.

The INTEGRAL mission operation concept has been derived from the XMM operation concept, adapted to the Integral specific needs, owing to the similarities between the missions. In view of this the re-use of the XMM Mission Control System (XMCS) modified to meet the Integral needs, is one of the two options being investigated in the on-going Integral MCS AD phase. The second option being investivated in the Integral MCS AD phase is the use of a SCOS 2000 based system to support the Integral mission.
The amount of re-use of the XMM MCS SW, should the first option be selected (selection is due in Jan. 99), is estimated in the order of 50%.

The functionalities of the different elements quoted above are briefly addressed in the following:

INTEGRAL Mission Control System (IMCS):

Currently, during the AD phase, Integral is investigating the possible use of either of two spacecraft control systems, SCOS-I or SCOS-2000. The data flow for both of these systems is the same, however the hardware configurations differ. Should it be decided to re-use the XMM system, based on SCOS-I, at the end of the AD phase then the relevant hardware diagrams contained within this document will be modified to reflect the actual configuration.

The INTEGRAL mission control system (IMCS) is dedicated to the mission control of the INTEGRAL spacecraft. The IMCS connects to the ground station baseband via the Network Controller and Telemetry Router System (NCTRS), the MOC Communication Node and the Ground Station Communication Node. IMCS interfaces internally in the MOC with Flight Dynamics for both attitude and orbit monitoring and control and to OBSMS for maintenance of on board software images. The external interfaces of IMCS are:

- With ISOC for exchange of planning files;
- With ISDC for provision of real-time / off-line telemetry (VC0 & VC7) and auxiliary data.
- With the PI Workstations which will be installed in MOC for PI support during pre-launch and commissioning activities. This interface is for provision to the PI WG of real time VC 0 + VC 7 TM.

The external interfaces above are routed via the Integral Security Data System (reference figure 5.2-17) whose purpose is to isolate the Operational LAN from potential external unwanted interferences.

Further IMCS functionality's are:

- Determination of time correlation between on-board clock and UTC
- OBSM i.e. facilities to up and downlink on-board SW images received from the PI's (via ISOC) or from the OBSMS or from the satellite and maintain them under configuration control.
- Interfacing between FDS and ISDC for provision to ISDC of near real-time attitude information (attitude snap shots) and of off-line auxiliary data (predicted orbit files, attitude history files, etc.)
- Provision to the Off-line Evaluation System of History files (TM/TC)
- Provision of facilities for FOP and IFOP maintenance and for ODB maintenance and for provision of ODB updates to ISOC and ISDC.

The data structure of TM/TC, handled by the IMCS is defined in RD 22. Such data structure deviates significantly from the one adopted by XMM. Deviation from RD 22 have been adopted in the SPI TM/TC, requiring therefore special processing within the IMCS (RD 20 and RD 21).

The hardware configuration of the IMCS is shown in the figure 5.2-4 below.

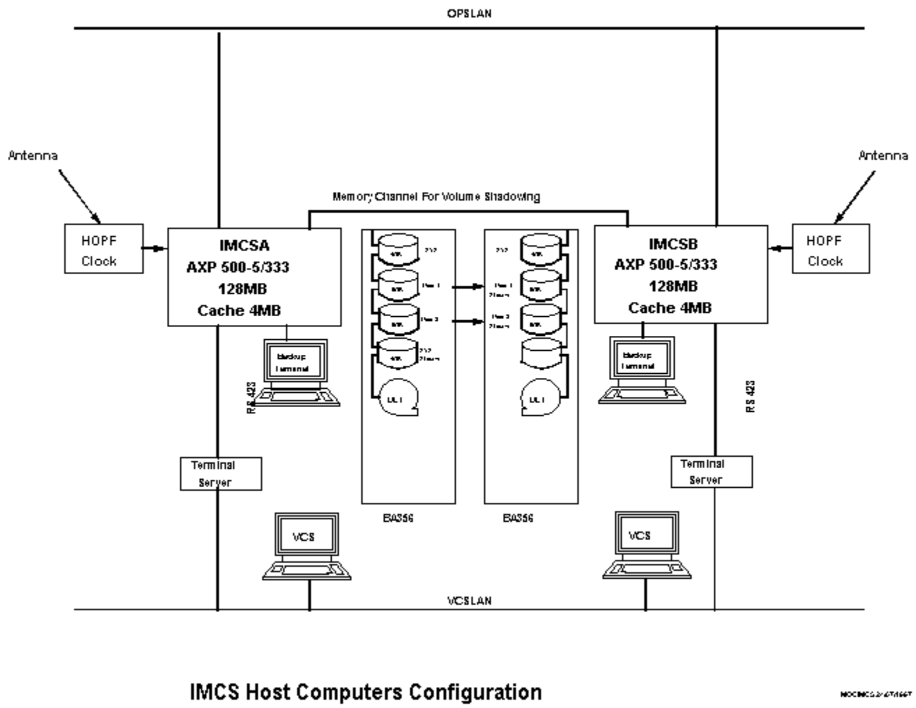

Figure 5.2-4: IMCS Host Computers Configuration

5.2.2.2 Mission Operation Centre Overall Configuration

The MOC overall hardware configuration, including LAN configuration, is presented in the figure below.

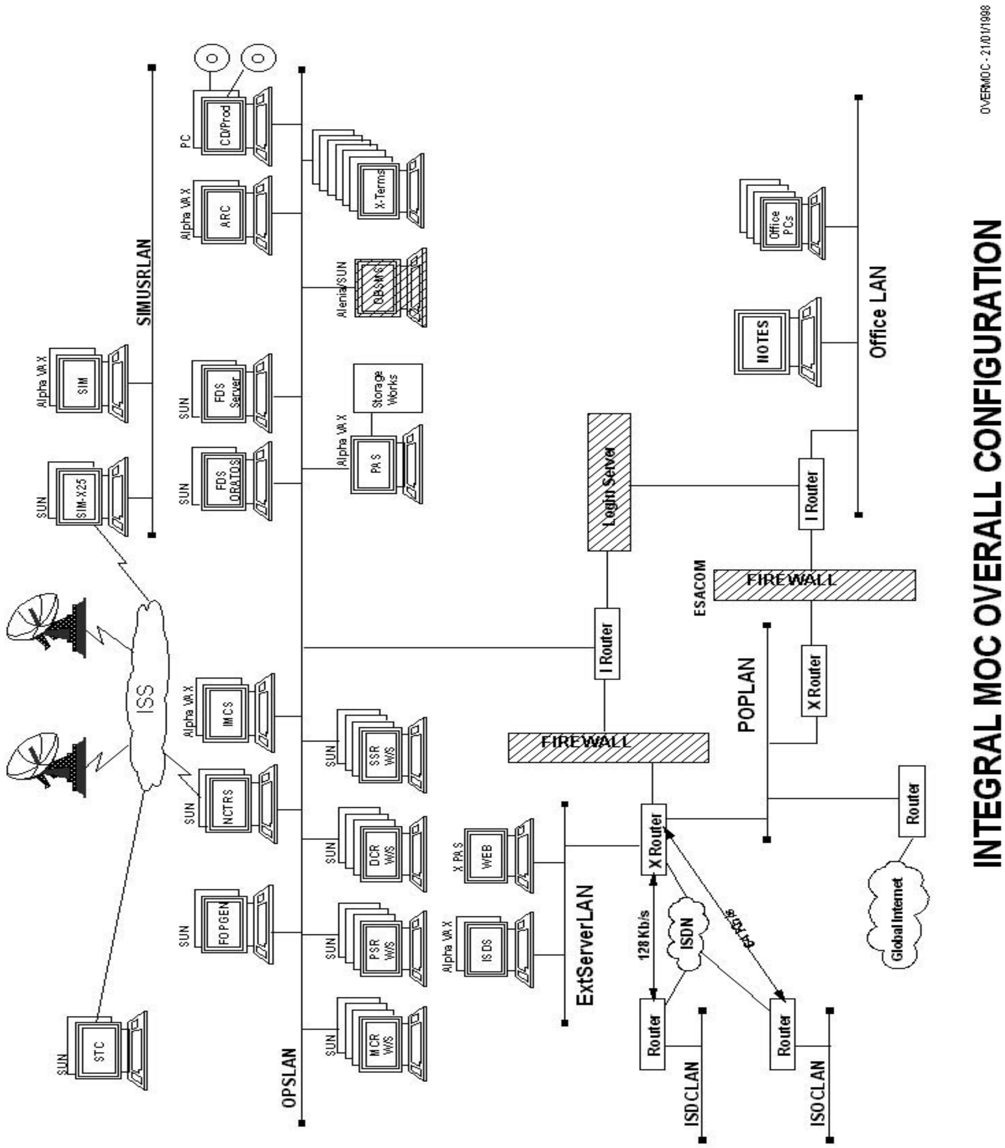

Fig. 5.2-5: INTEGRAL MOC Overall Configuration

Telecommand Processing Task

The command processing system, (reference figure 5.2-6), packetises the validated commands into a form suitable for transmission to the ground station and subsequent uplink to the spacecraft. All commands whether from the schedule or the manual stack are subjected to pre-transmission validation checks (PTV), which determine whether the command is permitted at that time. The checks, (reference figure 5.2-7), are defined in terms of rules concerning applicable spacecraft status, command system configuration and link status, and may include dependencies on previous commands (interlocks). Verification of uplinked command reception and on-board execution of the commands including interlock handling based on VC0 telemetry downlinked from the satellite.

From the planning files provided by ISOC to the Flight Dynamics System, the IMCS derives the operations timeline and the command schedule, which is automatically executed in real-time via the uplinker. The timeline is also routed to ISOC and ISDC to allow them to monitor the correct satellite operations.

Telemetry processing Task

The main functions of the Telemetry Processing System, (reference figure 5.2-8 & 9), is to extract raw parameter information from the VC0 received telemetry packet, process derived parameters and perform checks on the telemetry parameters for both raw and derived parameters. The checks performed can be any combination for validity, limit, status or consistency. All processed telemetry is made available for display purposes and long / short term archiving.

The nominal VC 0 Telemetry rate received by the IMCS from the ground stations is in the order of 8 Kbps.

The Integral Project has stated that in the case of DPE SW on board failure Science Telemetry normally flowing into VC 7 could be corrupted and could be interpreted by the on-board system as VC 0 Telemetry. In this case the VC 0 Telemetry rate would substantially increase. The Project requests that the IMCS be designed such that in such case, the system wouldn't crash as to allow rapid recoveryof the on-board failure from ground.

A preliminary analysis shows that in the case SCOS-I (i.e. the same system as used by XMM) would be selected for the support of the mission, the IMCS would react to an increased VC 0 Telemetry rate with a performance degradation possibly reaching the crash-treshold; should SCOS 2000 be selected in view of its distributed architecture, it would provide a better protection to such eventuality and would most probably not crash.

The specification has been injected in the IMCS SRD (RD 19) and is being analysed in the IMCS ADD (RD 20/21).

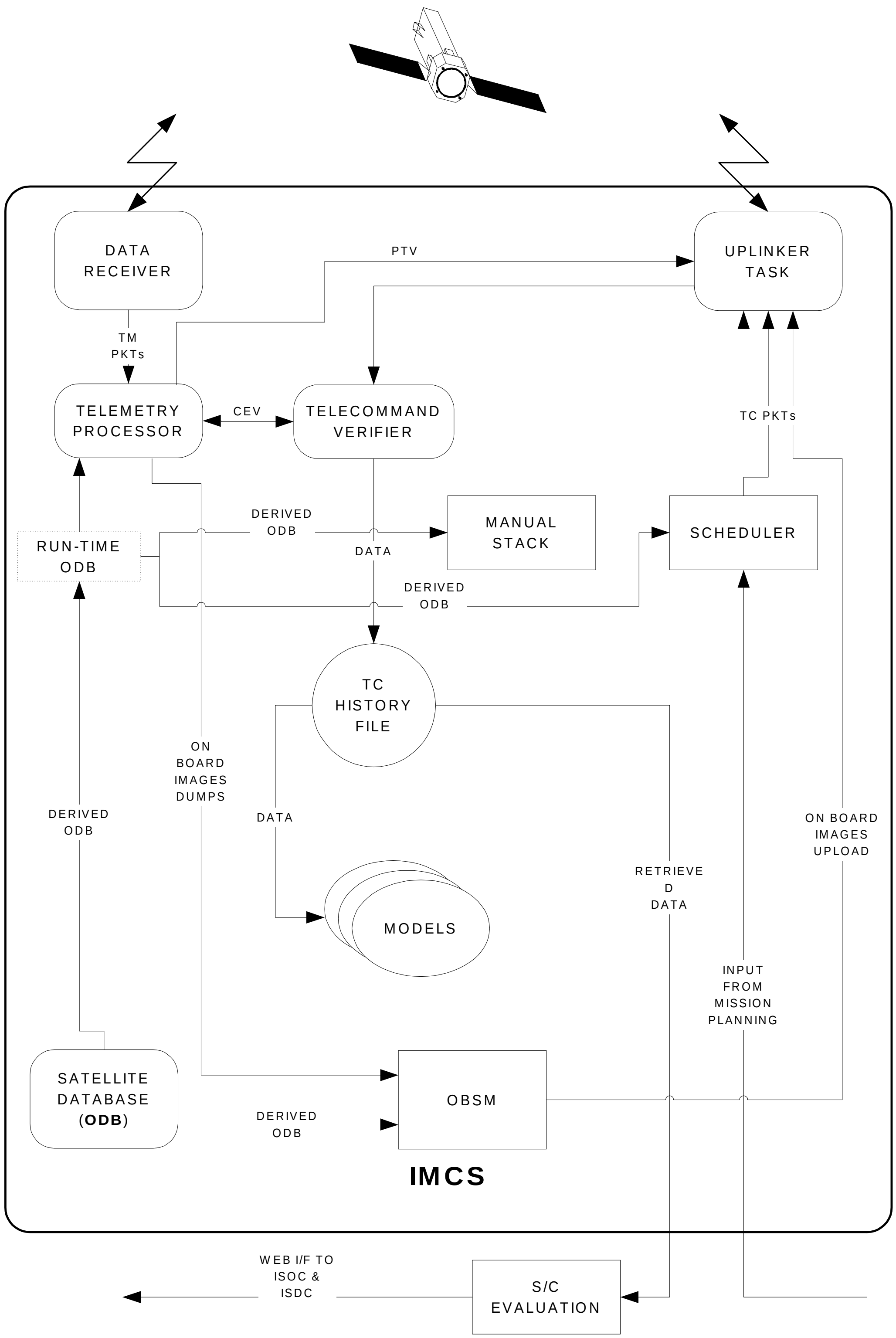

Fig. 5.2-6: Telecommand Data Flow

TELECOMMAND VALIDATION & VERIFICATION

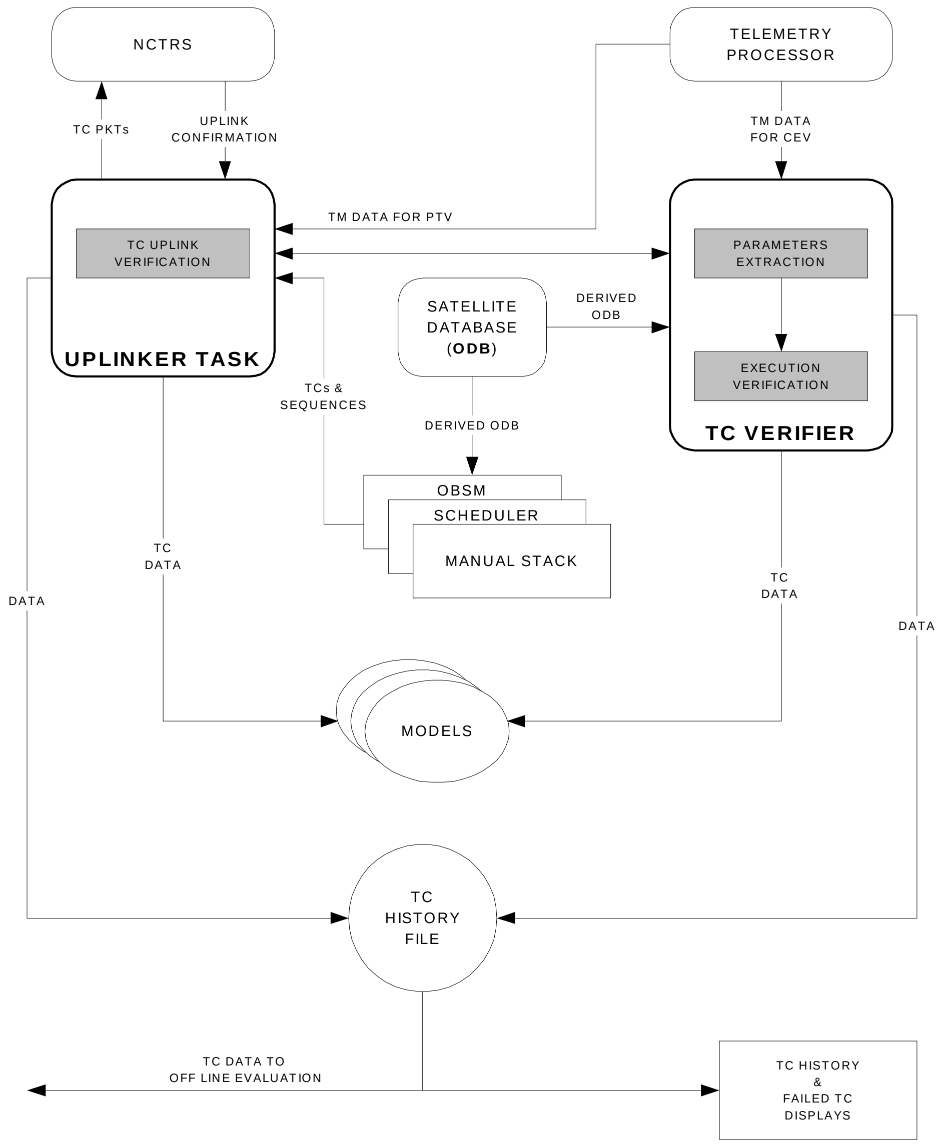

Fig. 5.2-7: Telecommand Validation and Verification

For telemetry, reference Figure 5.2-8 below, the IMCS receives from the ground stations, via Opsnet and NCTRS the real-time telemetry stream of VC0 frames (Satellite HK) and VC7 frames (science data).

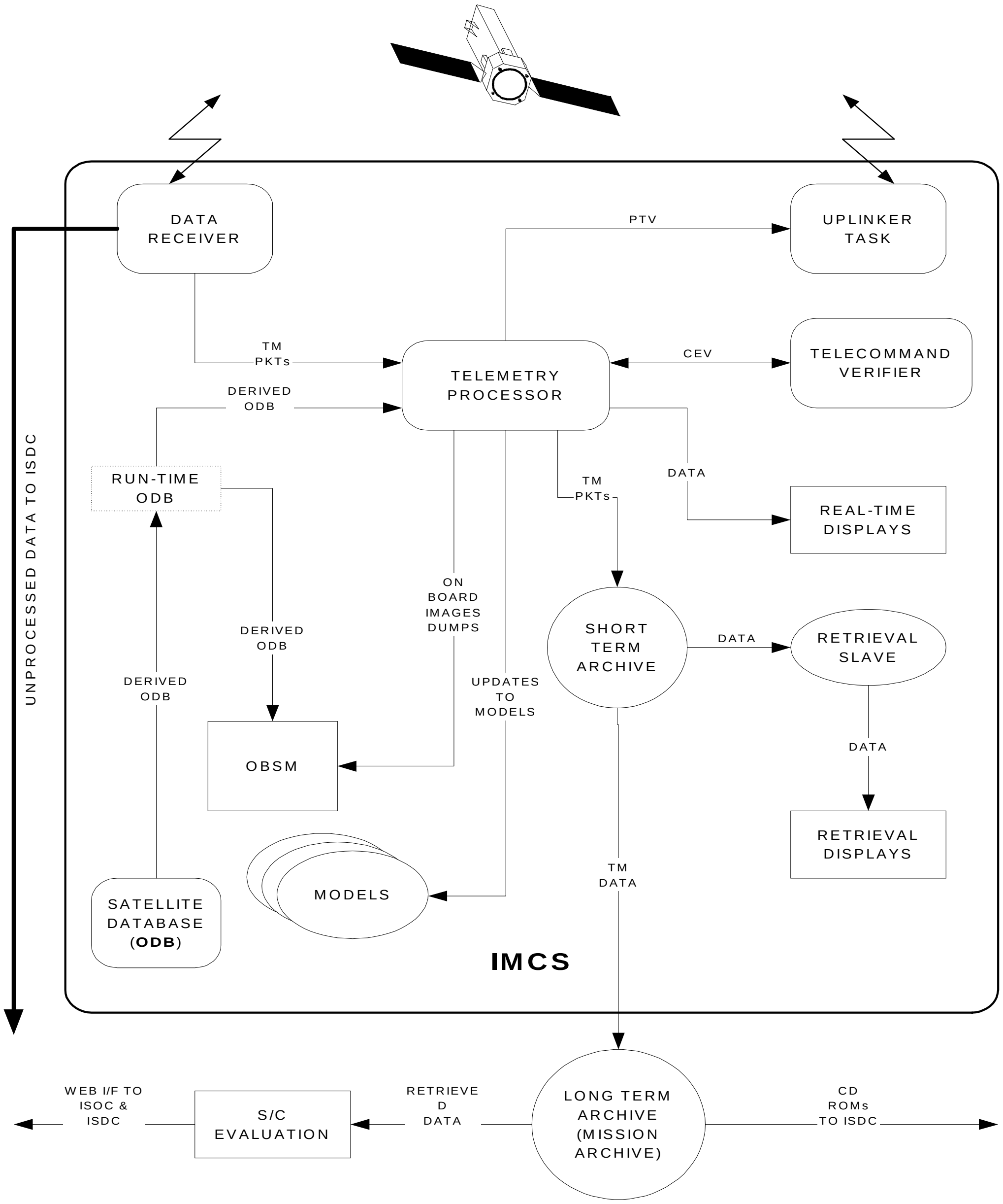

Fig. 5.2-8: Telemetry Data Flow

VC0 is further processed by IMCS for TC execution verification and to provide the MOC Operators with the displays required for monitor of the satellite performance. Part of the VC0 telemetry is provided to FDS to allow monitoring of AOCS, STR and RW performance that allows appropriate measures (via IPF) in case of non-nominal behaviour.

The VC0 and VC7 frames are identified by the IMCS and after addition of “annotations” are routed in real-time to ISDC in parallel to being added in the mission archive along with VC0 telemetry information. The mission archive is organized according to ERT time stamp provided on reception by the ground.

After the pass, the IMCS is configured to the last ground station for retrieval of frames that where not received in real-time during the pass. This data is then merged to the mission archive for archive consolidation and off-line provision of consolidated telemetry to ISDC via CD-ROM (see below).

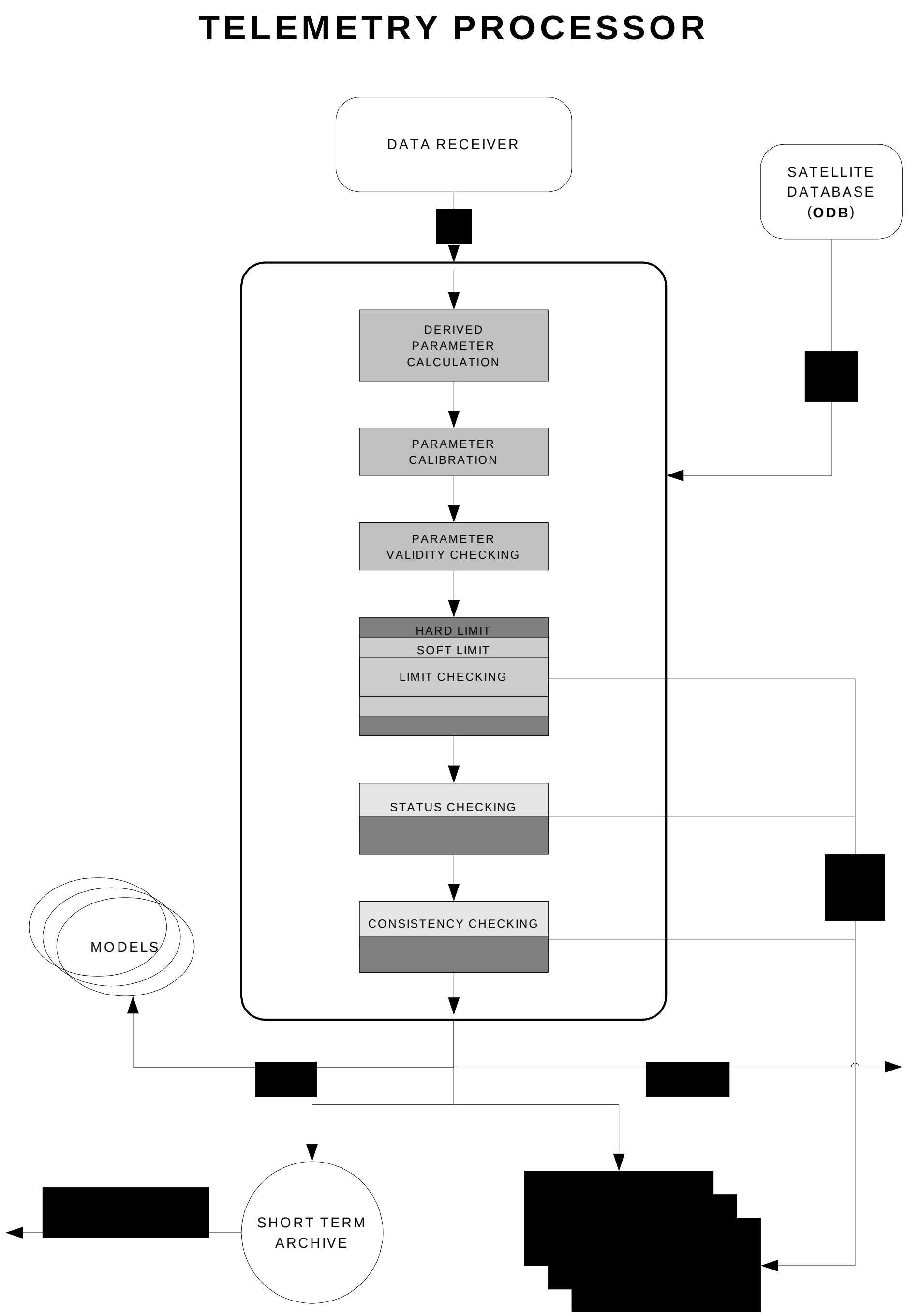

Fig. 5.2-9: Telemetry Processor

Operational Data Base Subsystem (ODBS)

The Operational Database Subsystem, (reference figure 5.2-11), directly supports the IMCS telemetry and command processing tasks and is an important component of this system. Operations staff can interrogate, modify and/or create entries in the operational database via dedicated editors that are used for the monitoring and control of the Integral Spacecraft. Derived parameter creation, used for special telemetry processing, is also supported by this system in addition to Command Sequence and Event Designator, ED, creation and generation.

The Operational Database (ODB) is derived from the Satellite Database (SDB) provided by the Satellite Main Contractor (Alenia) to MOC. The SDB is a global Database including TM/TC, Flight Dynamics and AIV database. Filtering of the information required to construct the ODB is provided at MOC. Once available, the ODB will be distributed to ISOC and ISDC for extraction at their side of the elements they will require for their tasks. Updates will be provided to ISOC and ISDC as required following ODB updates at MOC.

Until the end of the commissioning, the ODB maintenance will be performed by MOC in agreement with the satellite manufacturer. After commissioning phase, the ODB maintenance will be delegated fully to MOC. The instrument part of the ODB will be maintained throughout the mission (from commissioning onwards) based on inputs from the PI teams (Reference RD 24).

A subset of the Operations database mainly concerning the AOCS area is made available to Flight Dynamics in support of the orbit and attitude control software for the Integral spacecraft. The data in question is in form of ASCII files containing information from the SCOS PCF, PLF, PMF, PSF, CAF and TXT tables.

The Operational Database is used in support of Flight Operations Procedure generation, (reference figure 5.2-10) below, and associated automatic command sequence generation. The procedure generation system provides a direct gateway to necessary telemetry and command information required for procedure generation.

Currently Integral is investigating the use of either of two systems for procedure and command sequence generation, FOPGEN or WINFOPS.

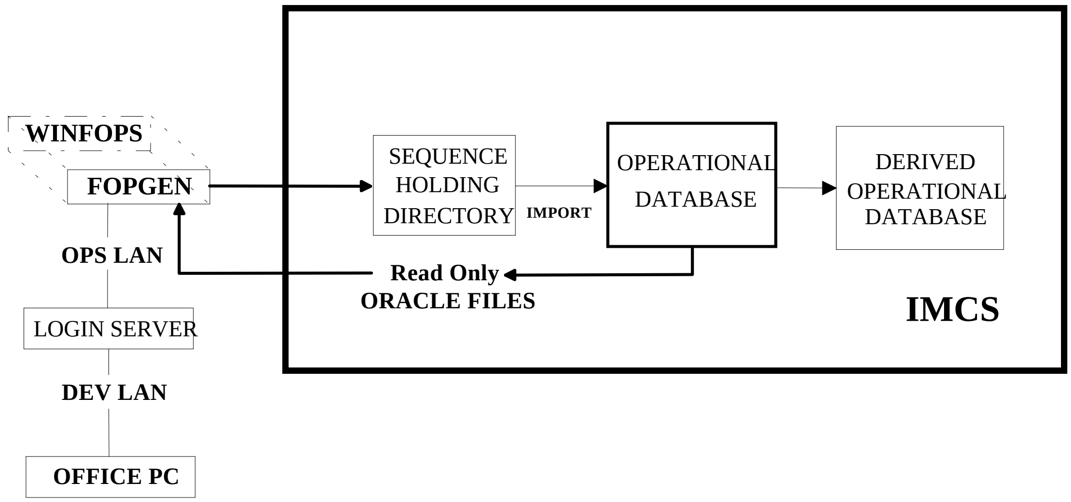

Fig. 5.2-10: Procedure Generation System Configuration

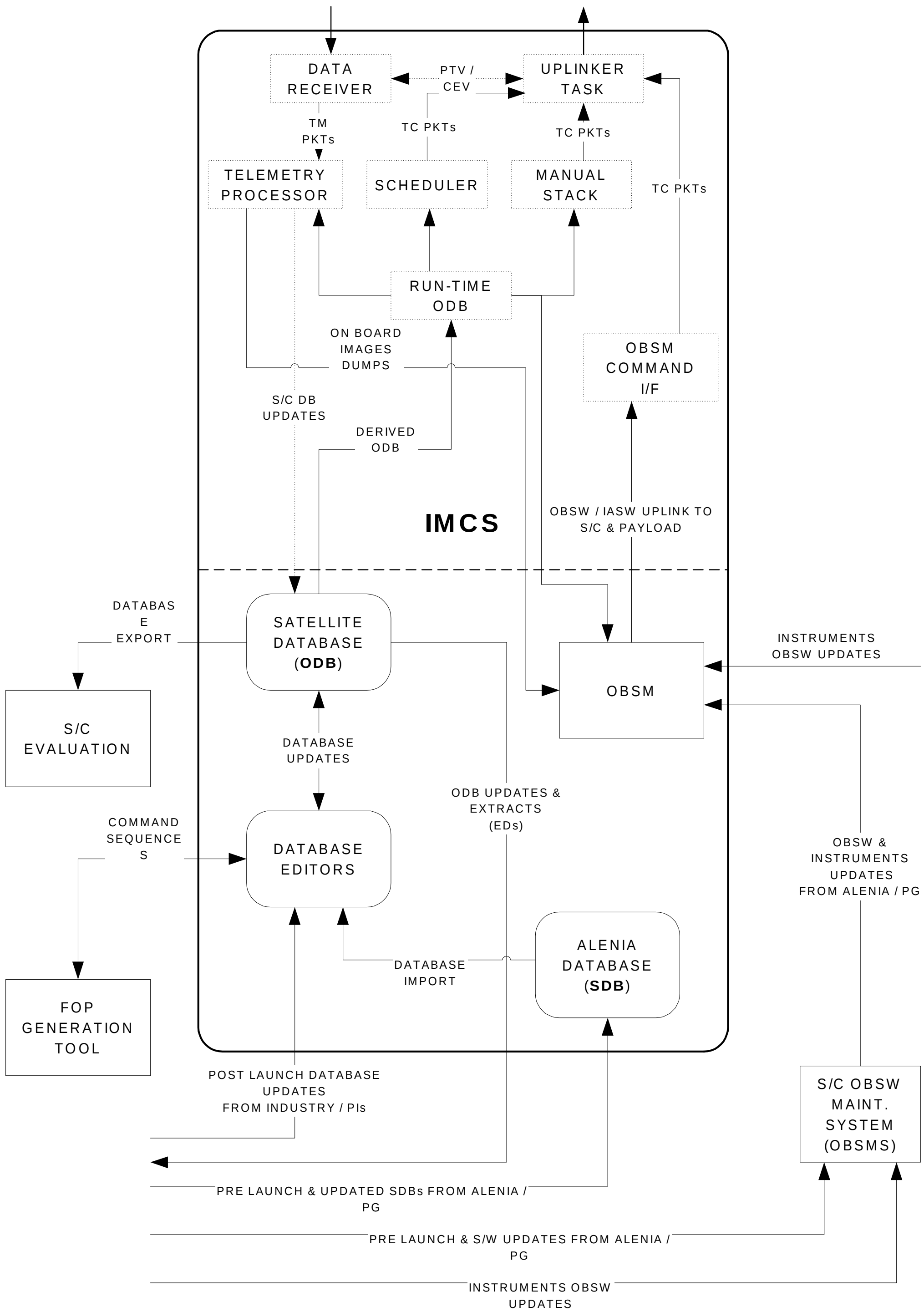

Fig. 5.2-11: Operational Database System, ODBS

Flight Dynamics System

The Flight Dynamics System, (reference figure 5.2-12), provides the following functions:

- Generation of PSF (based on individual revolutions of the satellite i.e. perigee to perigee) and provision of the PSF to ISOC
- Reception from ISOC of the POS and validation of the POS in terms of structure and compatibility with satellite and celestial constraints
- Derivation (from the POS) of files suitable for conversion into timeline and further into command schedule
- On-line monitoring of AOCS performance, STR performance, Reaction Wheel performance, pointing accuracy and attitude, and generation of commands (IPF) in case the above performances need to be corrected
- Post-revolution determination of Attitude History and provision of data to ISDC
- Pre and Post-revolution determination of the satellite orbit and provision of the related files to ISOC and ISDC
- Manoeuvres calculation and execution (via IPF)
- RMV monitoring
- AOCS, STR and RMU calibration
- On-board fuel consumption bookkeeping.

In addition, Flight Dynamics will provide ISOC with planning tools (visibility constraint checker, slew time predictor and DataBase of Observable Bins) required by ISOC for observation planning.

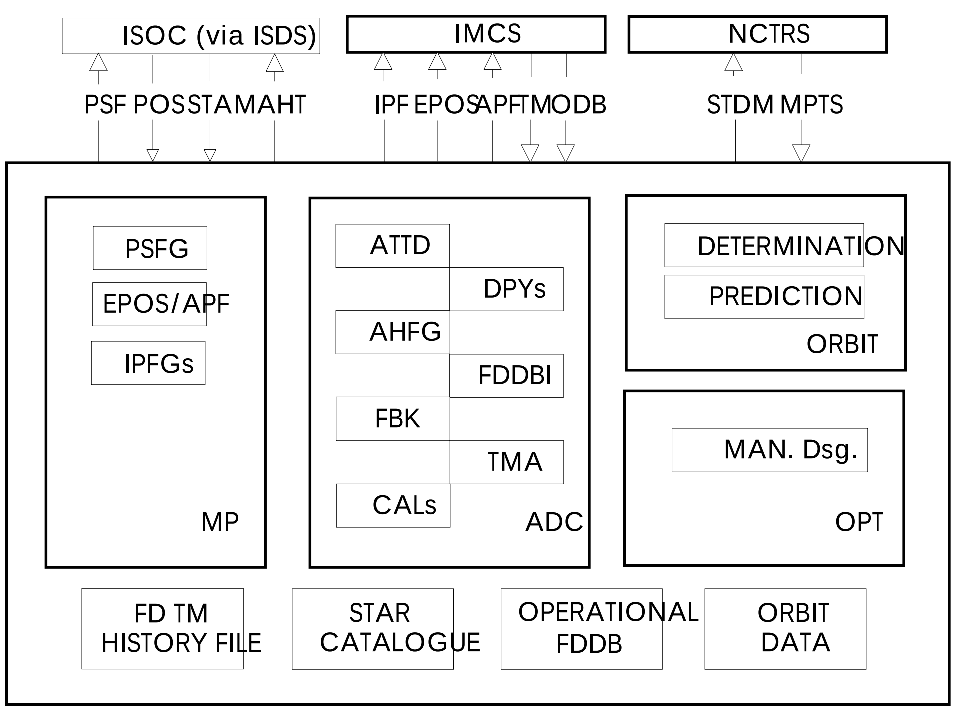

Fig. 5.2-12: FD System Configuration and Interfaces

Mission Archive

All telemetry received at MOC from the ground stations and all MOC generated auxiliary data transmitted to ISDC during operations will be archived, (reference figure 5.2-13), in the MOC mission archive.

The archive will be organised for both VC0 and VC7 based on Earth Receive Time i.e. ERT time stamps provided by the ground station on each telemetry transfer frame and on the time of transmission of MOC generated auxiliary data.

After a station pass, the archive will be checked for completeness and the missing frames will be requested for re-transmission from the ground station based on time gaps detected within the archive. The archive will then be consolidated with the missing frames and a CD-ROM covering 12 hours telemetry and related auxiliary data will be produced and mailed to ISDC.

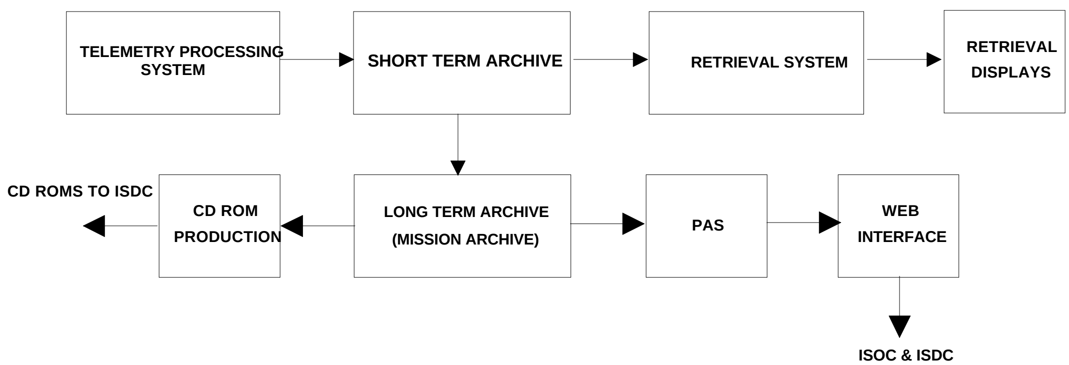

Fig. 5.2-13: Mission Archive Configuration

Off-line Evaluation System (PAS)

The TC History Files (including TC verification) and the TM History Files (limited to VC0) are periodically (every hour – TBC) archived in the Spacecraft Evaluation System (called PAS-Performance Analysis System), reference figure 5.2-14, together with their related ODB (this latter is however archived only when updated). The PAS provides the following functionalities:

- Mapping of the History Files to different ODB versions
- Analysis of parameters or group of parameter trends versus time.
- Access to the PAS will be provided to ISOC and ISDC via a Web interface.

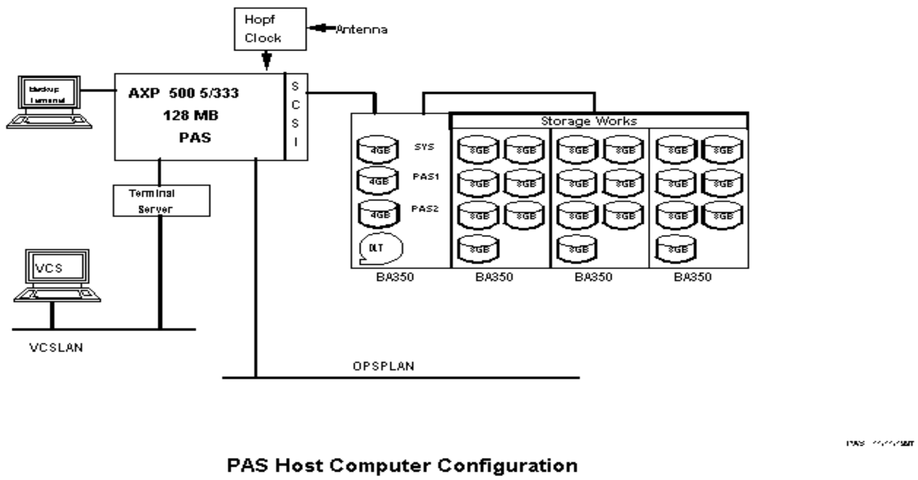

Fig. 5.2-14: PAS Host Computer Configure

<u>On-Board SW Maintenance System (OBSMS)</u>

Throughout the INTEGRAL mission, spacecraft on-board software will be maintained by the MOC, (reference figure 5.2-15). The instruments on-board software maintenance will remain a PI responsibility until the mission end. Integral currently assumes that the hardware configuration of the OBSMS will be the same as used by the XMM Project.

The responsibility of the maintenance of the on-board SW of the DPEs, i.e. of the elements interfacing spacecraft and Instruments, is at present unclear since it involves common services (CSSW) and specific instruments application software (IASW) which may highly depend on each other, depending on the instruments final design.
On-board software maintenance of the instruments peripherals (Front-End processors) is also the responsibility of the various PI's; the tools and procedures to perform this activity are TBD.

Spacecraft on-board software maintenance will be performed by MOC based on an OBSMS tool provided by the spacecraft manufacturer via the INTEGRAL project.
The functionality provided by this tool and its interfacing with the IMCS are described in section 6.5 of this report.

The hardware configuration of the OBSMS is still TDB pending provisions from the project of relevant documentation.

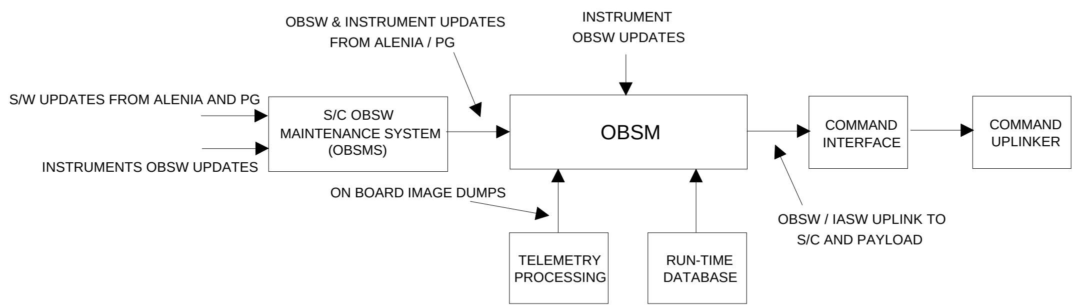

Fig. 5.2-15: OMSMS Configuration

INTEGRAL Overall Simulator (IOS)

The IOS is composed of two elements:

- Spacecraft (SVM) simulator
- Instruments simulator

The SVM simulator is being procured as a “Delta” to the XMM simulator based on the XMM SVM code modified to take into account changes from XMM implemented on board Integral SVM. The list of changes has been agreed between MOC-Project-Alenia at the start of the Integral SVM simulator development.

The SVM simulator includes an OBDH and AOCS “emulators” where the actual on board SW can be run. No “emulator” is provided in the Instrument Simulator. The science data are derived in the Instrument Simulator from AIV pre-recorded files provided by the Integral Project.

The lack of the “emulator” on the Instrument side of the simulator is an element of concern for the MOC, since will only allow limited validation of Instrument Flight Procedures (IFOP) and will only allow limited validation of Instrument on-board SW modifications provided by the PI (see section 6.5.3 of this report).

The IOS will simulate the INTEGRAL satellite in its orbit. The simulation fidelity will be such to allow proper training of the operation personnel for routine operations and for major contingencies recovery cases. Reference figure 5.2-16 for the computer configuration of this system.

The simulator will be connected to the MOC System via the MOC communications node and NCTRS. The IOS will be used at the MOC for IMCS testing, FOP and IFOP validation and pre-launch simulations.

Within the overall INTEGRAL Ground Segment, the IOS is the only tool to perform system validation and is planned to be used during the interface tests with SGS (TBC) and for the GSIT.

Provision of simulated data on a CD-ROM has been requested by ISDC for testing/validation of the ISDC system; this activity, not foreseen in the original MOC planning (and hence CTC), is presently under discussion.

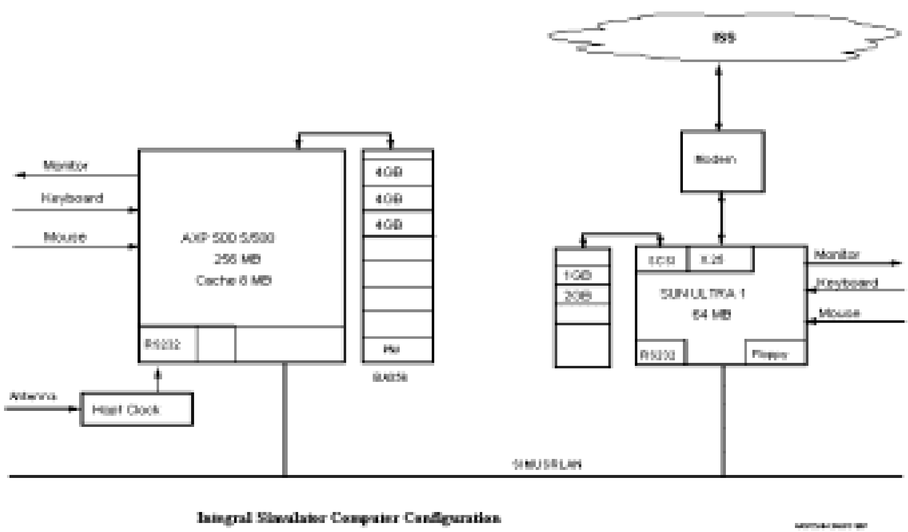

Fig. 5.2-16: Integral Simulator Computer Configuration

INTEGRAL Security Distribution System (ISDS)

The ISDS is an Alpha VAX based machine, (reference figure 5.2-17) below, allowing communications with MOC external entities (ISOC, ISDC and PI Workstations) through the MOC firewall, and therefore protecting the MOC Opslan from potential external interference.

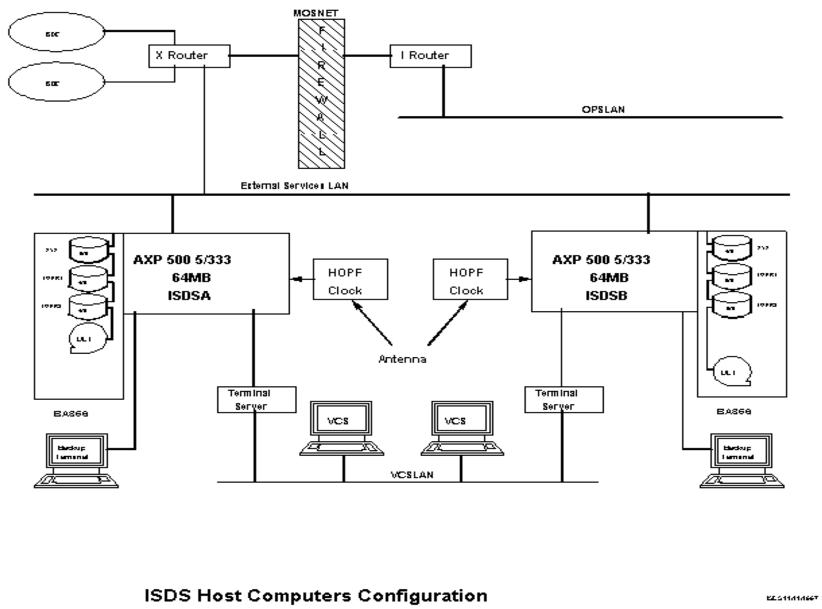

Fig. 5.2-17: ISDS Host Computers Configuration

5.2.3 Communications

Communications to Baikonour and of communications from MOC to Goldstone , to be added in the next issue of the report by MOC.

The establishment of the communication network between MOC and ground stations, and between OGS and SGS, i.e. MOC/ISOC and MOC/ISDC, is a task under MOC responsibility.

Two different networks using different technologies are planned:

a) The communications between MOC and Ground Stations will be via the “Opsnet”, a network based on the OSI stack communications up to the “session” layer.

The Network capacity has been dimensioned to the INTEGRAL requirements and entails leased lines providing a capacity of 128 Kbps + 64 Kbps. Redundancy of “essential communications” is provided via ISDN connections.
The lines are terminated at the MOC and station sides via communication nodes inter-connected via X25 protocol.

b) The communications between MOC and SGS (ISOC and ISDC) are provided as follows:

- Real time telemetry transfer to ISDC:
  A leased 128 Kbps line will provide the satellite telemetry to ISDC via a TCP/IP connection. The line is terminated at the two ends (MOC and ISDC) via routers. No redundancy is foreseen
- Real time (attitude snapshot) and off-line (planning and auxiliary data) file transfer to ISDC and off-line planning data to ISOC.
  The communications are provided either via leased lines or via ISDN (TBC) using the IFTS protocol.
  Also in this case no redundancy is provided.
- Access to PAS: Access to the MOC PAS system is provided to ISOC and to ISDC via WWW.

The general performance end-to-end (i.e. from the stations to the ISDC) specified for the transmission of science data received at the ground station is minimum delivery of real-time science data to ISDC of 95% of data received at the ground station within 1 month.
The maximum end-to-end delay specified for delivery to ISDC of science data is 5 minutes.

It is expected that the communication system will provide better performance than quoted above. Particularly in the area of the end-to-end delay in delivery of science data to ISDC the goal is to reach a delay in the order of seconds or tens of seconds, as to allow ISDC to timely detect phenomena like Gamma Ray Bursts and provide alerts to the Science Community in time to permit further observation of the phenomena from other observatories.

Concerning science product extraction from the received data the specification of 95% of data delivery above is not very critical since the extraction at ISDC is done off-line based on the data provided to them via CD-ROM (see paragraph 5.2.2.2 above under Mission Archive).

A preliminary communications loading analysis is contained in RD 23. A Final Technical Note on the Integral Ground Segment communications is pending. In this Technical Note, also the security issues pertaining communications will be dealt with (mainly in the routing MOC-JPL).

ESOC LOCAL AREA NETWORKS

Introduction

The ESOC "internal" Local Area Networks, (reference figure 5.2-18), can be broadly categorised as follows:

- Operational LANs - Security Class I
- Software development oriented LANs - Security Class II
- Office automation and administrative applications support LANs - Security Class III.

The network security requirements are most stringent for Class I, which is protected by dedicated Access servers for authorised users only. The Class II LAN is protected via dedicated user accounts and is not available to the general public within ESOC. All LANs, including Class III, the least stringent, are protected via the ESOC Firewall from the outside community.

Conceptually then, one can view the three LAN environments as separated from one another and from the outside by access security facilities.

OPSLAN - Access Server

Connectivity between the OPSLAN and an Access Server is via TCP/IP only. Any kind of TCP/IP is permitted, provided that the session is initiated by the OPSLAN node. The Access Server cannot initiate a session to a node on the OPSLAN.

The following services can be used :

- TCP/IP task-to-task communication;
- Telnet for interactive login;
- FTP for file transfer;
- SCOPY for file transfer (VAX/VMS - VAX/VMS only).

External World - Access Server

Any network or protocol can be used for connectivity between the external world and an Access Server on the DDOPLAN. In addition to access via the FELAN (e.g from Internet or SPAN), direct on-demand asynchronous connectivity to the Access Server can be granted, e.g preferred access via Internet. Alternative access on-demand via ISDN or PSTN, but not necessarily supported long-term.

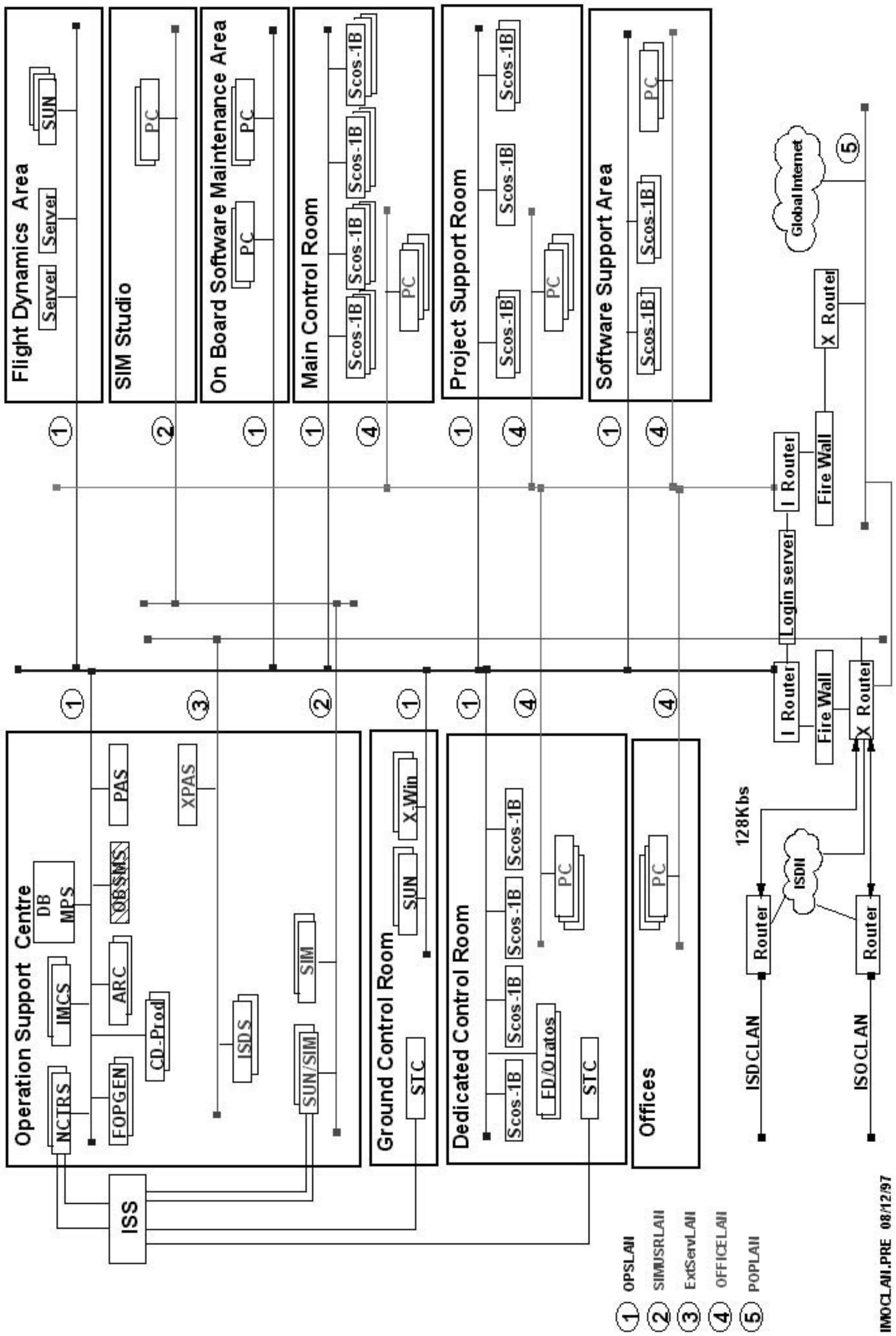

Fig. 5.2-18: ESOC LAN Configuration