

# SHARAD GROUND DATA SYSTEM (GDS)

M. GUELF, D. CALABRESE

ALENIA SPAZIO - VIA SACCOMURO 24, 00131 ROMA, ITALY

S. MATTEI

CO.RI.S.T.A. - CONSORTIUM FOR RESEARCH ON ADVANCED REMOTE SENSING SYSTEMS - VIALE KENNEDY 5, 80125 NAPOLI, ITALY

The SHARAD (SHALLOW RADAR) is a radar sounder that will be used to explore the subsurface and surface of Mars in the context of the Mars Reconnaissance Orbiter 2005 mission. The primary scientific objective of the SHARAD investigation is to map, in selected locales, dielectric interfaces to depths of up to one kilometer in the Martian subsurface and to interpret these interfaces in terms of the occurrence and distribution of selected materials, including rock, regolith, water and ice. The SHARAD instrument is a nadir-looking pulse limited radar sounder and altimeter, which uses synthetic aperture techniques to isolate subsurface reflections.

In order to support Principal Investigator (PI) experiment teams operation, a proposal has been submitted to the Italian Space Agency to develop a dedicated SHARAD Ground Data System. SHARAD GDS permits to:

- Manage instrument observations planning
- Manage instrument commanding (both Nominal and Contingency)
- Manage engineering and scientific monitoring of the instrument
- Manage science data processing and formatting
- Managing data archiving in coordination with ASI's ASDC

SHARAD GDS (Ground Data System) is part of a geographically-distributed architecture defined for controlling and monitoring the instrument, and for receiving and processing the downlinked Science Data.

## SHARAD GDS and MRO GDS connection:

- send SHARAD instrument command plan to the MRO GDS, which uploads it to the SHARAD instrument
- receive, through the MRO GDS, science telemetry data downlinked from the instrument
- receive ancillary data necessary to process the instrument science data

## SHARAD GDS and ASDC centre connection:

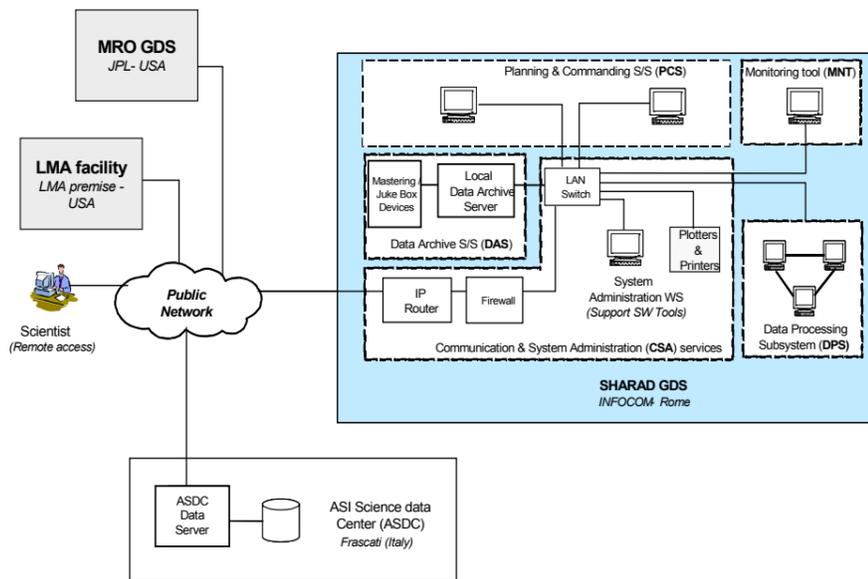
- archive processed science data for mission lifetime

## SHARAD GDS and LMA integration facility connection:

- transfer data and information (e.g. commands, TM, ancillary data) necessary for S/C qualification and operational readiness phase

## SHARAD GDS and Scientist connection:

- SHARAD instrument data products retrieve and exploitation by authorized scientific users



## PCS: Planning & Commanding Subsystem:

- generate, compute SHARAD instrument mission plans (Planning Tool) and associated command files (Commanding Tool)

## DPS: Data Processing Subsystem

- verify instrument health status from an engineering point of view (Monitoring Tool), and from instrument performance point of view (Quick Look Tool)
- scientific product generation (Deformatting/Level 1A Tool and Level 1B Tool)

## DAS: Data Archiving Subsystem

- front end to JPL, aimed at receiving instrument science TM and ancillary data sets from JPL
- archive/retrieve processed data sets (i.e. L1a, L1b, and metadata) in PDS-labelled format
- generation of Product Catalogue, which enables the Info-Com Scientists to browse, select, and retrieve data products
- export / import of data to / from the ASDC Data Server

## CSA: Communication and System Administration services

- external and internal connectivity to the SHARAD GDS centre.
- communication services public network infrastructure
- system management services
- S/W Development Environment (SDE) to support S/W maintenance

## GDS Software Tools Functional Description

### Planning Tool

GDS Planning Tool is a software that analyze the feasibility of scientific requests for SHARAD instrument operations, optimize the radar utilization for scientific purposes, and consequently define mission plan for the SHARAD instrument. Planning tool will be used in Interactive Observation planning and in the weekly operation planning to plan and schedule SHARAD operations all along the mission. Planning tool main function is to generate a Payload Target File (PTF) in which instrument proposed operation modes (timelines) are sequentially reported.

In order to generate the optimal PTF file a predefined target map, which takes under consideration variables such as surface coverage, surface statistics, orbital parameters, data volume, might be used aiding operative mode selection. PTF will be compared with other instruments request and then, after some iteration if necessary (TAG meeting) for conflicts solving, it will be integrated with all instrument requests to form the Integrated Payload Target File (IPTF).

### Commanding Tool

Commanding tool main function is to generate, based on the input IPTF (mission plan), Operational Sequence Table (OST) and Parameter Table (PT) files. SHARAD OST and PT files will be weekly generated and up linked in order to maintain a cross track position accuracy of 1.5 Km.

### Monitoring Tool

This tool is aimed at monitoring the instrument health. It will be incharge to performe the following control over instrument telemetry:

- Telemetry syntactic check
- Check and Graphic display of selected engineering telemetry of Spacecraft and SHARAD instrument
- Commands/Science Data reconciliation
- Instrument health assessment

### Deformatting /Level 1A Tool

In order to permit a correct and uniform interpretation of radar data by the scientific community, SHARAD science TM data must have a standard format. Data have to be located in time, converted to complex voltages, and with proper headers, according to PDS format, including engineering information, instrument modes, spacecraft information, etc.

The Deformatting/Level 1A Tool is devoted to this task. It takes as input the Ancillary, Engineering, Science, Orbital and HK data. Then it merges them all and gives as output a Level 1A PDS formatted file for both science and calibration data and packet quality testing.

### Processing /Level 1B Tool

This tool is aimed at processing and formatting Level 1A data. Hence inputs to L1b processing are Level 1A data, SPK, and calibration data. Output is the level 1B data products PDS-labelled.

In Level 1B processing, data are azimuth and range compressed using a standard chirp scaling processing. Chirp scaling processing will be function of orbital data. No refocusing algorithm is foreseen so far. Phase correction could be performed by means of contrast method phase distortion evaluated over signal time average data.

### Quick Look Tool

Quick look tool is aimed at checking, from a semantic point of view, information contents of science TM received from the instrument.

Quick look tool is a software used for a quick (few minutes after the science telemetry availability) check of the scientific functionality of SHARAD.

This tool can have as input either Level 1a or Level 1b products depending on Level 1b processing time velocity.

Comparison of received data with expected return (both scientific data, in term of principal range and azimuth characteristics, and auxiliary data in term of comparison of tracking data with expected Mars altitude) – power versus time graphs for given ground locations will allow a radar expert operator to make assessments on instrument performance.