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FIRST

FIRST Science Operations Definition Group

Presentation to the Science Advisory Group (SAG)

FSODG

25 June 1996

PT-02624

Contents

Introduction - Background

- FIRST SIGNIFICANTLY ABOVE CS4 BUDGET
- MAJOR SAVINGS REQUIRED IN ALL AREAS OF THE MISSION INCLUDING OPERATIONS

BUT

- OVERALL SCIENCE OUTPUT STILL NEEDS TO BE MAXIMISED

⇓

- EARLY (PRE-PHASE B) DEFINITION OF THE OVERALL MISSION OPERATIONS CONCEPT
- TOTAL SYSTEM APPROACH : SATELLITE, OPERATIONS, GROUND SEGMENT, AIV
- ALLOCATION OF IMPLEMENTATION AND OPERATIONS RESPONSIBILITIES TO THE MOST QUALIFIED ENTITIES

Introduction - FIRST Science Operations Definition Group

FSODG SET-UP END JANUARY 1996

- **OBJECTIVE :**
  - **DEFINE A SCIENTIFIC OPERATIONS CONCEPT WHICH MINIMISES OVERALL COST OF SCIENTIFIC OPERATIONS**

- **TASKS :**
  - **IDENTIFY MAIN FUNCTIONAL COMPONENTS (e.g. PROPOSAL HANDLING, MISSION PLANNING, SCIENTIFIC DATA PROCESSING)**
  - **ALLOCATE COMPONENTS TO IMPLEMENTERS**
  - **COST**
  - **DEFINE (COMMON) INSTRUMENTS OPERATIONAL INTERFACES WITH THE GROUND SEGMENT (e.g. ON-BOARD S/W DATA MANAGEMENT, COMMANDING, TELEMETRY PROCESSING)**
  - **PRODUCE INSTRUMENT DESIGN GUIDELINES (ISSUED WITH THE AO)**
  - **PRODUCE GROUND SEGMENT IMPLEMENTATION GUIDELINES**

Introduction - FSODG - Schedule of Work

- 25.06.96 PRESENTATION to SAG - PRELIMINARY FINDINGS
- 31.10.96 (DRAFT) MISSION CONCEPT / GROUND SEGMENT DOCUMENT (PRELIMINARY COST ESTIMATES)
- 31.01.97 ISSUE 1 - REFINED COST ESTIMATE
- 01.06.97 :
  - INSTRUMENT - GROUND SEGMENT INTERFACE DOCUMENT
  - INSTRUMENT DESIGN GUIDELINES
  - GROUND SEGMENT IMPLEMENTATION GUIDELINES
  - IMPACT OF MISSION CONCEPT ON SATELLITE SYSTEM SPECS

Introduction - FSODG - Composition

▶ BOL - REPRESENTATIVE (QMC)	K. King
▶ HET - REPRESENTATIVE (SRON)	P. Roelfsema
▶ PHOC - REPRESENTATIVE (MPE)	O. Bauer
▶ PROJECT SCIENTIST (ESTEC/SSD)	G. Pilbratt
▶ SCIENCE COMMUNITY REPRESENTATIVE	O. Bauer
▶ FIRST PROJECT	P. Estaria (Operations) H. Schaap (AIV)
▶ ESOC	A. Robson

Main Assumptions (1)

- FIRST IS AN OBSERVATORY-TYPE MISSION
- SELECTED PAYLOAD WILL HAVE 3 INSTRUMENTS
- PI SELECTION TAKES PLACE MID 1998
- LAUNCH IN 2006
- MISSION DURATION IS 3 YEARS (COSTING)
- TM & TC ACCORDING TO ESA PACKET STANDARDS
- THE MISSION OPERATIONS CENTRE (MOC) IS RESPONSIBLE FOR ALL SATELLITE OPERATIONS INCLUDING EXECUTION OF INSTRUMENT OPERATIONS AND RESPONSIBILITY FOR INSTRUMENTS HEALTH AND SAFETY
- MAX TM BIT RATE 64 KBS

Main Assumptions (2)

- MAX TC BIT RATE 2 KBS (4 KBS ?)
- 3-DAY SPACECRAFT SAFETY / AUTONOMY MODE (INSTRUMENTS SWITCHED OFF)
- NO SCIENCE OPERATIONS DURING ECLIPSE
- ISO-TYPE ORBIT
- NO SCIENCE OPERATIONS BELOW 40.000 KMS (TBC)
- SCOS II } USED IN THE MOC
- ORATOS
- TYPICAL OBSERVATION DURATIONS AS ISO

Key Concepts (1)

- OPTIMUM USE OF THE INSTRUMENT TEAMS' EXPERTISE
  - INSTRUMENT CONTROL CENTRES (ICCs)
    - \+ SCIENCE DATA PROCESSING SOFTWARE
    - \+ TIME ESTIMATORS
    - \+ INSTRUMENT SOFTWARE SIMULATORS FOR OPERATIONAL TESTING
    - \+ INSTRUMENT USER'S MANUAL
    - \+ INSTRUMENT OPERATIONS
- OVERALL SYSTEM APPROACH

  (FSODG INPUT TAKEN INTO ACCOUNT IN SATELLITE SYSTEM SPECIFICATIONS, e.g. RASTER POINTING, MASS MEMORY UNIT)
- MAXIMUM COMMONALITY BETWEEN INSTRUMENTS

Key Concepts (2)

- MAXIMUM COMMONALITY BETWEEN AIV AND OPERATIONS
  - + TM & TC DATA BASE
  - + INSTRUMENT COMMAND SEQUENCES
  - + DISPLAYS
- MAXIMUM COMMONALITY IN SOFTWARE DEVELOPMENT
  - + COMMON STANDARDS
  - + REQUIREMENTS ISSUED BY ESA WITH AO
- MAXIMUM REUSE OF USEFUL CONCEPTS (e.g. ISO)
  - + CALIBRATION UPLINK SYSTEM (CUS)
  - + ASTRONOMICAL OBSERVATION TEMPLATES (AOTs)
  - + INSTRUMENT COMMAND SEQUENCES (ICSs)
  - + TRANSPARENT DATA

Key Concepts (3)

- ARCHIVE (A WORKING DATA REPOSITORY) OFF ALL MISSION DATA WITH CONTROLLED ACCESS TO ALL FIRST PARTICIPANTS IS A KEY FEATURE
  - \+ "BEST" CALIBRATION DATA AVAILABLE
  - \+ "BEST" SCIENTIFIC DATA PROCESSING SOFTWARE AVAILABLE
  - \+ TM / TC & RELATED DATA
- NO ARCHIVING OF "INTERMEDIATE" PRODUCTS ⇨ RE-PROCESS
- NO GENERATION OF STANDARD DATA PRODUCTS
- NO DISTRIBUTION OF STANDARD DATA PRODUCTS
- NO CONCATENATION OF OBSERVATIONS
- LINKING OF OBSERVATIONS THROUGH STANDARD MISSION PLANNING FACILITIES

Overall Ground Segment Management

Costing of the various Scenarios

- POST OPERATIONAL AND ARCHIVE PHASES NOT COSTED
- COMMUNICATION LINES NOT INCLUDED
  (30 KAU/YEAR FOR A 64 KBS DEDICATED LINE)
- ESTIMATES ARE VERY PRELIMINARY
  (NOT BETTER THAN 30% ACCURACY)
- ESTIMATES BASED ON ACTUAL FIGURES
  FOR ROSAT, CLUSTER JSOC, ISO
- ASSUMPTIONS - START OF WORK MID 1998 -
  END OF OPERATIONS END 2008
- COMPARISONS / EXTRAPOLATIONS EXTREMELY DIFFICULT

Costing of the various Scenarios (2)

- COST FOR ALL SCENARIOS ARE ROUGHLY THE SAME (EXCEPT B1 = CHEAPER)
- MORE ACCURATE COSTING REQUIRES :
  - RESOLUTION OF OPEN POINTS
  - DEEPER LEVEL OF DEFINITION
- COSTS INCLUDE INFRASTRUCTURE, HARDWARE, SOFTWARE, MANPOWER, OVERHEADS, ETC.
- ICC COST (WITHOUT ARCHIVE) ≈ 10.5 MAU
- FSC COST (WITHOUT ARCHIVE) ≈ 11.0 MAU

Costing of the various Scenarios (3)

	A1	A2	B1	B2
ICC	35*	35*	32*	32*
FSC	-	-	11	16
FSO	12	12		
ARCHIVE(S)	7*	11	5	8
TOTAL	54	58	48	56
ESA per PI # PI's	12 14 (3)	23 12 (3)	- 12 (4)	24 11 (3)

* 1/3 PER ICC
FSC AND FSO INCLUDE ≈ 1 MAU FOR BUILDING
IMPLEMENTATION IN ESOC; SCALING FACTOR = 1.5

MOC COSTS TO BE DETERMINED

Operations Scenario Features (1)

A1 :

- ESA COORDINATION OF THE SCIENCE PROGRAMME PREPARATIONS
- ICC HAVE COMPLETE CONTROL OF THEIR INSTRUMENT OPERATIONS
- ICC HAVE COMPLETE CONTROL OF THE DATA MADE AVAILABLE TO THE COMMUNITY
- SEPARATE ARCHIVING SYSTEMS, HOWEVER SAME DESIGN
- SCIENTIFIC COORDINATION DIFFICULT DURING THE MISSION

A2 :

- AS 'A1' WITH A CENTRALISED ARCHIVE AT ESOC
- SCIENTIFIC COORDINATION LESS DIFFICULT DURING THE MISSION
- ARCHIVE DEVELOPMENT BY ESOC
- CENTRALISED ACCESS FOR SCIENTIFIC DATA

Operations Scenario Features (2)

B1 :

- EXISTENCE OF A FIRST SCIENCE CENTRE WITH A CENTRAL ARCHIVE SYSTEM
- SINGLE INPUT / OUTPUT INTERFACE FOR ALL USERS
- POTENTIAL 4th PI / INSTITUTE FOR DEVELOPMENT / OPERATIONS
- EFFECTIVE SCIENCE COORDINATION BEFORE AND DURING MISSION
- ONLY OFF-LINE TASKS FOR THE ICC's
- ICC HAVE NO DIRECT CONTACT WITH OBSERVERS
- ICC DO NOT PRODUCE TARGET LISTS
- ICC NOT RESPONSIBLE FOR MAKING SCIENCE DATA AVAILABLE TO USERS

B2 :

- AS 'B1' WITHOUT A 4th PI / INSTITUTE
- FSC IMPLEMENTED AND OPERATED BY ESA
- SCIENCE COORDINATION WITH ESA THROUGHOUT THE WHOLE MISSION

Instrument Design Guidelines

ALL INSTRUMENTS SHOULD USE :

- **IDENTICAL INTERFACES TO THE S/C**
- **IDENTICAL MICRO-PROCESSORS AND PROGRAMMING TOOLS**
- **A KAL TO PRESERVE RAM CONTENTS WHEN UNPOWERED**
- **IDENTICAL INTERNAL REDUNDANCY CONCEPT**
- **IDENTICAL ON-BOARD SOFTWARE MANAGEMENT TECHNIQUES**
- **A MACRO-COMMANDING STRUCTURE WHEREBY BASIC OPERATIONAL BUILDING BLOCKS SHOULD BE INSTRUMENT RESIDENT**

Instrument Testing Guidelines

- ONE INSTRUMENT PARAMETER DATABASE
- COMMONALITY FOR THE VARIOUS TEST LEVELS SUCH AS ILT, IST AND COMMISSIONING PHASE
- THREE INSTRUMENT TESTS :
  - SFT SHORT FUNCTIONAL TEST
  - SIST SHORT INTEGRATED SYSTEM TEST
  - IST INTEGRATED SYSTEM TEST
- TWO TEST LEVELS : PLM LEVEL
  SYSTEM LEVEL

Main Open Points (1)

- **ESA's OVERALL ROLE IN MISSION OPERATIONS**
- **TYPE OF MISSION**
  - **PI MISSION**
  - **OBSERVATORY MISSION (ASSUMPTION)**
  - **SURVEY MISSION**
  - **KEY PROGRAMMES**
  - **OTHER**
- **FIRST ORBIT**
  - **# OF GROUND STATIONS**
  - **TM / TC COVERAGE**
  - **ON BOARD DATA STORAGE : - TELEMETRY**
    - SCHEDULE

Main Open Points (2)

- CRYOSTAT OR CRYOCOOLER ?
- PLATFORM - XMM BUS ?
- MULTI-INSTRUMENT VERSUS SINGLE INSTRUMENT OPERATIONS ?
- SERENDIPITY OPERATIONS ?

Conclusions

- AGENCY / INSTITUTES WORKING GROUP SET-UP TO DEFINE AND COST SCIENCE GROUND SEGMENT AND PROVIDE INSTRUMENT DEVELOPMENT GUIDELINES RELEVANT TO OPERATIONS

- KEY GROUND SEGMENT CONCEPTS
  - DISTRIBUTION OF DEVELOPMENT AND OPERATIONAL ACTIVITIES TO BEST QUALIFIED GROUPS
  - INSTRUMENT CONTROL CENTRES AT INSTITUTES
  - ARCHIVE / WORKING DATA REPOSITORY FOR ALL DATA EXCHANGES
  - OBSERVER ACCESS TO RAW TM DATA, NECESSARY PROCESSING SOFTWARE AND CALIBRATIONS
  - NO PROCESSED DATA DISTRIBUTION
  - BEST OPTION FORESEES A FIRST SCIENCE CENTRE

- RUDIMENTARY COSTING PERFORMED

- REACTION AND FEEDBACK REQUIRED FROM SAG TO PRELIMINARY FSODG WORK

MAJOR FIRST MILESTONES

(of relevance to the FSODG work)

• Cryostat Study completed (option costed)	
• Cryo-cooler Study completed (option costed)	31.10.96
• Re-usability of XMM bus (3 options: ISO-orbit, XMM-orbit, L2-orbit) Study completed (option costed)	
• Science Management Plan	28.02.97
• Operation Requirements and Concept	31.03.97
• Overall Cost to Completion Estimate	30.01.97
• Mission Reconfirmation	30.06.97
• Issue of AO	30.09.97
• Payload Selection	01.06.98

esa european space agency
european space research and technology centre

FIRST PROJECT TELEFAX

Priority :	Originating signature :	Authorised by :
URGENT		

Date : 18 June 1996
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Subject : **SAG PRESENTATIONS**

Please find annexed the viewgraphs for the SAG presentation on 25 June. Suggested improvements from Andy have already been implemented. What is not yet included is the drawing of the A1, A2 / B1, B2 scenario's. This drawing in under preparation.

Please review and send your comments (hopefully minimal) to us.

Regards,

P. Estaria H. Schaap

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