5. ECS RMA Functional Descriptions and Block Diagrams

5.1 FOS Functions

5.1.1 FOS Critical Real-Time Functions (EOSD3800)

FOS Critical Real-Time functions consist of Critical Command and Control Systems that provide functions to support the followings: launch, early orbit checkout, orbit adjustment, anomaly, investigation, recovery from safe mode, routine real-time commanding and associated monitoring for spacecraft and instrument health and safety.

For Release A/B, the FOS Critical Command and Control Systems that perform critical real-time functions consist of redundant groups of Real-Time Servers, Data Servers (for Events archiving function only), FOT (Flight Operations Team) Work Stations, RAID (Redundant Array of Independent Disks) storage devices, Time Systems and the EOC network equipment (e.g. concentrators, Hub/Bridge assemblies). The following Figure 5.1.1-1 shows the reliability block diagram of the FOS Critical Real-Time Functions with their associated hardware Commercial-Off-the-Shelf (COTS) Reliability, Maintainability, Availability (RMA) data. The reliability block diagram is a short hand graphical representation of all hardware and their configuration that are required to achieve the function's success. The block diagram displays the hardware configuration item (HWCI) description, redundant configuration and other pertinent RMA data of the HWCI such as availability, MTBF, MTTR, ALDT, etc. From this diagram, reliability models for the required function were developed to support the availability calculations. Detailed description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.1.2 FOS Non-Critical Real-Time Functions (EOSD3810)

FOS Non-Critical Real-Time functions consist of the following hardware:

- The Data Server provides a focal point for performing non-real-time functions such as servicing requests for historical data (i.e., telemetry and event history data).
- The RAID Data Storage Unit provides the storage of FOS data locally. This includes the short-term telemetry housekeeping data and event history data, scheduling data, operational data, and data base files.
- Laser printers, color printers and line printers are connected to the EOC network enabling access by any EOC computer.
- A time server provides an external clock source to ensure the resolution and accuracy of the computer time.

- Hub/Bridge assembly provides communication interfaces with the Local Area Networks (LAN).

Figure 5.1.2-1 shows the reliability block diagram of the FOS Non-Critical Real-Time Functions with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability calculations. Detailed description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

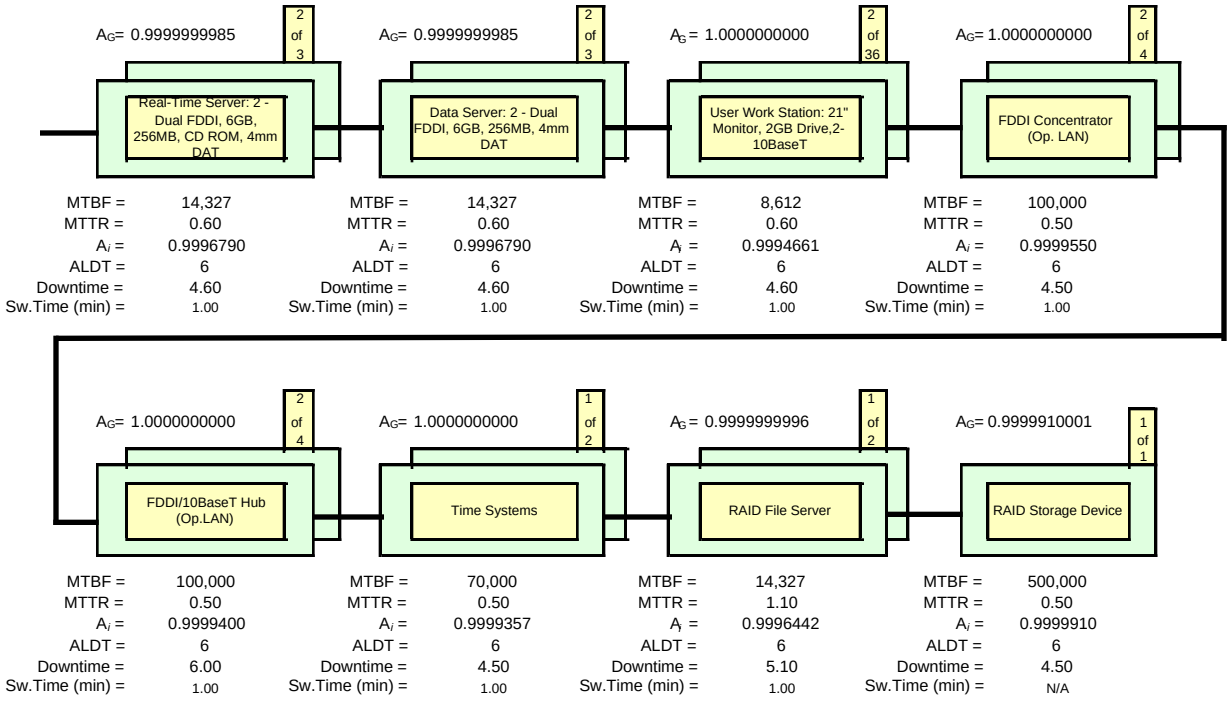

Figure 5.1.1-1. Release A/B FOS Critical Real-Time Functions Hardware Reliability Block Diagram

5.2 SDPS Functions

5.2.1 SDPS Function of Planning and Data Processing (EOSD3700)

The Science Data Processing Segment (SDPS) Function of Planning and Data Processing is defined in order to assure that all major SDPS hardware components are analyzed.

The Planning and Data Processing function is derived from the EOSD3700 System-Level Availability Requirement which states that all equipment providing other functionality not

explicitly stated in the Segment-level availability requirements will be subject to an operational availability of 0.96 at a minimum and an MDT of four (4) hours or less.

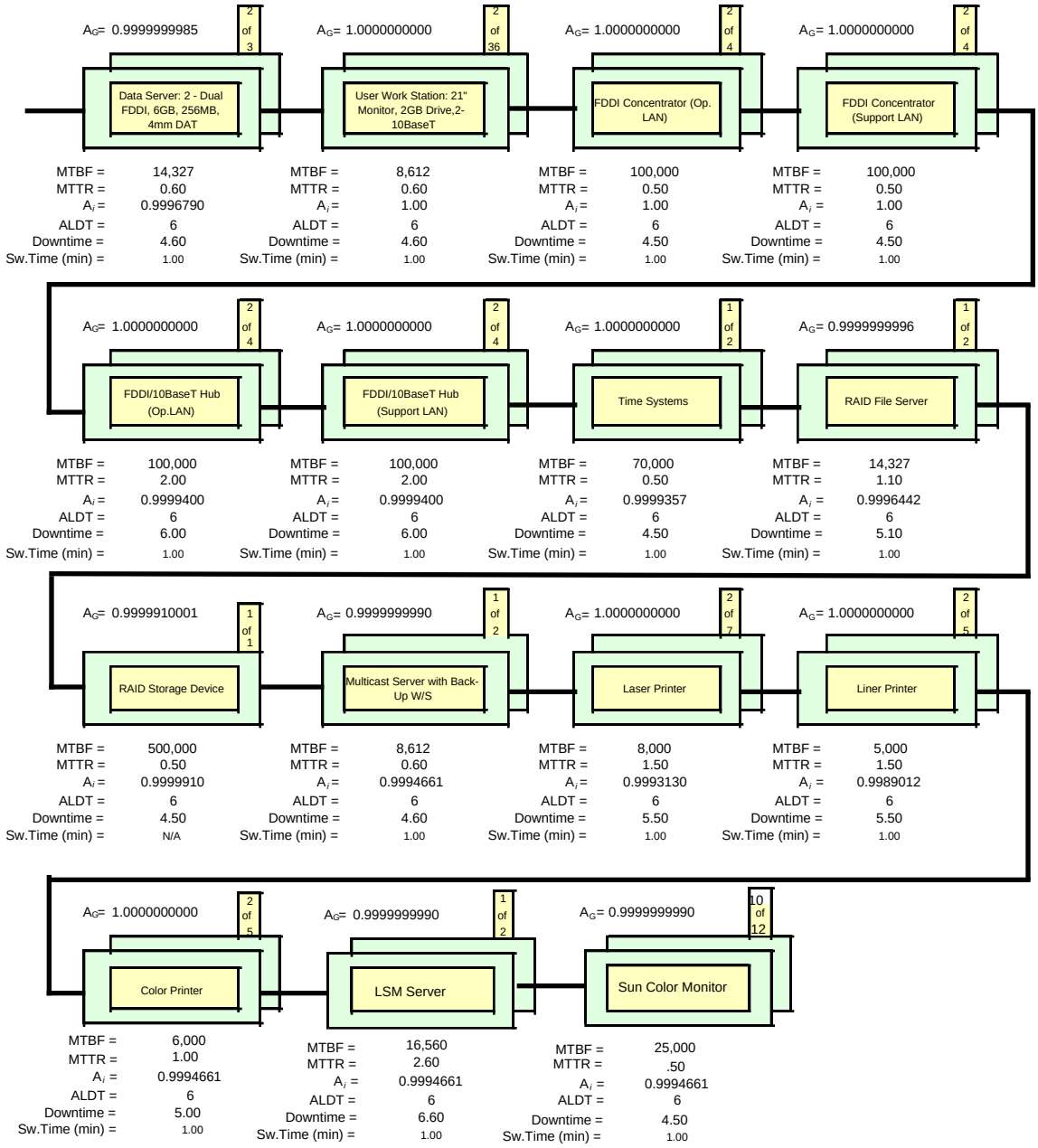

Figure 5.1.2-1. Release A/B FOS Non-Critical Real-Time Functions Hardware Reliability Block Diagram

The Science Data Processing Segment (SDPS) Function of Planning and Data Processing is performed by the Data Processing Subsystem (DPS) and the Planning Subsystem. The DPS is responsible for managing, queuing, and executing processes at each DAAC site and consists of

the Science Processing hardware (SPRHW). The Planning subsystem is responsible for supporting the operations staff in managing the data production activities at a DAAC site and for coordinating this production with the Data Server Subsystem and Data Processing Subsystem. The Planning hardware (PLNHW) consists of a Production Planning/Management workstation and a Planning DBMS server.

The Science Processing HWCI (SPRHW) is the primary HWCI in the Processing Subsystem and contains staging (working storage), input/output (I/O), and processing resources necessary to perform routine processing and subsequent reprocessing. The SPRHW consists of science processors and queuing server. The science processors provide site specific processing for science software integration, standard production, and reprocessing and consist of SMP (Symmetric Multi-Processor) Science Processors and host attached RAIDs. The queuing server provides support for production queuing, monitoring and control.

The Production Planning/Management workstation supports routine production planning and task queuing production management operations. The Planning DBMS server maintains the status and planning database repositories of the Data Processing Subsystem.

Reference Release B SDPS Data Processing Subsystem Design Specification for the ECS Project, 305-CD-027-002, and Release B SDPS Planning Subsystem Design Specification for the ECS Project, 305-CD-026-002, for more design details.

Figure 5.2.1-1 shows the reliability block diagram of the SDPS Function of Planning and Data Processing with their associated hardware and generic COTS RMA data. From this diagram, reliability models for the derived function were developed to support the availability calculations. A detailed description of these models is provided in Section Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.2.2 SDPS Function of Receiving Science Data (EOSD3900)

The Science Data Processing Segment (SDPS) Function of Receiving Science Data will be performed by the Ingest Subsystem. The Ingest Subsystem contains a collection of hardware and software that supports the ingest of data into ECS repositories on a routine and ad-hoc basis and triggers subsequent archiving and/or processing of the data. The Ingest Subsystem hardware components consist of the client host servers, working storage, and L0 archive repository.

The client host servers manage the transfer of data into, out of, and within the Ingest Subsystem. Additional functions to be performed include logging, status, and reporting activities, coordination of data transfers between working storage and the ingest L0 archive, maintaining a database of all data contained within the Ingest Subsystem, and servicing queries and retrievals on the archived L0 data. The client hosts will perform pre-processing of the ingested data sufficient both to ensure the basic quality of the received data and to prepare it for archiving and/or further processing.

Short term working storage provides a staging area for data moving both into the Ingest Subsystem from network connections or ingest peripherals, and out of the Ingest Subsystem to

the Processing and Data Server Subsystems. This function will be implemented using high performance RAID 5 magnetic disks. Arrays will be shared across ingest client host servers.

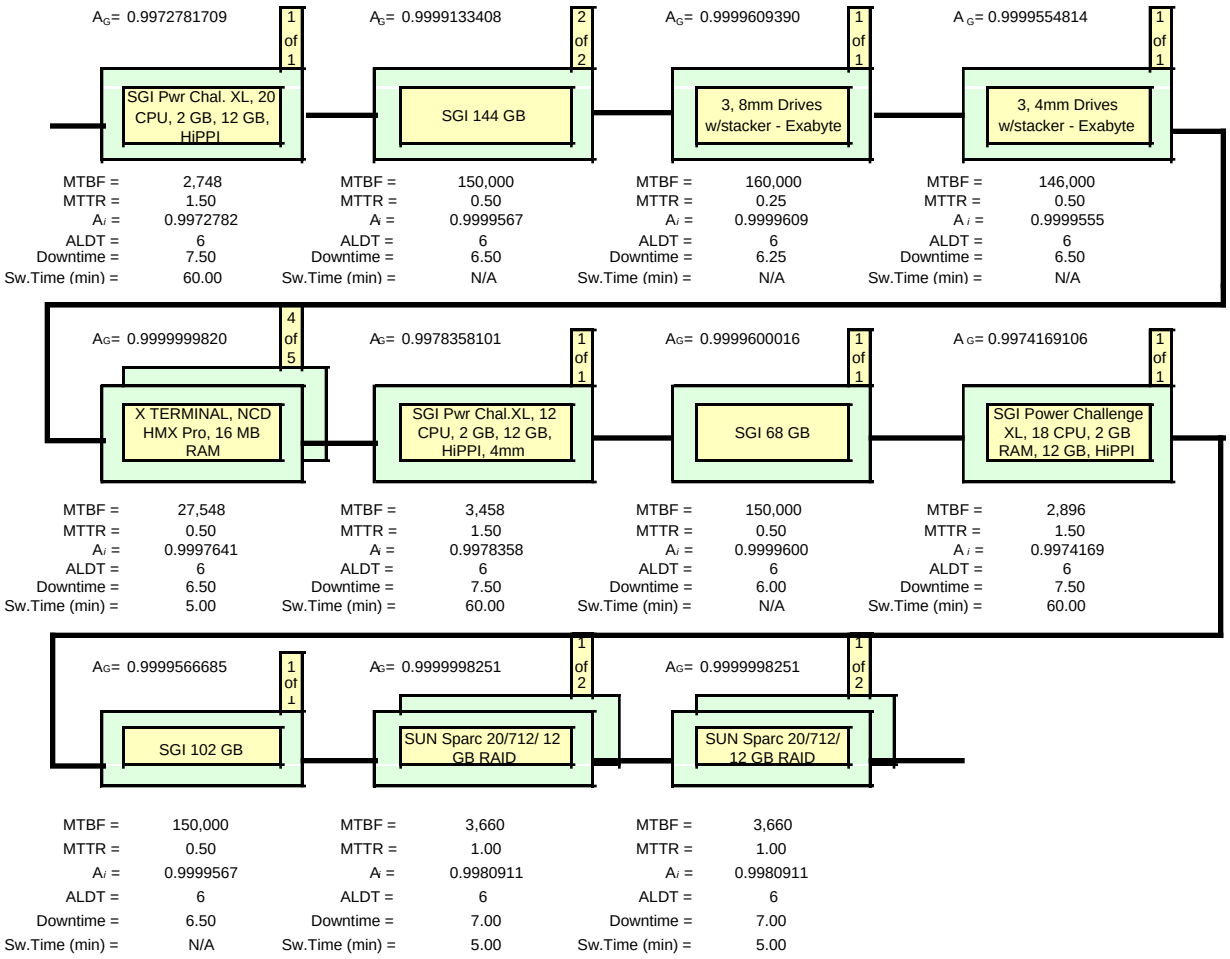

Figure 5.2.1-1. SDPS Function of Planning and Data Processing

The L0 archive repository provides the long term storage portion of the Ingest Subsystem for all ingested spacecraft Level 0 data as received from EDOS for a period of one year. In addition, the long term archive repository, along with short term working storage, passes ingested data to other ECS subsystems as required for processing, and other needs of the data system.

Reference Release B SDPS Ingest Subsystem Design Specification for the ECS Project, 305-CD-025-002, for more details.

Figure 5.2.2-1 shows the reliability block diagram of the SDPS Function of Receiving Science Data with their associated RMA data at the LaRC DAAC. From this diagram, reliability models for the required function were developed to support the availability calculations. Detail

description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

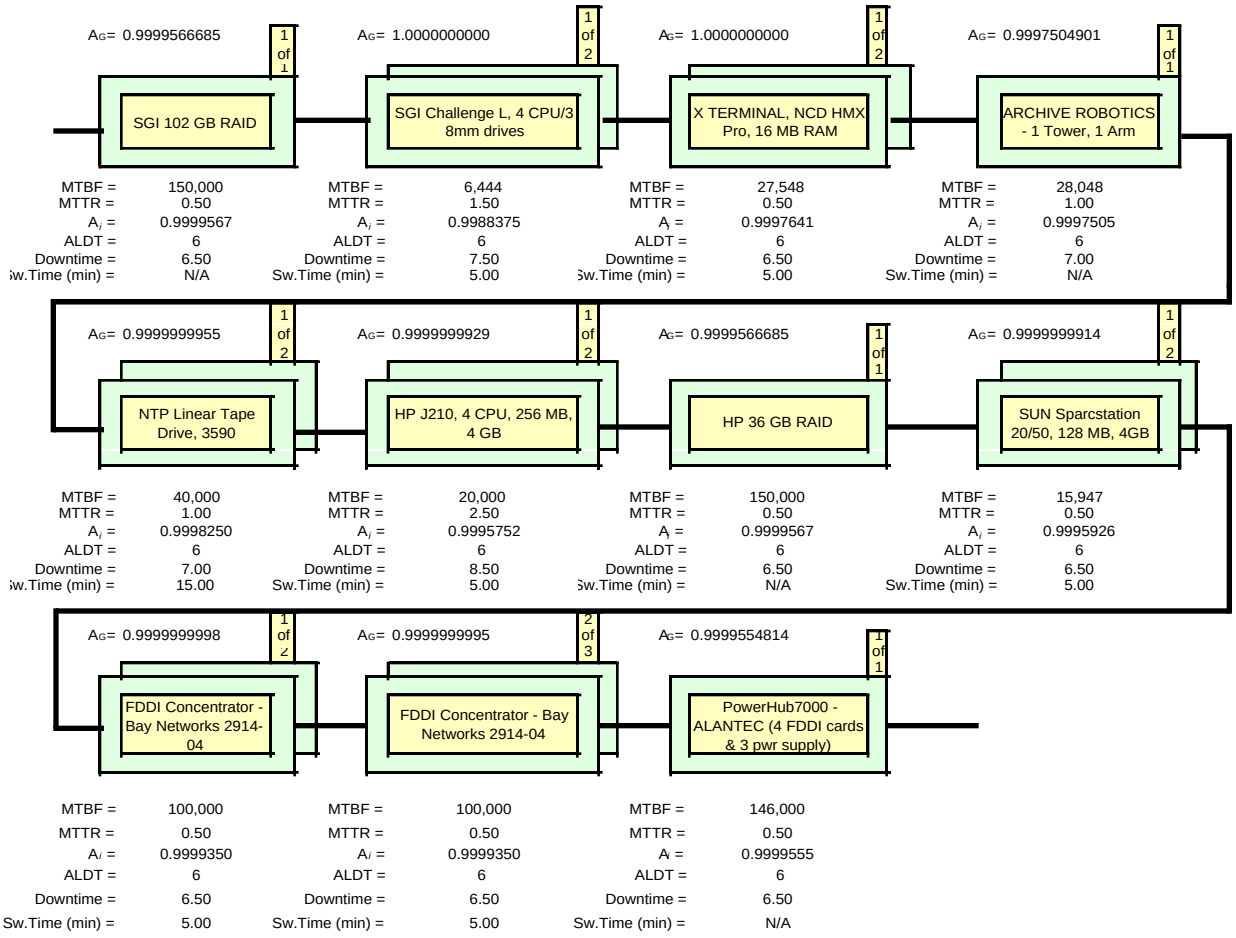

Figure 5.2.2-1 SDPS Function of Receiving Science Data

5.2.3 SDPS Function of Archiving and Distributing Data (EOSD3920)

The Science Data Processing Segment (SDPS) Function of Archiving and Distributing Data will be performed by the Data Server Subsystem. This subsystem has the responsibility for storing earth science and related data in a persistent fashion, providing search and retrieval access to this data, and supporting the administration of the data and the supporting hardware devices and software products. As part of its retrieval function, the subsystem also provides for the distribution of data electronically or on physical media.

The Data Server Subsystem hardware consists of:

- Access Control and Management hardware which is responsible for supporting the access to the data server. The Access Control and Management hardware allows for client access (both the client subsystem and direct "push/pull" user access) to the Data Server, provides tools and capabilities for system administration, and supports many of the infrastructure requirements of the Data Server. The Access component is broken down into two components; Administration Stations (AS) and Access/Process Coordinators (APCs). Administration Stations will host and/or allow access to the Administration Services for one or more data servers. The Access/Process Coordinators (APCs) will be used to interface the data server services to the clients. The APCs will support Client session establishment and control.

- Distribution and Ingest Peripheral Management hardware is responsible for hard media distribution methods for data dissemination from the system, as well as hard media ingest of data into the system. The hardware of the Distribution and Ingest Peripheral Management component consists of a variety of recording devices used for both hard media data distribution and hard media data ingest.

- Working Storage HWCI (WKSHW) hardware is responsible for supporting the needs for temporary and buffer storage. The Working Storage (WS) hardware component of the data server supplies a pool of storage used for temporary file and buffer storage within the Data Server architecture.

- Data Repository hardware HWCI (DRPHW) is responsible for permanent data storage and maintenance functions for the Data Server. Data Repositories (DRs) are the hardware components that store and maintain data permanently. For the bulk data holdings that form the lower levels of the data pyramid (i.e., level 1a - level 4), large tape based robotic archives coupled with other robotic based media will be the most cost effective and robust method of permanent data storage. Data that comprises the higher levels of the data pyramid may utilize a different data repository technology for permanent storage, specifically the technology used for operational storage and access. Such technologies can be, as an example, faster access linear tape or, for very fast access, RAID banks.

Reference Release B SDPS Data Server Subsystem Design Specification for the ECS Project, 305-CD-024-002, for more design details.

Figure 5.2.3-1 shows the reliability block diagram of the SDPS Function of Archiving and Distributing Data with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.2.4 SDPS Function of User Interfaces to IMS Services at Individual DAAC Sites (EOSD3930)

The Science Data Processing Segment (SDPS) Function of User Interfaces to IMS Services at Individual DAAC Sites will be performed by the Data Server Subsystem and the Data Management Subsystem. The Data Server Subsystem description can be found in Section 5.2.3 The Data Management subsystem provides services which search for, locate, and access data on behalf of a user or another program.

The Data Management subsystem contains hardware resources for the persistent storage of data dictionary and schema data across one or more DBMS servers, supports processing, DBMS management, data specialists and user support functions. The primary technologies employed within this subsystem include DBMS servers, World Wide Web servers, host attached disk, possible use of RAID disk and a variety of communications capabilities. Pools of local workstations will support DBMS management, data repository administration, data specialist, user support and phone/mail support functions. The hardware associated with the DMGHW CI consists of servers, low-end uni-processor workstations, RAID disk, and 8mm tape drives used in support of Release B Advertising Service CI and Gateway CI database configurations. The number of physical components, and whether or not certain components will be used, is dependent on each DAAC specific configuration.

Reference Release B SDPS Data Management Subsystem Design Specification for the ECS Project, 305-CD-023-002, for more design details.

Figure 5.2.4-1 shows the reliability block diagram of the SDPS Function of User Interfaces to IMS Services at Individual DAAC Sites with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.2.5 SDPS Function of Information Searches on the ECS Directory (EOSD3940)

The Science Data Processing Segment (SDPS) Function of Information Searches on the ECS Directory will be performed by the Data Server Subsystem and the Data Management Subsystem. The Data Server Subsystem description can be found in Section 5.2.3. The Data Management Subsystem description can be found in the previous Section 5.2.4.

Figure 5.2.5-1 shows the reliability block diagram of the SDPS Function of Information Searches on the ECS Directory with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.2.6 SDPS Function of Data Acquisition Request Submittal (EOSD3950)

The SDPS Function of Data Acquisition Request Submittal (DAR) only applies to Japanese Advanced Spaceborne Thermal Emission and Reflection (ASTER) instrument data requests received from ECS user's who have the ECS Client software. The DAR processing will be performed in Japan. The user's DAR is transferred via the Internet, through the GSFC SMC router, and than to the EBNet (EOSDIS Backbone Network). Therefore, ECS provided hardware to support DAR submittals consists only of the router at the GSFC SMC.

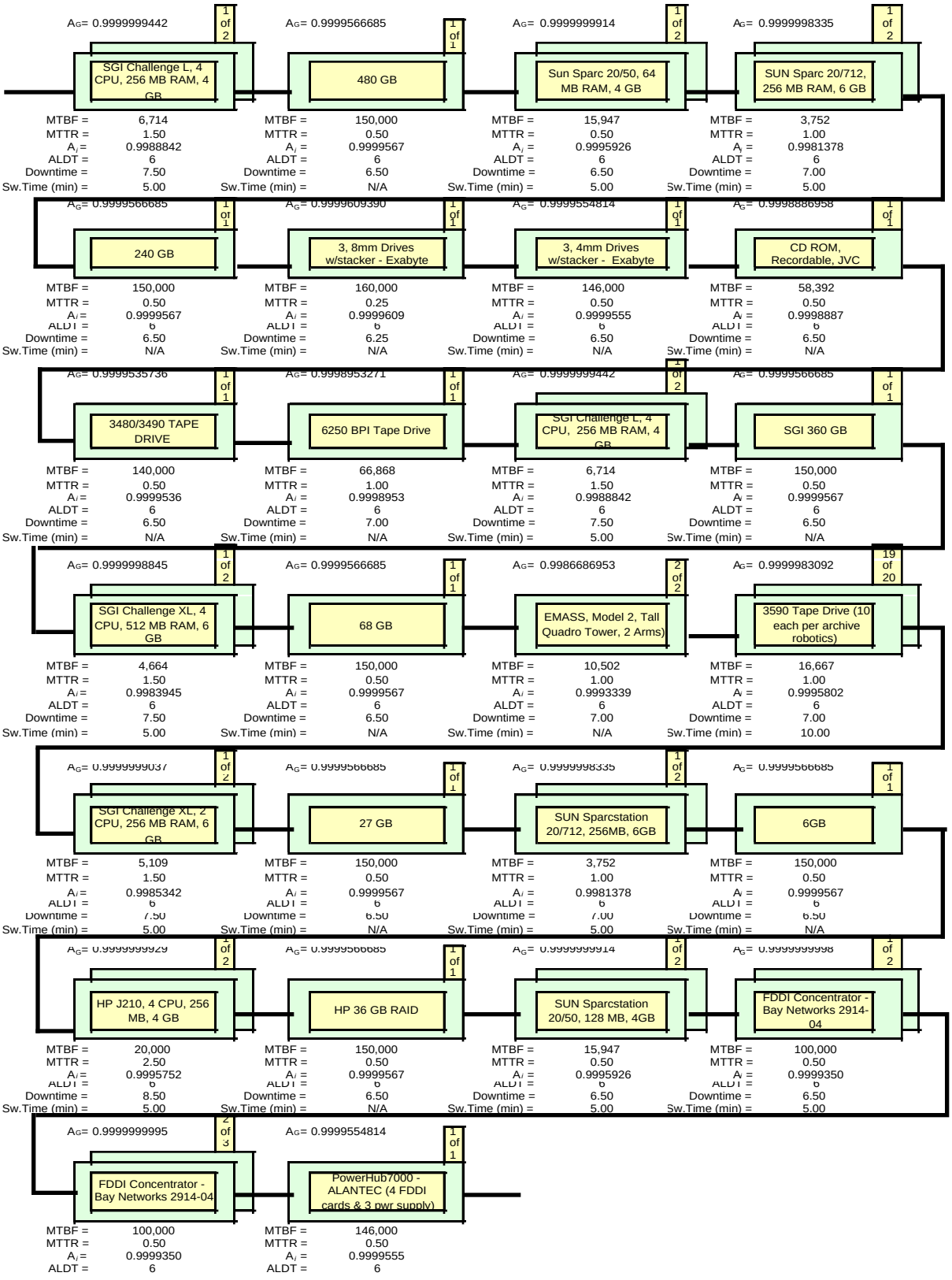

Figure 5.2.3-1 SDPS Function of Archiving and Distributing Data

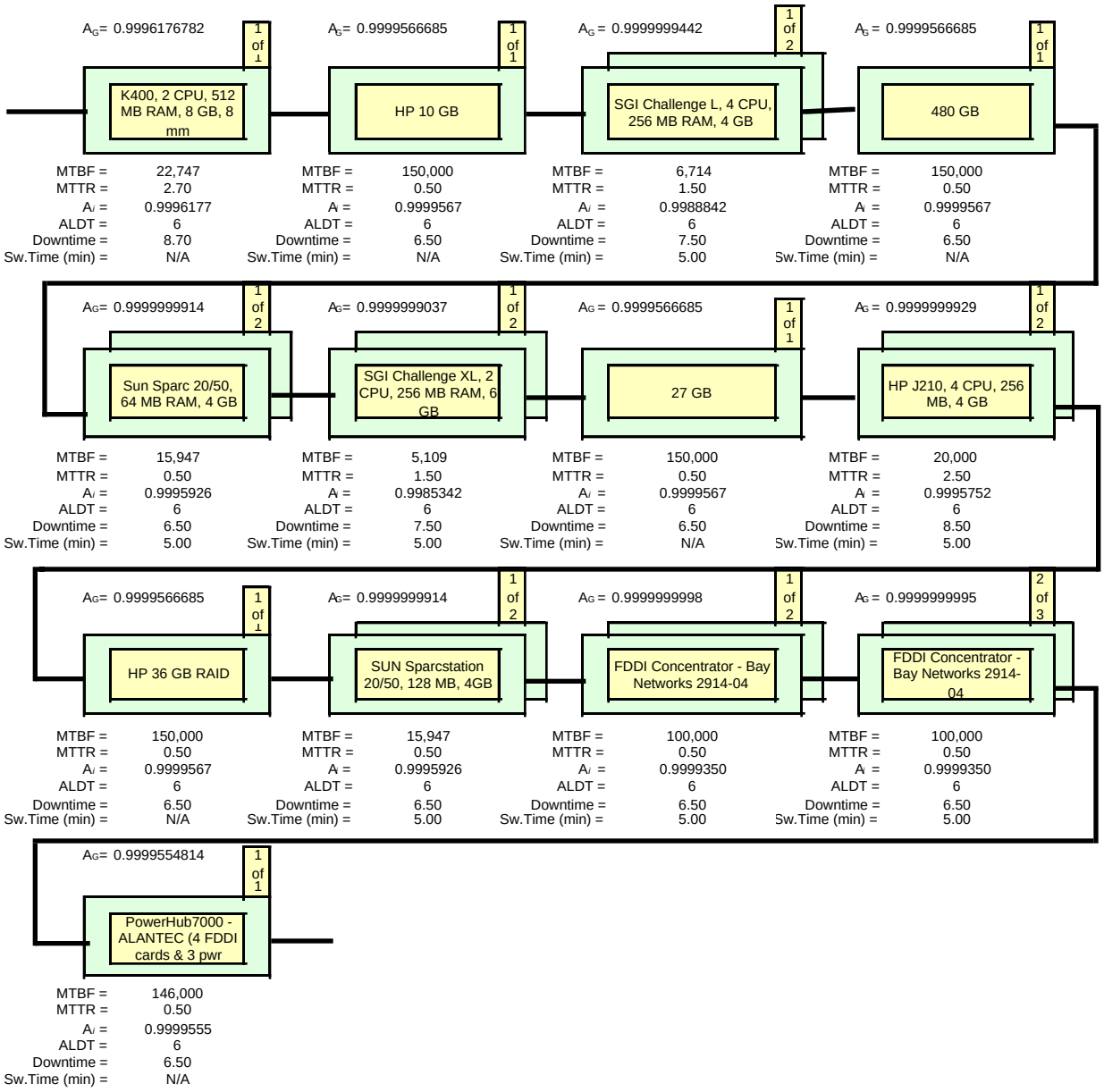

Figure 5.2.4-1. SDPS Function of User Interfaces to IMS Services at Individual DAAC Sites

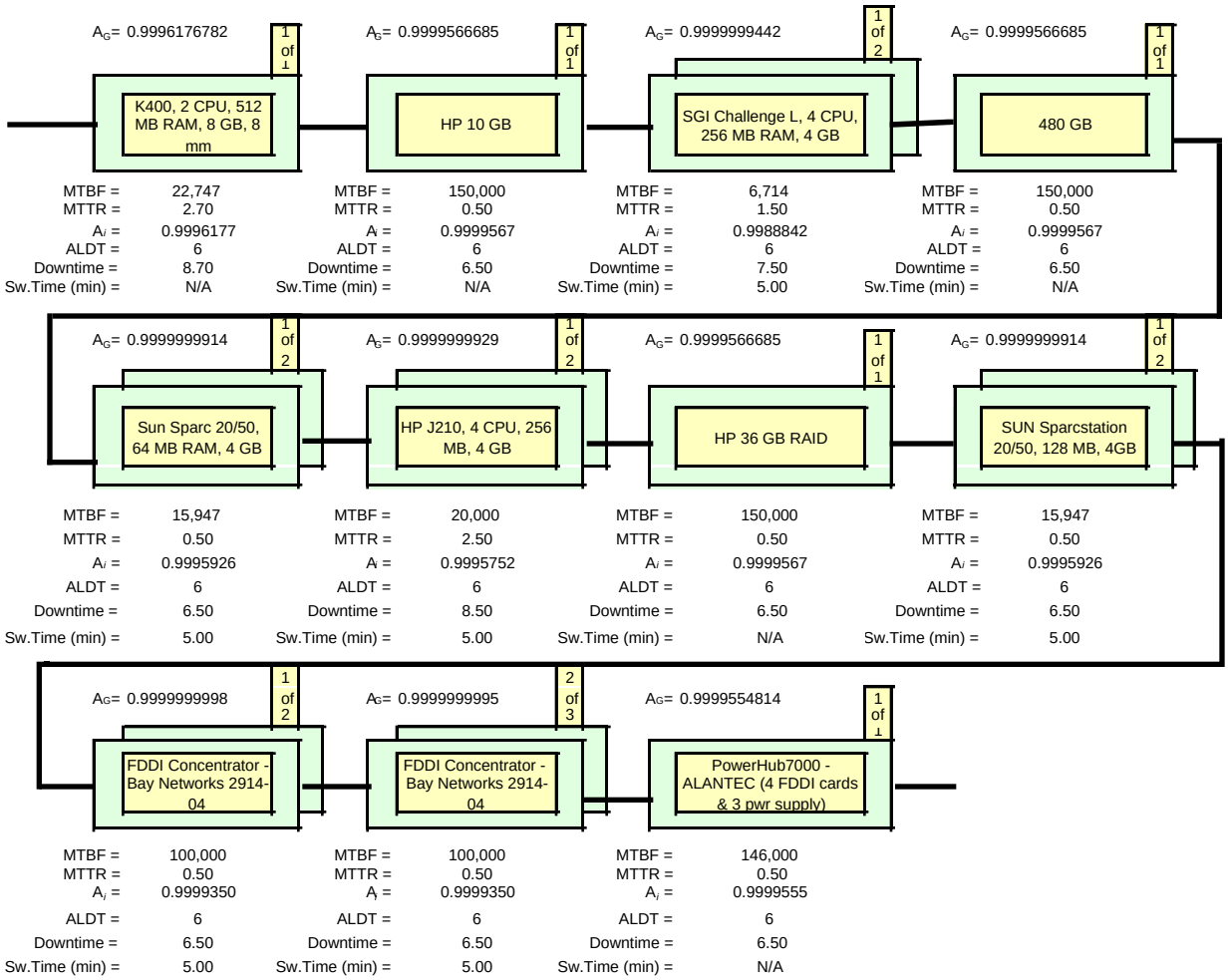

Figure 5.2.5-1. SDPS Function of Information Searches on the ECS Directory

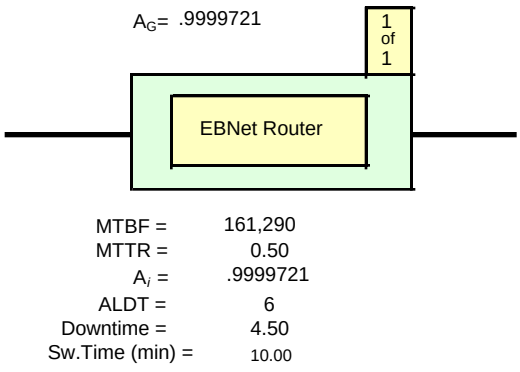

Figure 5.2.6-1. SDPS Function of Data Acquisition Request Submittal

5.2.7 SDPS Function of Metadata Ingest and Update (EOSD3960)

The Science Data Processing Segment (SDPS) Function of Metadata Ingest and Update will be performed by the Data Management, Ingest, and Data Server subsystems. The Data Management subsystem description can be found in the previous Section 5.2.4. The Ingest subsystem description can be found in the previous Section 5.2.2. The Data Server Subsystem description can be found in Section 5.2.3.

Figure 5.2.7-1 shows the reliability block diagram of the SDPS Function of Metadata Ingest And Update with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.2.8 SDPS Function of Information Searches on Local Holdings (EOSD3970)

The Science Data Processing Segment (SDPS) Function of Information Searches on Local Holdings will be performed by the Data Server Subsystem. The Data Server Subsystem description can be found in Section 5.2.3.

Figure 5.2.8-1 shows the reliability block diagram of the SDPS Function of Information Searches on Local Holdings with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.2.9 SDPS Function of Local Data Order Submission (EOSD3980)

The Science Data Processing Segment (SDPS) Function of Local Data Order Submission is performed by the Data Management and Data Server subsystems. The Data Management subsystem description can be found in Section 5.2.4. The Data Server Subsystem description can be found in Section 5.2.3.

Figure 5.2.9-1 shows the reliability block diagram of the SDPS Function of Local Data Order Submission with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

5.2.10 SDPS Function of Data Order Submission Across DAACs (EOSD3990)

The Science Data Processing Segment (SDPS) Function of Data Order Submission Across DAACs will be performed by the Data Management, and Data Server subsystems. The Data Management subsystem description can be found in Section 5.2.4. The Data Server Subsystem description can be found in Section 5.2.3.

Figure 5.2.10-1 shows the reliability block diagram of the SDPS Function of Data Order Submission Across DAACs with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability

calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

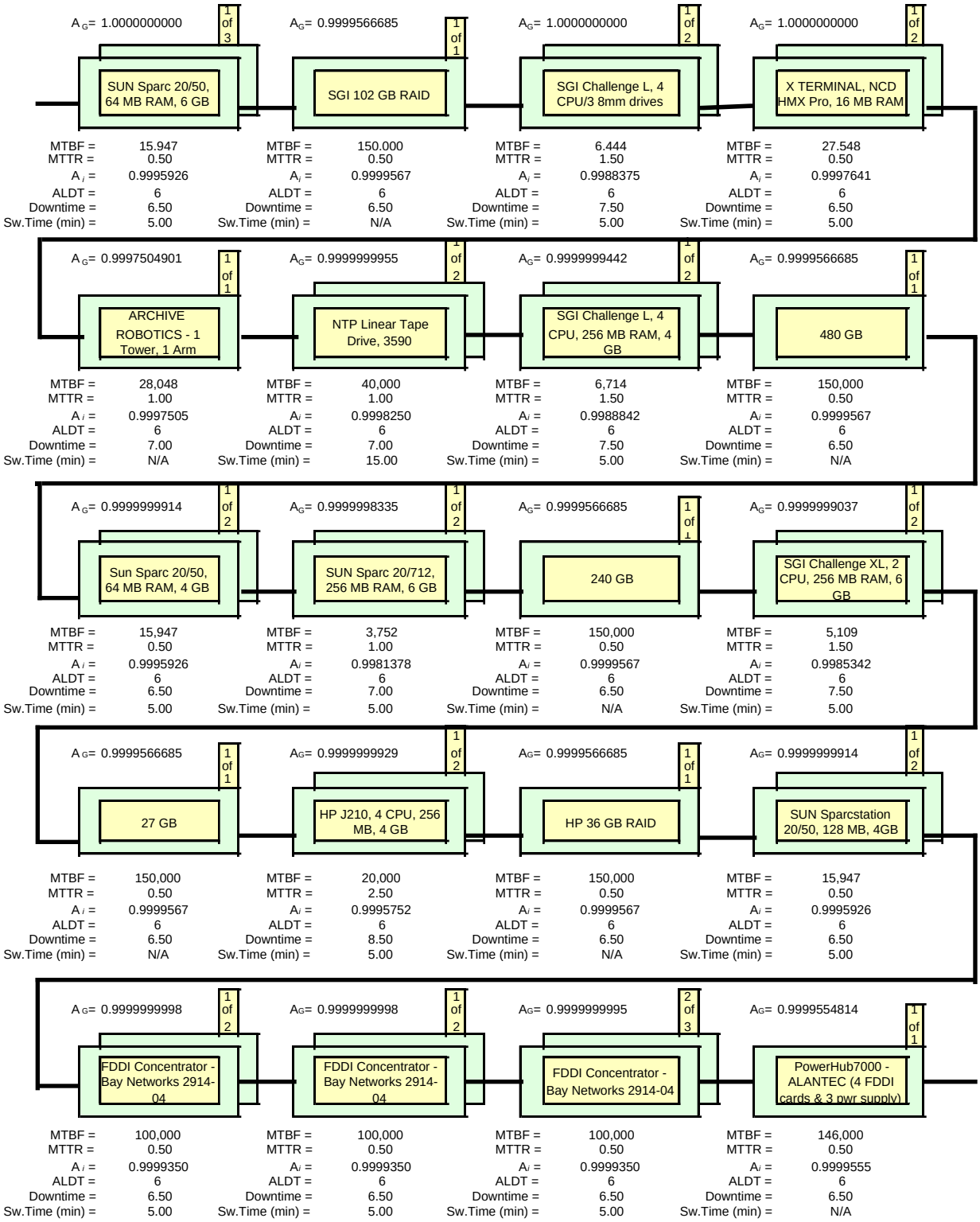

Figure 5.2.7-1. SDPS Function of Metadata Ingest And Update

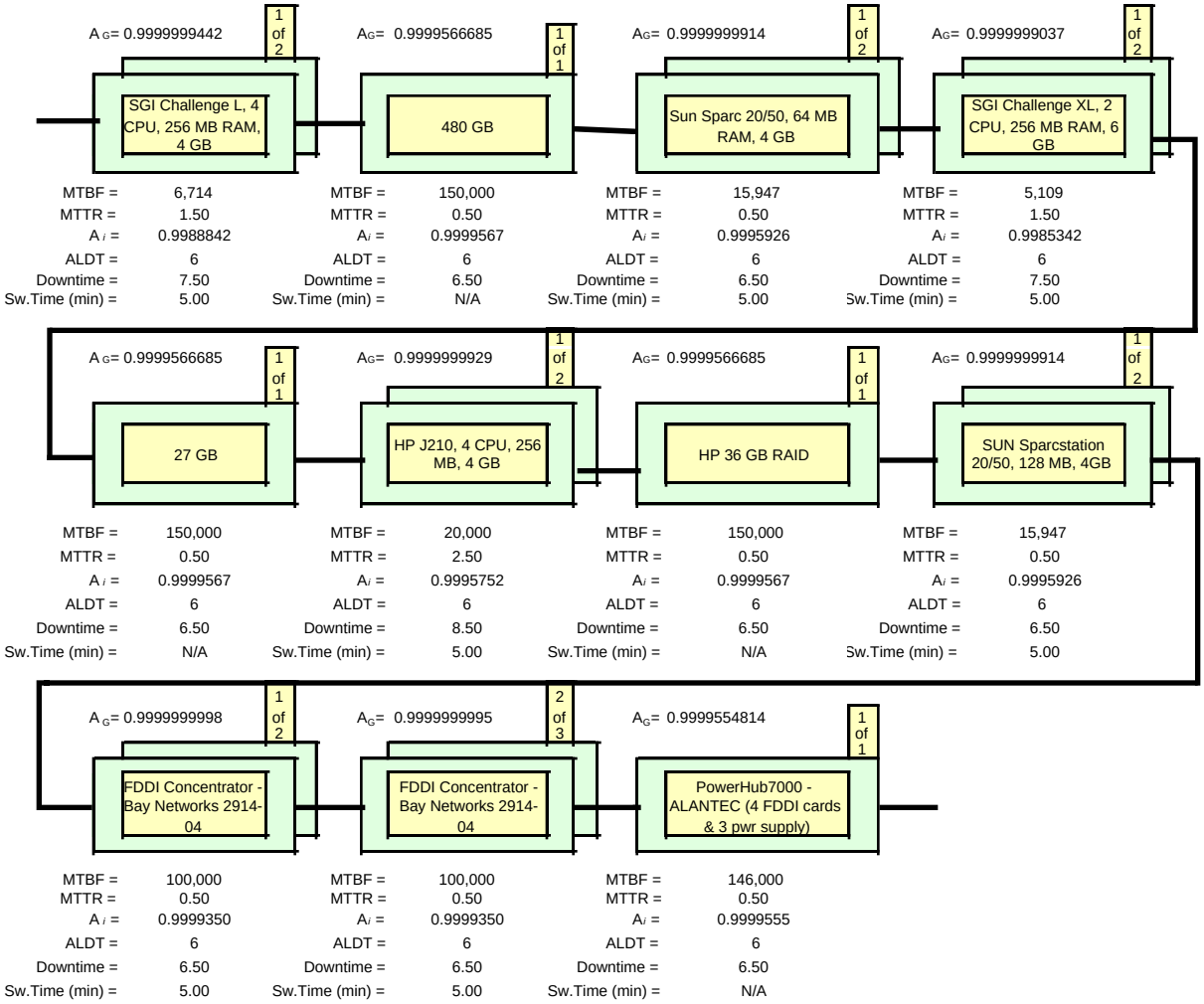

Figure 5.2.8-1. SDPS Function of Information Searches on Local Holdings

5.2.11 SDPS Function of IMS Data Management and Maintenance Interface (EOSD4000)

The Science Data Processing Segment (SDPS) Function of IMS Data Management and Maintenance Interface will be performed by the Data Management, and Data Server subsystems. The Data Management subsystem description can be found in Section 5.2.4. The Data Server Subsystem description can be found in Section 5.2.3.

Figure 5.2.11-1 shows the reliability block diagram of the SDPS Function of IMS Data Base Management and Maintenance Interface with their associated COTS RMA data. From this diagram, reliability models for the required function were developed to support the availability

calculations. Detail description of these models is provided in Sections 6.0 and 7.0, and their results are provided in Appendix A.

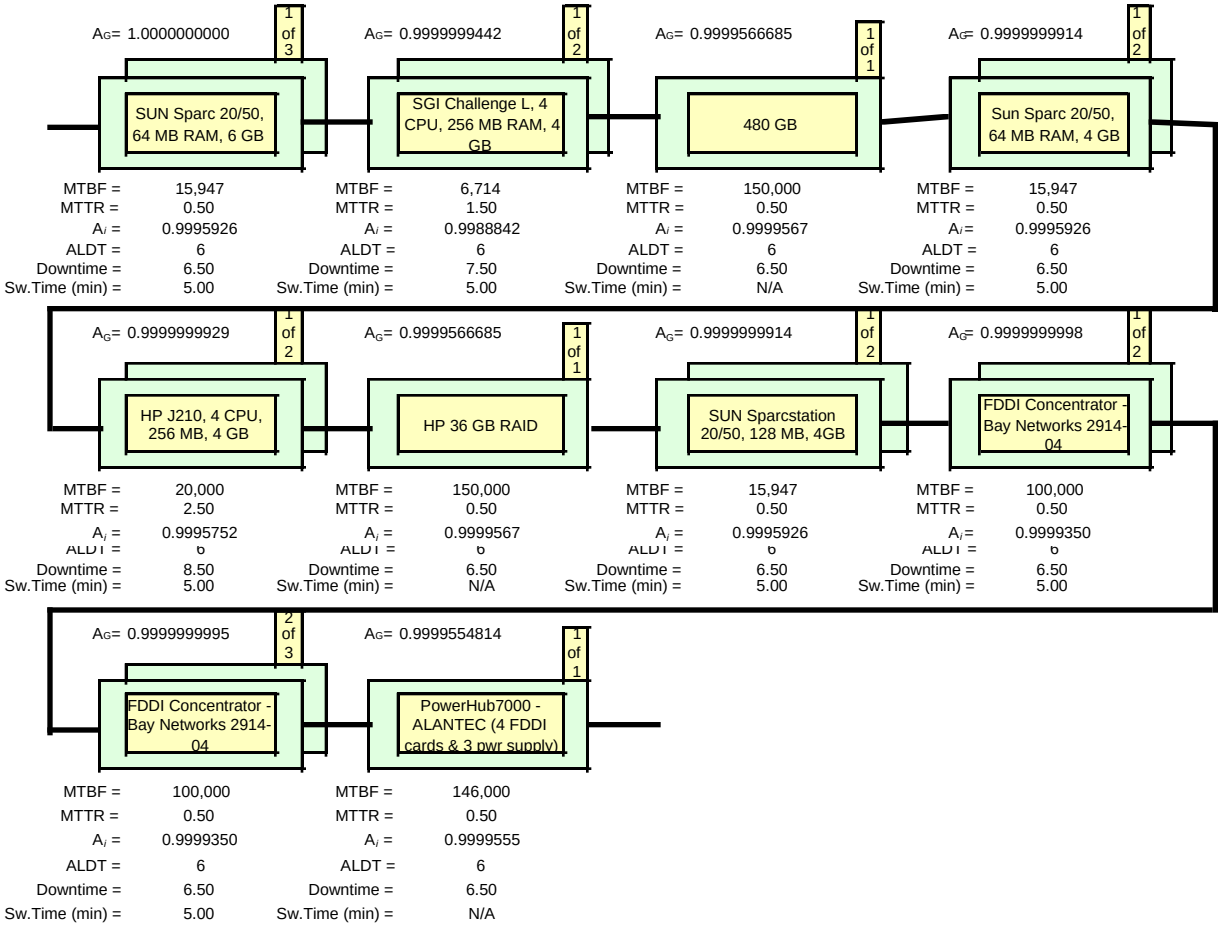

Figure 5.2.9-1 . SDPS Function of Local Data Order Submission

5.2.12 Computer Providing Product Generation (EOSD4010)

The product generation computer, which is part of the Data Processing Subsystem, provides a batch processing environment to support the generation of data products. It manages, queues and executes Data Processing Requests on the processing resources at a provider site. A Data Processing Request can be defined as 1 processing job. Each Data Processing Request encapsulates all of the information needed to execute this processing job. Data Processing Requests are submitted from the Planning Subsystem; which in turn have been triggered by arrival of data or a user request (i.e. Data Server) or internally through Planning itself (e.g., reprocessing).

The product generation computer can be one of the following.

SMP-L is a shared memory processor initially configured as a single processor machine but is scalable (can easily be upgraded with multi-processors).

SMP-H is a shared memory processor which can either be logically shared and physically distributed (up to 64 processors) or be logically shared and physically shared (such as a vector processor). A "minimum" configuration is 2 processors.

A SMP Cluster is a grouping of SMPs that provides increased scalability.

The product generation computer availability (Ao) requirement is 0.95 and is calculated as follows:

$$A_o = \frac{MTBM}{MTBM + MDT}$$

The MTBM and MTTR are obtained from the COTS vendor. The MDT is equal to the MTTR plus 6 hours of estimated logistics delay time. Therefore:

$$A_{o\,(\text{computer generation})} = \frac{2{,}748}{2{,}748 + (1+6)} = .997821$$

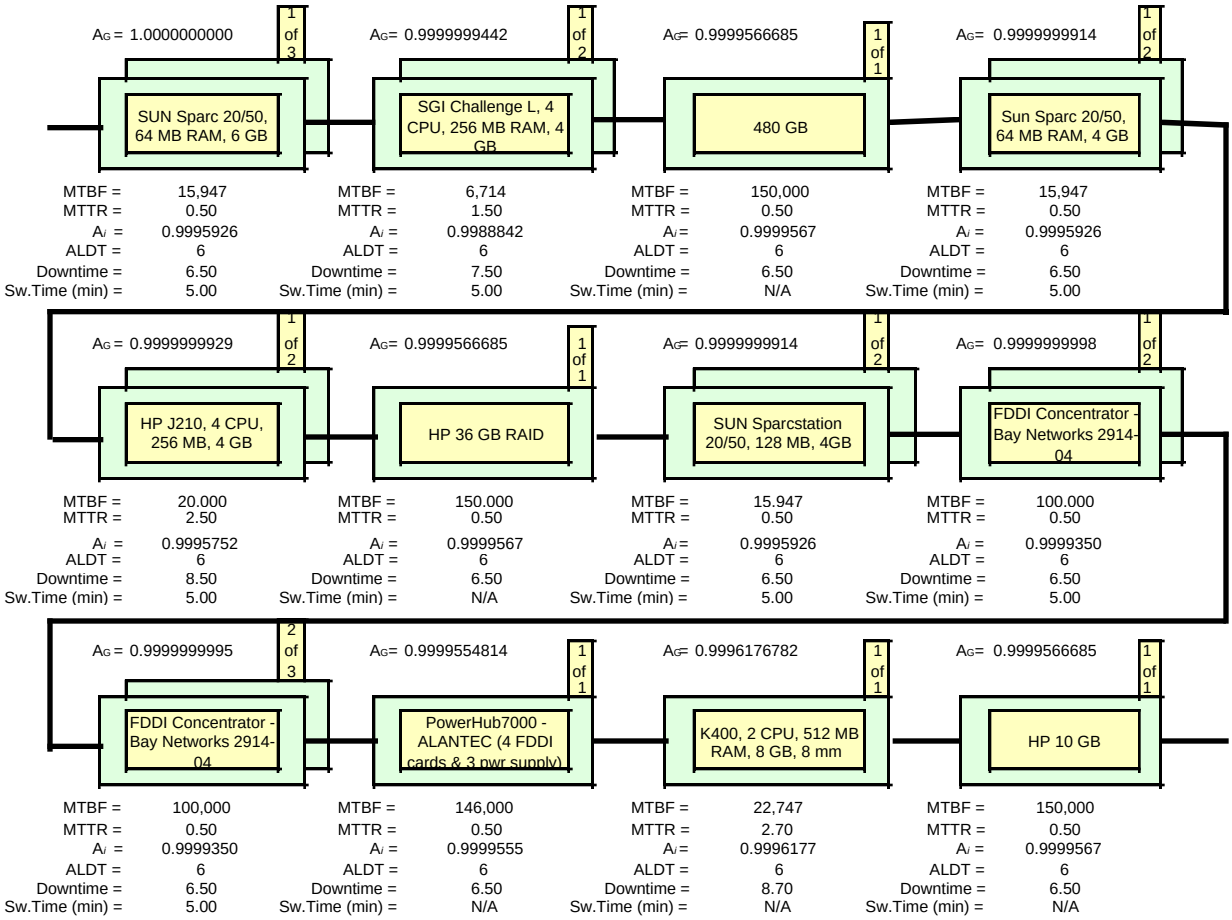

Figure 5.2.10-1. SDPS Function of Data Order Submission Across DAACs

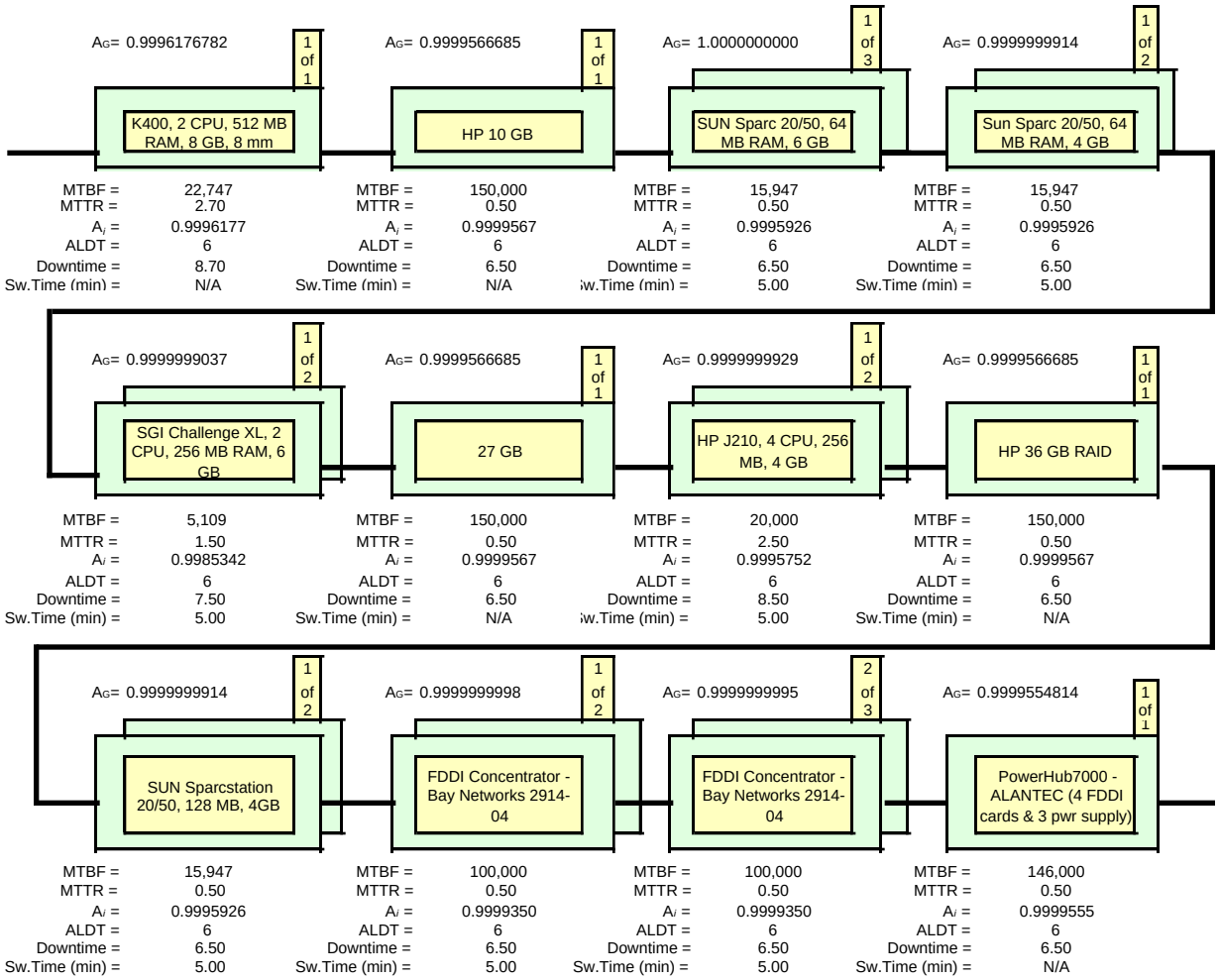

Figure 5.2.11-1. SDPS Function of IMS Data Base Management and Maintenance Interface

5.3 CSMS Functions

5.3.1 SMC Function of Gathering and Disseminating System Management Information (EOSD4030)

The Systems Monitoring and Coordination (SMC) Function of Gathering and Disseminating System Management Information provides an enterprise monitoring and coordination capability to all of ECS, respecting DAAC and EOC autonomy. The SMC resides at GSFC which includes Communication Subsystem (CSS) and Management Subsystem (MSS) servers. The SMC includes the CSS Distributed Communications Hardware Configuration Item (DCHCI) bulletin

board server, the CSS-DCHCI enterprise communications server, the MSS-MHCI enterprise monitoring server, and instances of the MSS-MHCI management workstations and printers.

The string analysis supports the integration of the CSS and MSS server to serve as warm standby for each other, cross-strapped to RAID devices for critical data access by either server. All data is replicated throughout ECS, and routinely safe stored in the ECS data server archive. In the event of a total site SMC failure, critical directory and security access information is replicated throughout the ECS infrastructure, providing multiple access points for communications data. Dual attached FDDI with fault tolerant networks and/or fault tolerant hubs are used within the local DAAC LAN designs for critical RMA links. Throughout ECS, routing tables will be updated to configure around network faults.

Figure 5.3.1-1 shows the reliability block diagram of the SMC Function of Gathering and Disseminating System Management Information with their associated COTS RMA data at the GSFC DAAC. From this diagram, reliability models for the required function were developed to support the availability calculations. Detailed description of these models is provided in Sections 6.0 and 7.0, their results are provided in Appendix A.

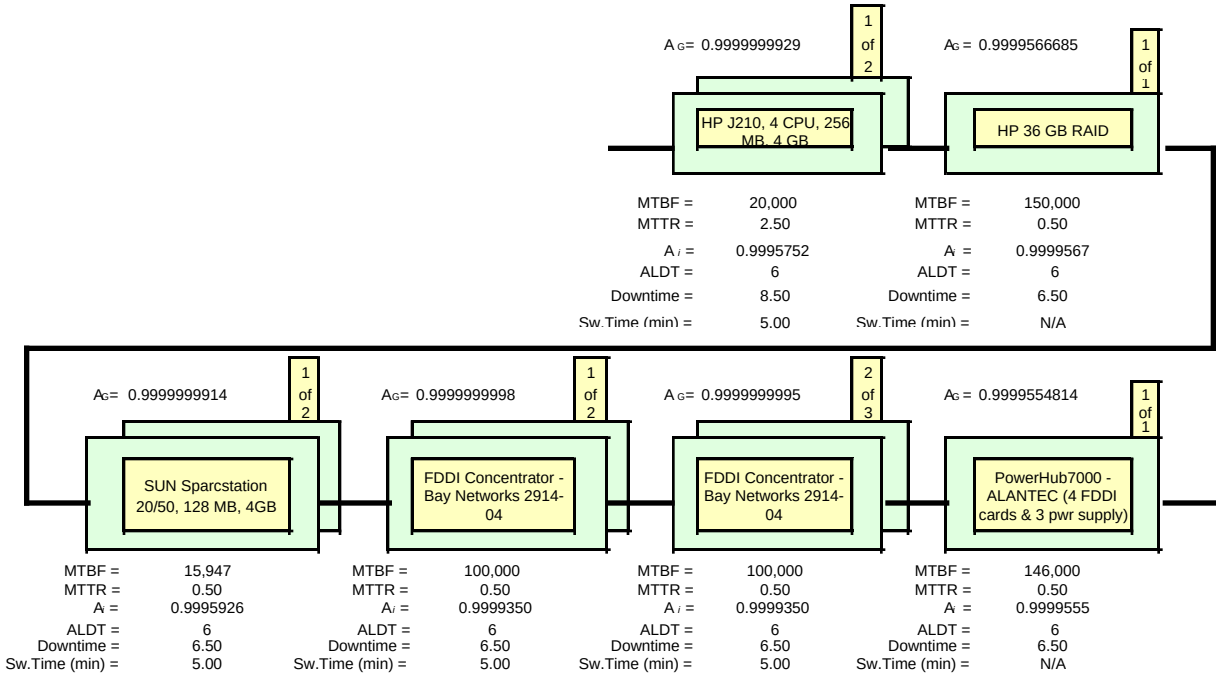

Figure 5.3.1-1 SMC Function of Gathering and Disseminating System Management Information