



Space Operations Management
National Aeronautics and Space Administration

FUTURE VISION FOR NASA GROUND SYSTEMS

Presented at Ground System Architectures Workshop (GSAW 97)

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by

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THE PAST APPROACH

- **Previously to 1996, each NASA Associate Administrator had control over the approach to operations and the facilities and capabilities that were developed with the funds from that Associate Administrator.**

- Space Science - Low Earth Orbit Flight Center



Goddard Space

- Space Science - Deep Space Laboratory



Jet Propulsion

- Earth Science (Mission to Planet Earth)



GSFC

- Manned Space - Vehicle Center



Johnson Space

- Manned Space - Science Payload Flight Center



Marshall Space

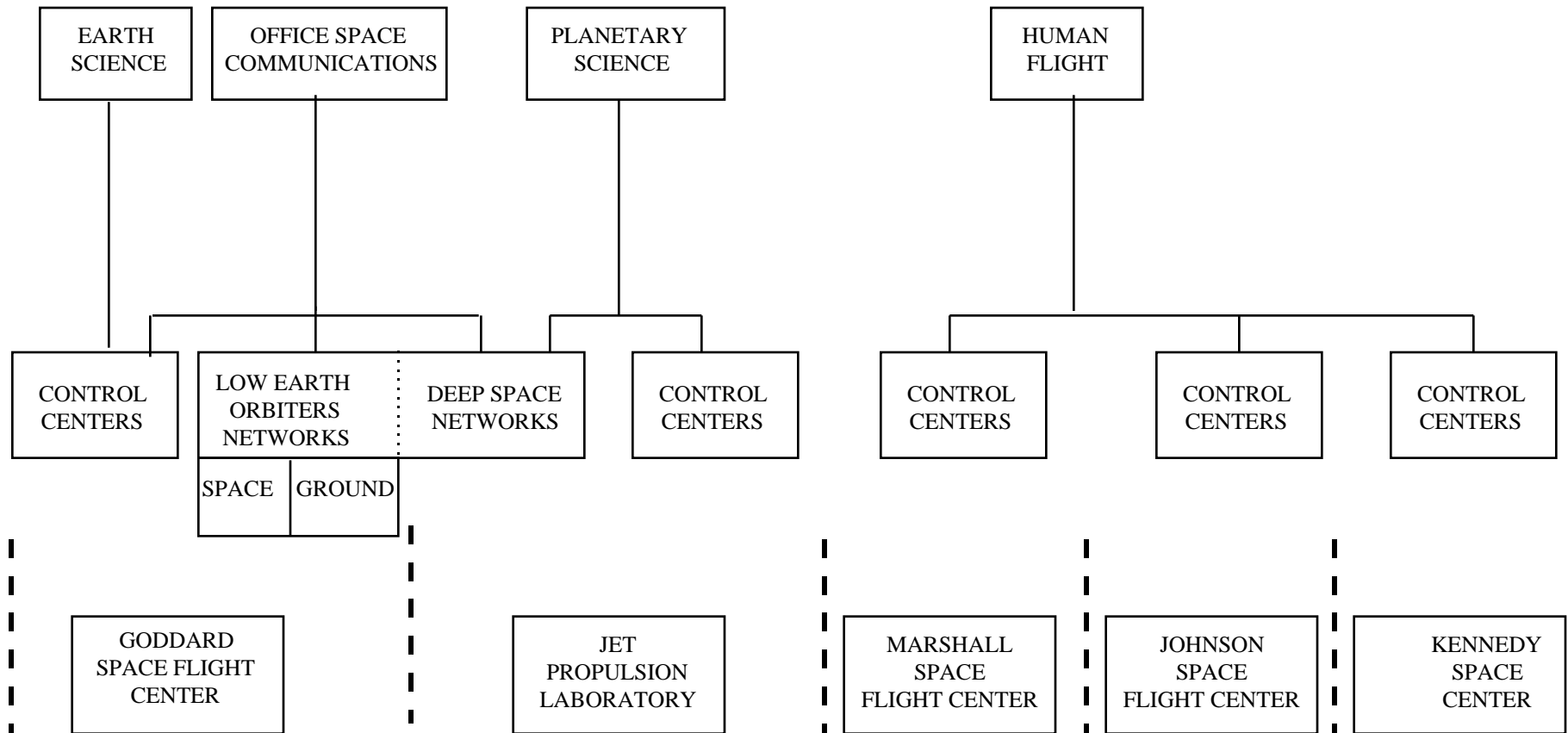
- Space Communications -



GSFC & Goddard



THE OLD ALIGNMENTS





NEGATIVE ATTRIBUTES OF THE ALIGNMENTS

- **Similar capabilities being developed and operated at each center.**
- **Agency wide solutions to common problems were not identified.**
- **Each Center having one or more contracts to support the development, sustaining and operations of the center capabilities supporting mission operations.**
- **Contractors having several contracts related to operations, with NASA at the various Centers, each managed independently.**
 - Sometimes a contractor has several contracts with a single center related to mission operations support.



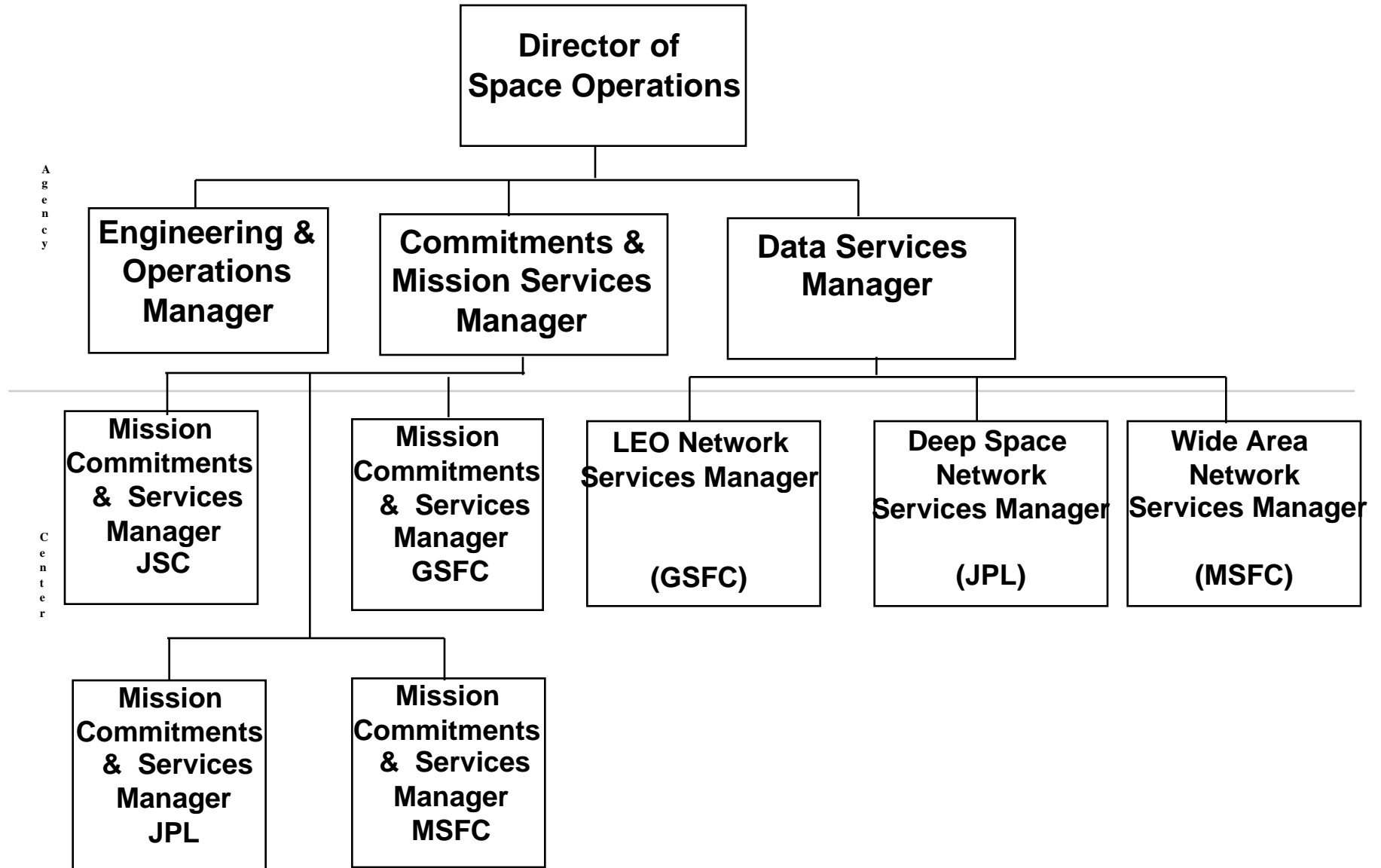
AN AGENCY WIDE APPROACH

- **There is one Office responsible for NASA Space Operations - The Space Operations Management Office (SOMO).**
- **The Office is located at the Johnson Space Center.**
- **The Office reports to an Operations Council composed of the NASA Associate Administrators responsible for development of space missions.**



AN AGENCY WIDE APPROACH

- **Any new space operations assets (facilities or facility capabilities) that are required for future missions must be analyzed by the Space Operations Management Office and approved by the Space Operations Council.**
 - Thus a request by Space Science to build a new polar tracking network, must be approved by the Associate Administrators for Space Flight (manned) and Mission To Planet Earth, as well as the Deputy Administrator - Technical for NASA.

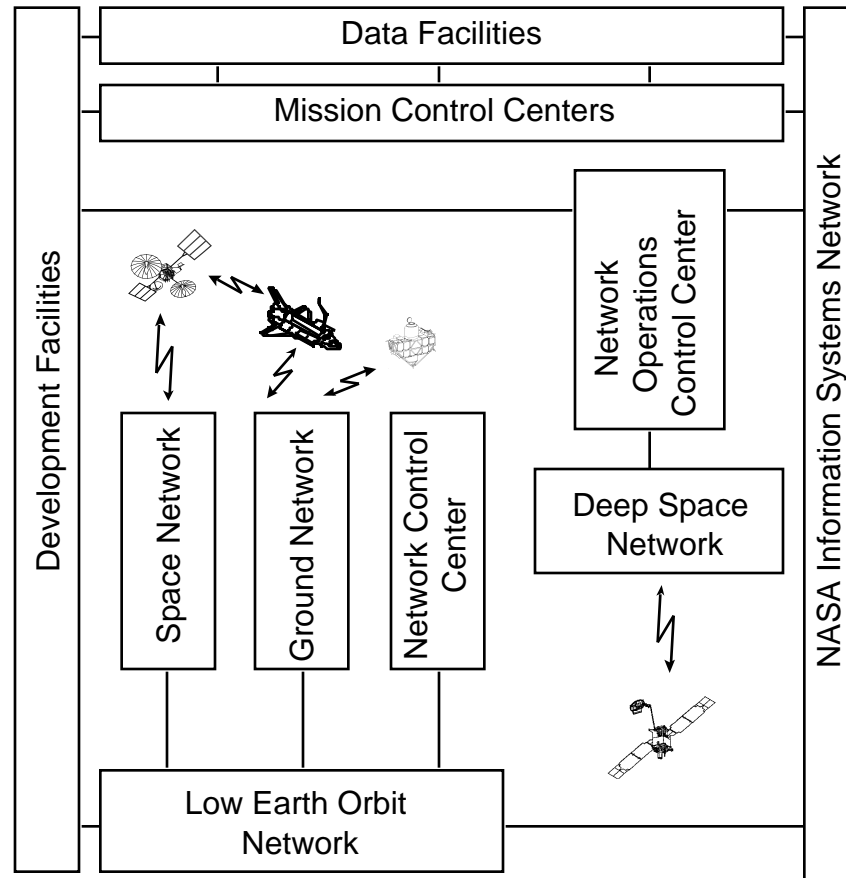


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NASA CURRENT ARCHITECTURE



NASA SPACE OPERATIONS SYSTEM
PRELIMINARY CONCEPT

R. P. MATHISON

**SYSTEM ENGINEERING WORKING
GROUP**

7 JANUARY 1997

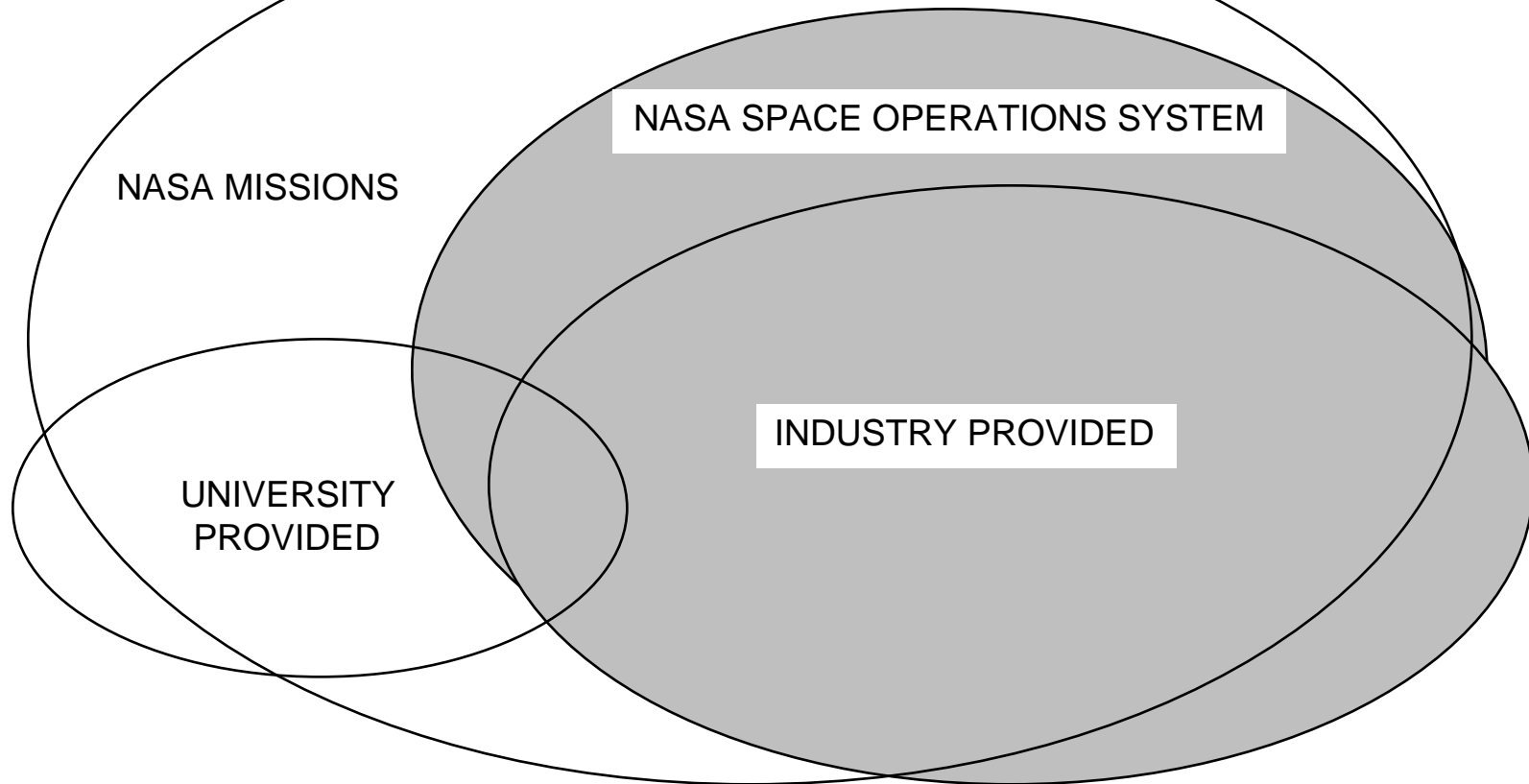


DEFINITION

The NASA Space Operations System (NSOS) is defined as the people (organization), processes, services, tools, and physical elements that do space operations for NASA Missions.

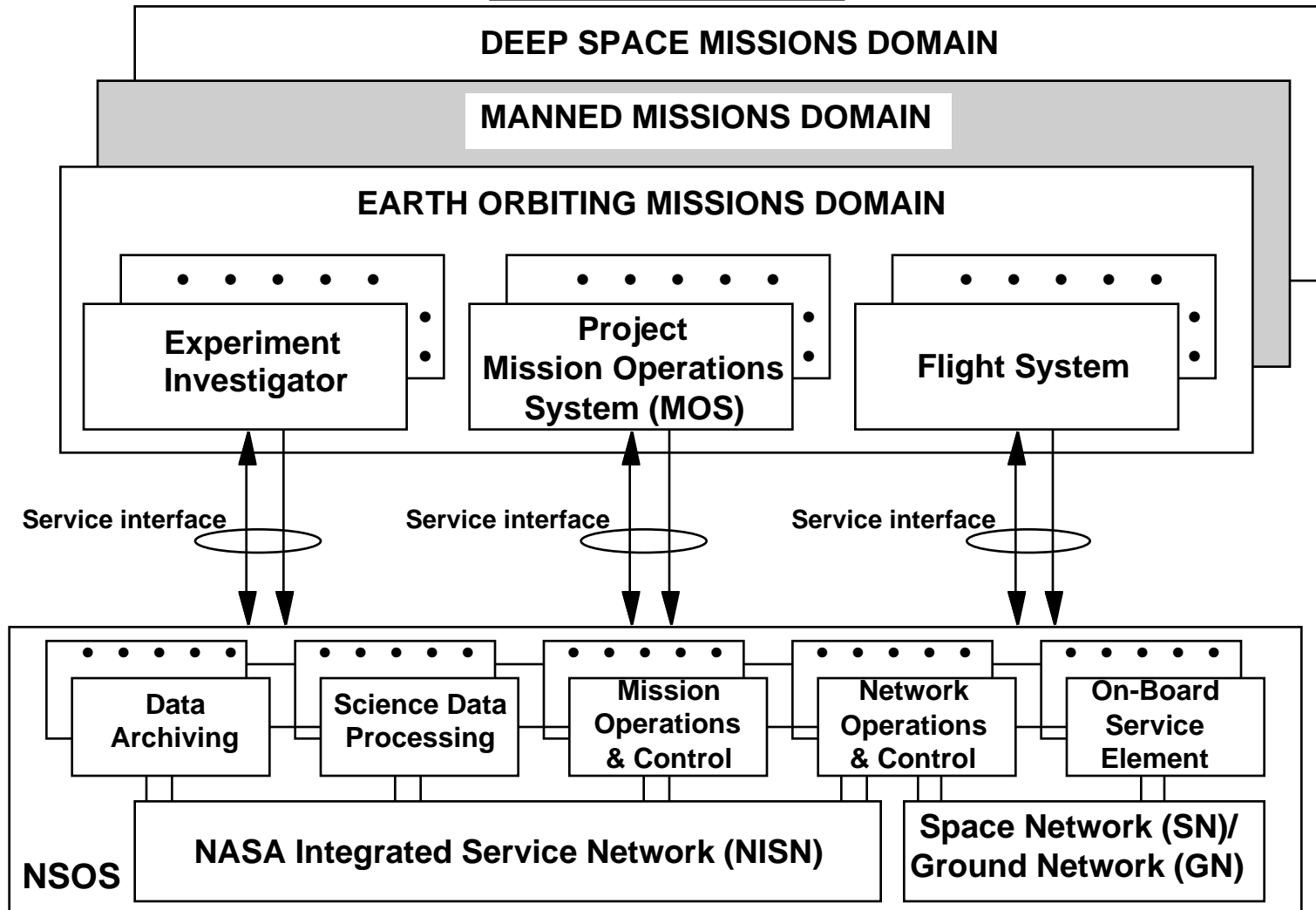


CONTEXT





CONTEXT





KEY CHARACTERISTICS

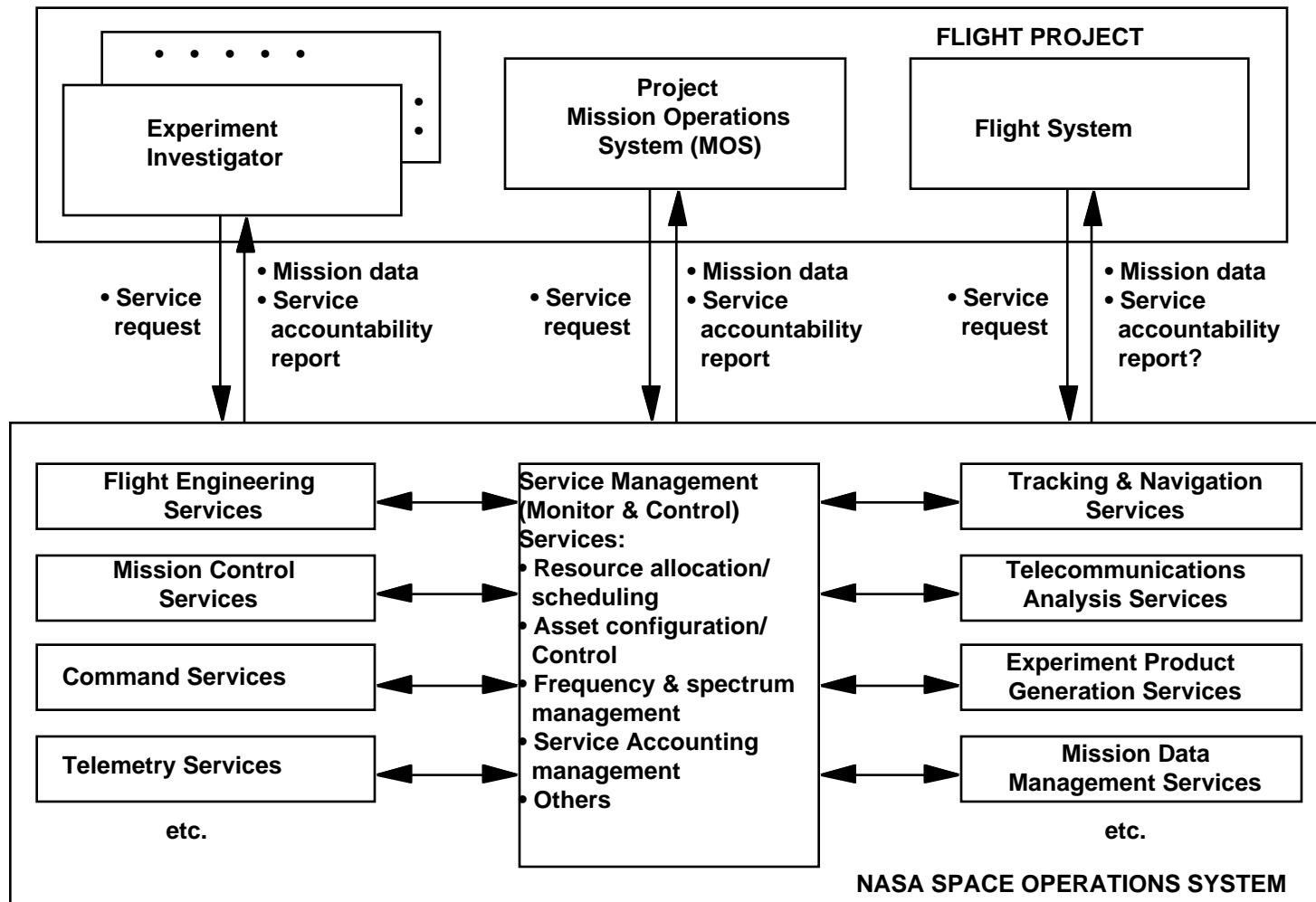
The NSOS will be established based on the concept of Integrated Space Operations Architecture. It has the following key attributes:

- **The NSOS is a collection of SOMO operations system elements functionally interconnected (not just physically networked) to provide customers, i.e., project MOS and PI, seamless interface for services. By service interface, it means the request for services and provision of data as result of service execution.**
- **Among these operations system elements, interoperability is accomplished through a set of standard services such that any customer, i.e., project MOS or PI, can obtain different types of services from multiple operations system elements to fulfill its mission operations needs.**
- **Among these operations system elements, each individual service can be instantiated through replication of objects such that the identity of each operations system element can be “transcribed” to other operations system elements within the constraints of physical assets. This implies multiple instances of the same service type can be available at different operations system elements, if needed.**
- **Unique identities are preserved for each of these operations system elements, according to the primary mission domain it supports. Missions supported by SOMO are divided into 3 mission domains: Earth orbiting missions, manned missions, and deep space missions.**

NOTE: An Operations System Element (OSE) in this context could be a tracking station, mission control center, science data processing center, or archive center.

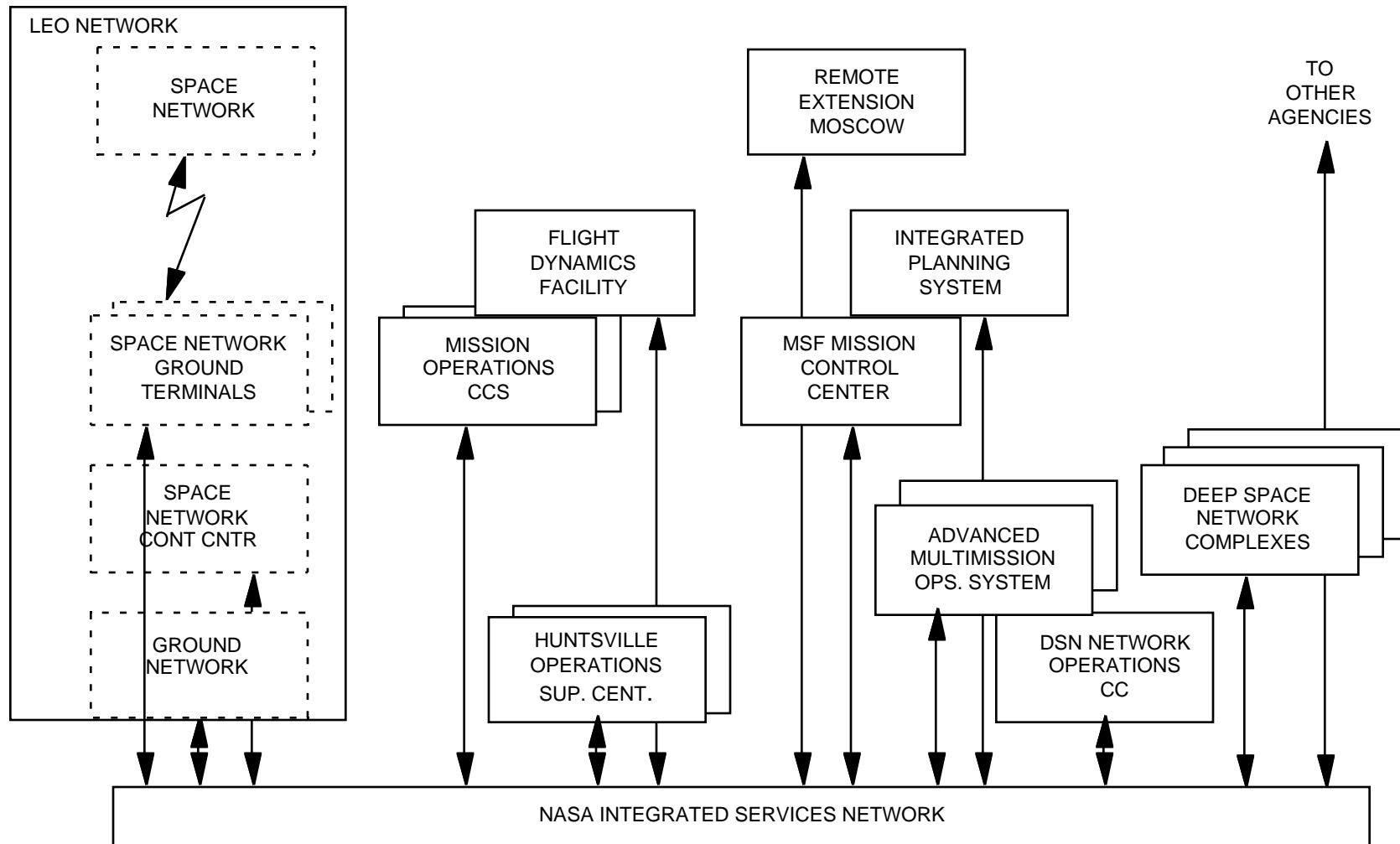


CUSTOMER INTERFACE VIEW





CURRENT PHYSICAL ELEMENTS





DEFINITION OF TERMS

In the context of SOMO, support functions provided by SOMO to flight projects and PIs are classified into 3 categories:

- **Mission operations services: A service is the work performed by a SOMO-funded system that produces mission and science operations results for a customer, i.e., flight project or PI**
- **Tools:**
 - Operational Tools - tools used by flight project personnel and PIs for them to perform their operational activities
 - Development Tools - tools used by flight project personnel and PIs for them to develop their mission operations systems or system elements
- **Engineering support: Activities performed by SOMO to support flight projects and PIs in mission design, telecommunication link analysis, end-to-end integration and test, etc.**

Distinctions between them are necessary due to their respective ramifications in cost accountability, performance accountability, and change authority



DEFINITION OF TERMS (CONT'D)

- **Standard Service:** Standard service are those defined in the SOMO Service Catalog from which customers can make selection for their needed services to support their missions without the expenditure of non-recurrent engineering.
- **Tailored Service:** A tailored service is one requested by customers for functionality different from a corresponding standard service offered in the SOMO Service Catalog and, for fulfilling this service, modification of capabilities with additional implementation effort will be needed
- **Service Family:** A collection of functionally related types of services
- **Service Type:** A service type is characterized by the unique function performed and the result produced by the service
- **Service Instance:** An occurrence of service type
- **Service Request:** Service requests specify what services are wanted by a customer. Each service request applies to a single instance of service.
- **Service Accountability:**



KEY ATTRIBUTES OF STANDARD SERVICES

- 1. CUSTOMER RELEVANCE:** Services offered to the customers must be visible and meaningful to the customers. This implies hiding the level of details of the capabilities and activities from the customers, yet allowing visibility and accountability available to the customers.
- 2. PICK-AND-CHOOSE:** The services must be selectable by SOMO customers. Subscription to a service by a customer should not require buy-in of other services which are not relevant to the customer's needs.
- 3. PLUG-AND-PLAY:** The use of any SOMO standard services (as distinguished from the tailored services) must be based on definitions which appear in the SOMO Services Catalog. Once a service, as it exists on the Services Catalog, is subscribed to, it must be "immediately" available for use by the customer. It should not require any implementation effort beyond interface testing, configuration setup, and parameter table updates, by the SOMO as a services provider.



KEY ATTRIBUTES OF STANDARD SERVICES (CONT'D)

- 4. STANDARD INTERFACES:** The use of the SOMO services, in terms of control and data interfaces, by the customers will be via standard interfaces. “Standard” interfaces include those formally established by standards organizations, those widely applied by the industry as de facto standards, and those defined by SOMO as common mechanisms to all customers. No additional development effort on the SOMO or the subscriber’s system other than that required for conforming to the standard interfaces will be necessary.
- 5. DIRECT SERVICE CONTROL:** The customers will be allowed to directly control the service (within the bounds of the system’s capabilities and safety criteria).
- 6. INTEROPERABILITY:** Services will be standardized, whenever applicable, to enable interoperability with other service providers whenever the same service is requested.



KEY ATTRIBUTES OF STANDARD SERVICES (CONT'D)

- 7. PERFORMANCE ACCOUNTABILITY: Performance of each individual SOMO service subscribed to by a customer will be measurable and reportable.**

- 8. COST ACCOUNTABILITY: Services will be provided by the SOMO to a customer on a fee schedule basis. This means all standard services will be defined, structured, and priced in such a way that customers' recurrent costs can be tracked and reported to them**



SCHEDULE

- **Multi-center system engineering working group is current working on the NSOS Service Definitions**
 - Completed April 1997
- **NSOS consolidation options will be analyzed during the spring / summer 1997 period.**
 - NSOS recommendation to be made August 1997
- **CSOC Integrated Architecture Study Phase**
 - May 1997 - October 1997
- **Architecture and contractor selected**
 - May 1998
 - Proposal will include transition plan from current architecture to proposed architecture