REPORT OF THE REVIEW PANEL FOR THE EOSDIS INDEPENDENT ARCHITECTURE STUDIES

On September 21-23, 1994, a panel consisting of those listed in attachment 1 met to review the results of the EOSDIS Independent Architecture Studies. This report gives our consensus findings and is intended to document our review, to provide guidance to Hughes, and to provide feedback to those who performed the studies.

The three studies were performed by teams from the University of California, George Mason University together with scientists from the Universities of Delaware and New Hampshire, and the Universities of North Dakota and Nebraska. Their three studies differed considerably in what they offered but were complementary. Each study focused on a different segment of the user community; the UC team focused on Earth science researchers with strong focus on particular sites and considerable abilities to reinterpret remote sensing, the North Dakota team focused on applications users such as those providing data to the agriculture community, and the George Mason team took a less focused view, but included Earth science researchers as well as those who would use the data for other government purposes. One major conclusion of our panel was that the architecture one proposes is strongly influenced by ones view of who are the users.

In summary, the California team proposed an alternative architecture featuring a data base centric view of EOSDIS. Their design solution featured heavy centralization of data at two super DAACs along with a less clear set of extensions to "Peer DAACs" whose functions were to provide more products than the super DAACs but with less reliability. The study provided creative new names for a number of new and existing concepts and system elements and generally provided a crisp and clear analysis of functions from a computer science standpoint. The study's database centric point of view clearly reflected the considerable excellence of the team in the world of data base systems. The study acknowledged that current DBMS systems will need considerable extensions in order to meet EOSDIS requirements but felt that with specific funding targeted to medium and small sized DBMS and Hierarchical File Management System (HFMS) COTS vendors, products would come to market which would meet EOSDIS' needs in a timely fashion. The team acknowledged considerable ties to DBMS companies. In general, the issues of performance were addressed by advocating the acquisition of more hardware (or iron as the study referred to it) to achieve whatever was desired. The study emphasized the need to invest considerable resources in database design efforts. In particular, the concept of queries from hell was discussed and it was acknowledged that such massive queries of the entire

data base would be accomplished as part of roughly monthly cycles of reading/refreshing the database.

The North Dakota - Nebraska team devoted their study to definition of the concept of a PARC. PARCs would be extensions of EOSDIS to focus on specific user communities such as the agriculture community in a particular region. PARCs would provide data products tailored to the needs of such communities. The team advocated that PARCs start as government sponsored entities but acknowledged that they could evolve into for profit, value added businesses. The study highlighted the need for timely availability of data, pointing out that many data are degraded in value with time. They strongly supported making data available through direct broadcast from EOS satellites. In general, the key architectural issue raised for EOSDIS is the need to ensure that extensions to the system can be implemented and that data from EOS can be made available in a timely fashion.

The team led by George Mason University (GMU) provided a specific architectural design that was generally compatible with the overall institutional building blocks and division of responsibilities of the baseline EOSDIS architecture. The point of view adopted by the team could be characterized as Global Change DIS or Environmental studies DIS. The architecture assigns different types of information, such as levels of metadata, to different servers. The concept of a Virtual Client Protocol was advocated to enable servers responding to queries relayed through other servers to provide responses directly to the original requesting client. This study provided a wealth of detailed ideas and analyses which should prove useful to Hughes system implementers. In particular, the user scenarios provided by this study should be added to the set of scenarios currently being used by Hughes. This study also pointed out the need for connection to many external data systems both to extend EOSDIS and to provide user access to additional data.

The Panel concluded that there need to be many extensions of EOSDIS to better serve specific user groups, to provide enhanced focus on select products, and to off-load the DAACs and that EOSDIS must maximize its ability to adapt and evolve. The EOSDIS problem has not been solved before, and its solution requires ideas and concepts which have not been instantiated. There is no change to the current approach for EOSDIS implementation which would greatly improve the system while still meeting the current requirements -- there is no magic bullet. A number of the recommendations from the alternative architecture studies dealt with changing the requirements on EOSDIS. These go beyond assessing alternative architectures, but the issues raised should be examined by NASA to ensure that maintaining these requirements will not preclude critical efficiencies in EOSDIS implementation. The studies have provided a number of detailed ideas to be examined on all time scales whose implementation may improve EOSDIS. We spent considerable time discussing these ideas and the options

they present system development. Our assessment of these items and the time scale on which they should be considered is included in this report as attachment 2.

The alternative architecture studies, particularly that of the California team, raised a significant question as to whether the EOSDIS baseline approach is data base centric. By this term we mean the degree to which the system architecture and design will use the considerable power of data base management systems to accomplish its functions. Our panel included members who felt strongly that this was the only way to go as well as others who expressed reservations. Hughes provided a succinct exposition of the way in which data base management systems are included in the current architecture and their expectations as to how they would factor into system design. Our conclusion, based on this explanation, is that the design is currently data base centric to a degree commensurate with the expected readiness of extensions to current data base management systems and that the design does not preclude an evolution to a full data base centric approach. Furthermore, we concluded that this represents a reasonable approach for now.

All three study teams raised significant questions as to whether the Common Object Request Broker Architecture (CORBA) would be ready to meet the needs of EOSDIS in the future. The current baseline architecture assumes an eventual evolution to CORBA. This cautionary note should not be forgotten.

There are six items which we would like to emphasize specifically which merit further study or effort.

1. The California team proposed two identical archives each of which would hold all the data. This points to potential savings in having a common system design for all archiving elements of EOSDIS. Thus, a study should be made to determine if EOSDIS would be benefited by having the same archive system design applied to the Level 0 back-up archive as is being used for the DAACs.

2. EOSDIS should examine its various software development plans to determine if there are cases in which requirements could be better met by spending money to influence COTS development. Hierarchical Storage Management Systems may present one such area for application of this development technique.

3. At every step, the architecture of EOSDIS should be analyzed and tested to ensure that it easily enables extensions to the system by others.

4. The User Model must be clearly established and related to the services that can be provided within overall cost constraints on the system.

5. The current EOSDIS design permits support for bringing user defined processes or functions to the data centers to be run. In essence, this is bringing the process to the data. The current implementation plan does not provide computational resources at the data centers to support this. The question of bringing the process to the data versus bringing the data to the process should be reexamined and, if possible, a means should be found to allow this decision to be made adaptively.

6. There are considerable questions surrounding the issue of routine production of standard products. While the California team pointed to users who would need only the lowest level of standard product, all teams pointed to the need to produce products tailored to specific sets of users. The decision as to what products to produce routinely is clearly a function of the actual user needs as well as one of capturing measurement related expertise which may otherwise be lost over time. The routine production decision is also entangled with the costs the user will pay under the principle of charging no more than the cost of fulfilling the user request (COFUR). If a product is routinely produced the user bears no cost for its production, but if it is processed on demand the costs of production may be charged to the user. This situation requires further study to determine its effects on the efficient operation of the system.

For those members of the panel with long EOSDIS experience, the review of these studies pointed up a significant need to better communicate the key concepts of EOSDIS and the approach being taken in its development. There were so many critical instances where the study teams misunderstood some aspect of the current system approach or some principle governing its requirements that fault must lie in the communication by NASA and its contractors about EOSDIS. The panel strongly recommends that this situation be remedied.

In conclusion, the panel acknowledges the considerable work and inventiveness demonstrated by the independent architecture study teams. Although each of the studies took a different approach to their work and delivered different products, EOSDIS should benefit from the work of all three teams. The panel thanks the personnel at Hughes for their excellent support to us in conducting this review.