*(Note: The following report was originally written as a classified document. This unclassified version has been prepared by the staff of the Director of Central Intelligence. Small additions to the text have been inserted to clarify sentences where classified information has been deleted. Every attempt has been made to retain the meaning and intent of the Panel's report.)*

MEMORANDUM FOR: Director of Central Intelligence

SUBJECT: Small Satellite Review Panel

This report provides the results of the Small Satellite Review Panel. The Panel intends to meet further during the next few months and provide a final report in September.

A Panel was convened as you requested. As Chairman, I conducted some preliminary discussions with members of the Intelligence Community with the assistance of Marty Faga. Preliminary briefings and materials were provided to the other six Members prior to our plenary session. One two-day, plenary meeting was held on April 24-25 and is the primary basis for this first report. The intention of the Panel is to provide our best early judgments on these issues which would affect the use of FY 96 funds and the construction of the FY 97 Budget by the Congress. Given the short time available, there were many issues and details which the panel could not fully address but we were able to identify a rather significant set of points on which we could agree.

## A New Approach for Space Reconnaissance

The most important judgment of the Panel is that now is an appropriate time to make a qualitative change in the systems architecture of the nation's reconnaissance assets. These changes should affect the distribution of spacecraft functions, how space reconnaissance systems are acquired and how they are operated. Several factors argue for these changes now.

The technology and industrial capabilities of the country permit the creation of effective space systems that are substantially smaller and less costly than current systems. We see the opportunity to move towards an operational capability for the country, at least for imagery systems, that consists of an array of smaller, cheaper spacecraft in larger numbers with a total capacity which is at least as useful as those currently

planned and to transport them to space with substantially smaller and less costly launch vehicles.

We see the opportunity to exploit the growing commercial industrial base to access a broader set of technologies and industrial capabilities. The acquisition practices needed to access these commercial capabilities should be more efficient and in line with other acquisition reform and commercial practice initiatives across the government.

The security environment can and should be adjusted to facilitate the application of commercial capabilities and ease the exploitation of the system products.

Smaller is Better

Two elements of the NRO presented alternative views of the future both of which depend on a more modern approach, lighter weight and less expensive satellites.

The Imint Directorate, which is responsible for the current systems, advocates a new generation of imaging satellites. Individual spacecraft would be only half the size and cost of the current and planned versions. A plausible transition plan was displayed which could be accomplished without any near-term funding increases. It was a thoughtful advocacy which appeared sound and would be an improvement over current plans.

The Office of Special Applications advocates a greater departure from today's style of operation with more, smaller, less costly, and individually less capable spacecraft and a new ground environment. The spacecraft weights were more in the order of 20-25% of current systems with each of the smaller satellites having about one-half the capability of the individual satellites in the currently planned large satellite constellation. A mix of several types of spacecraft would provide the full capability.

Several commercial space imaging companies also presented their designs and business plans. Their performance characteristics were not as great as the NRO proposals and would not satisfy many of our core information requirements. However, their system attributes are relevant, will clearly provide useful images and their prices were lower. These inputs were useful to our deliberations.

The Panel's judgment is that smaller is better for the reasons outlined below and can be implemented while satisfying the critical needs of the country. We believe that sizing the satellites in the 20-25% weight class each with 40-50% of currently planned capability is a better concept than current plans or the 50% weight class presented by the Imint Directorate. We do not believe that our key needs can be met by the products of the current commercial space imaging companies.

## The Case for Smaller Satellites

### Cost

Much of the background provided to the Panel linked the advocacy for smaller satellites to reduced costs. We agree that, to the first approximation, satellite cost is linear with weight and we now have the opportunity to create smaller, less expensive satellites with a more modern approach. Both NRO proposals were for smaller lower cost systems. However, the Panel's preference for one-fourth size rather than one-half size is not dominated by cost. We were not presented with any evidence that the same level of capability could be achieved at lower cost with one-fourth weight satellites than with one-half size satellites. However, either approach should, in time, be substantially less costly than the currently planned constellation of large satellites. The panel does believe, however, that there are many other advantages which argue for the smaller option. A brief identification of some of these follows.

### Robustness

A more proliferate constellation of smaller, cheaper, less-capable satellites places less of the total system capability at risk with the loss of a single satellite. Further, the more proliferate approach implies the production of new satellites on a more regular basis. Thus, a new satellite will routinely be nearer completion whenever an operational system fails. On-orbit storage to provide for a surge capability also becomes an easier decision.

### Flexibility

There are many dimensions to the flexibility of a proliferated system. Since each satellite represents a smaller percentage of the whole, it is easier to ratchet the total system capability and cost up or down in response to the current circumstances. By dividing the functions now on a single satellite on to smaller, separate satellites, the system can be re-balanced to achieve a different mix of capabilities without having to launch a system which includes all functions. As an example, with a proliferated system, we could improve the revisit time for medium resolution coverage to respond to military operational needs without investing to better the revisit times for all of the other functions now on each satellite. Further, since the functions on a multi-function satellite may not live the same lifetime, there is currently a need to place in operation a full set of functions when only one or two are needed. This has historically resulted in "residual capabilities" which have been very comforting to the nation but represent operational capabilities and costs beyond our formal intentions.

## Injection of new Technologies and Operational Techniques

By having a more proliferate system which is being renewed more often with a smaller percentage of its total capability, there is increased opportunity to introduce new technology through directed procurement or new competition. This formulation also permits operational experimentation with different configurations without the cataclysmic potential of perturbing all of the nation's capabilities.

## Industrial Base

The more proliferated and distributed system architecture has a major impact on the industrial base from which these assets will be procured. By acquiring more, smaller, and cheaper systems, a smoother flow of delivered products is possible and a smaller work force is needed. Beyond this removal of the "lumpiness" of buying a very big thing infrequently, the smaller systems are much nearer to the capabilities of the emerging commercial space industries. This permits the use of components and perhaps complete systems that have been created through other's investments and are being procured in numbers by others.

## Requirements

By any measure we can devise, the true needs of the nation for support from these imaging systems exceed the capabilities currently available and those planned for the future.

A specific set of requirements parameters was used in the Panel's consideration of satellite alternatives.

## The First Step

The panel believes a decision should be made now to build a specific type of satellite of the 20-25% weight class and with one-half of the capability of a currently planned satellite.

Although the Panel has not yet resolved for itself a complete, objective architecture and implementation plan, it believes that investment now in a smaller satellite is consistent with any likely outcome.

We believe that industry is prepared to produce this kind of system and do not believe that a technology demonstrator is needed to assure ourselves it can be done. The investment might best be considered an operational prototype which would be expected to demonstrate operational utility and be the basis for developing operational procedures but which must also bear the full burden of satisfying operational needs.

The panel had little opportunity to deal with the question of ground architecture but agrees that the new system should allow for operation with a new ground environment and not be dependent on the current ground environment. However, we recognize there is a large investment in the installed ground system base which should be drawn upon as appropriate.

The Panel did not have time to do a complete financial review to determine with precision its recommendations on how to fund this investment. However, this is an important first step for the enterprise and we believe it can and should be initiated within any level of resources planned for the whole operation. It is our recommendation that funds appropriated for small imagery satellites in 1996 be applied to this objective and that adequate resources be included in subsequent years.

We did review our recommendation with respect to the Congressional direction on the costs of any system to be built. It is our judgment that the first step we recommend will not likely be achievable within the constraints of the Congressional language. We further believe that to be constrained by the Congressional funding limit specified in 1996 for the complete range of functions including total spacecraft, launch, operations, ground processing and dissemination are unrealistic for the requirements baseline which we assumed, and which we are convinced constitute a good minimum capability.

## The Role of the Emerging Commercial Sector

The panel heard some interesting commercial imaging business descriptions. Coupled with our prior understanding, we have drawn some preliminary judgments.

A substantial segment of the companies which now make up the industrial base upon which the NRO depends are investing with others in commercial satellite imaging ventures. If at least some of them are successful, they will create new industrial capabilities and new systems capable of delivering products of value for our information needs. In addition, the commercial communications sector is investing heavily in systems which involve large numbers of smaller satellites. Taken together, they will create a new base of industrial capabilities, components, systems skills and useful products which should be exploited by the nation for its national security needs.

To take advantage of the trends in the industrial sector, the government must revolutionize the way it contracts for goods and services. It must move to the application of commercial business practices. This includes the acquisition of routinely available products on a price-for-value rather than a cost-for-requirements basis. This is a desirable move in any event but made necessary to permit contracting with commercial industries who will not comply with the governments unique acquisition requirements.

Also, if successful, these businesses will be routinely capable of delivering imagery products with resolutions ranging from one to four meters. The government should encourage satisfying as many of its needs in this resolution range as possible by using these products to reduce the investment necessary to satisfy its unique and more demanding needs. The government should consider issuing a policy and developing a mechanism which would facilitate a more effective match between legitimate users and commercial providers. Such a policy statement might clarify the business perspective for these emerging commercial businesses and enhance the prospects of having some routine image needs satisfied without government investment.

**The Importance of Research and Development and Retaining a Competitive Edge**

As we recommend a transition to satisfying much of the operating needs for satellite reconnaissance through a more proliferate array of smaller, less-capable and less costly systems, we want to emphasize the need for continuing investment in technologies and techniques which would maintain the leadership which the United States enjoys in this field. One of the reasons we can safely move to a more commercial and proliferate system is the maturity of this business and the maturity of its industries. As we do so, however, we risk losing one of the advantages of past practices which was the ability to create extremely capable systems, protected by compartmentation and largely decoupled from the rest of industry. The unique and superior capabilities produced by this approach served the nation well. While we do not believe the whole process must be continued in this way, it will be important to provide for a mechanism for creating "high-end" systems which would be beyond the reach of other societies. We recommend that a vigorous research and development program be maintained and targeted at several specific performance objectives.

**Space Transportation**

One of the advantages of reducing the size of the spacecraft in our future architecture is the potential to use smaller and less costly launch systems. Movement to sizes more like those used in other parts of the commercial and national security sectors should provide for more routine competitive choice. We recognize that moving this segment of the reconnaissance assets away from the larger launch systems will produce problems in other sectors. Our view is, however, that the government will be better served in the long run by this more proliferate architecture and should not retain the current dependence on such very costly launch systems. The problems of the other sectors must also be addressed and we did not have time to do so but that does not argue against making this move now.

## Future Architecture and Systems Trade Studies

The Panel agrees that parametric studies should be expeditiously conducted to refine and optimize the architecture suggested by our recommendations. These studies should determine the system cost and performance relationships as affected by such parameters as orbit selection, segmentation of operational functions between spacecraft, technical risk, ground environment configuration and communications strategy.

In conducting these studies, the Panel believes the following points should be considered.

- Focus on satellites in the order of 20-25% of the size of currently planned systems but explore a range of excursions.

- Only consider configurations and technologies which can be developed in an orderly program with suitable risk reduction activities prior to and during developments.

- Identify any significant reductions in system cost which could be achieved with small changes in the driving requirements.

- Determine the utility and cost of new concepts within the architecture.

## Follow-on Activities of the Panel

You may wish to terminate our work at this point. However, we originally envisioned that the Panel would need to meet further to extend and refine its judgments Our judgment is that we would produce a more complete and credible report in the Fall if we were to meet two-three more times. Among other things, we could be more definitive with respect to the characteristics of an end architecture, more complete with respect to transition issues and add some judgments about a supporting Research and Development Program.

Bob Hermann, Chairman
Lew Allen
Dick Brandes
Sid Drell
Marty Faga
Howard Schue
Ed Stone
Larry Welch