

APPENDIX A

Issues in Space

Dr. Daniel Hastings

Chair of the Air Force Scientific Advisory Board

Talk to the Federation of American Scientists

20th Feb 2003

It is a pleasure to be able to address this group. The Air Force has a good, coherent view of air power and its use and is working hard to bring the same level of intellectual understanding for space power and its use. These underpinnings were essential in order to properly discuss the architectures and systems necessary to fight and win conflicts of the 21st Century.

Space will continue to be the proverbial high ground for the foreseeable future. Desert Storm and Allied Force and operations in Afghanistan showed that space assets integrated with air, ground, and sea assets can play a critical role as force enhancers in fighting and winning conflict (who would have thought of B-52s using bombs like bullets? As Gen. Myers pointed out, this is enabled by space assets.) Control of space and access to it are fundamental to economic and military security and underpin the national military strategy as directed towards J2020. The US now depends critically on space assets and this is apparent to any adversary.

This national military strategy relies on information dominance. Information dominance means that a smaller number of assets can be forward deployed and be effective through reaching back to rear based sources of information. This trend is increasing in the use of military forces. In Desert Storm, the total bandwidth required was 100 Mbps while by Allied Force, which deployed only 10% of the Desert Storm forces; the bandwidth required of these forces was 250 Mbps. This increased bandwidth was provided largely by commercial geosynchronous satellite communications (over 75% by the end of Allied Force). In addition, currently, just one Global Hawk, which provides tremendous ISR capabilities to US forces, requires 50 Mbps, all of which is provided by commercial space communications. Thus, the US military has already placed itself in the position of being critically dependent on access to long haul communication assets. Commercial space assets have thus become key enablers for the national military strategy.

Since the Air Force is in the business of deterring and if necessary, helping to fight and win the nation's wars, it is appropriate to focus on the immutable tactical needs of a warfighter. These will not change and will continue to be critical in fighting and winning wars. These are:

- Locate military targets
- Obtain insight into target content
- Determine adversary intent
- Make rapid force decisions
- Execute in near-real time

As the world continues to change and technology continues to spread, the nature of warfare given these needs is undergoing significant change which it is important to understand. Some of these are

With information widely available, there will be an emphasis on integration of information and speed of execution.

Our high dependence on communication links and information operations will make these the two most likely places to attack us.

The pace and effectiveness of war will increase by emphasizing integrated air, space and information operations.

The cost of war in space and information operations will be reduced by making widespread use of commercial systems.

Operations from CONUS and the increasing pace of war will put emphasis on rapidly deployable, zero footprint forces.

The reduced emphasis on mass as well as the quickening pace of war will place the emphasis on rapid, precision target specific strike to achieve desired effects and to minimize collateral damage.

Taking these implications into account then some of the military functions that will be important are:

Intelligence, Surveillance and Recon (below ground, on the ground, in the air and in space)

Target specific, precision strike (below ground, on the ground, in the air, in space, in cyberspace)

Missile Defense

Information and Communications defense and attack (in real space as well as in cyberspace)

The next step is to reflect on the architectures to achieve these functions using both current assets and plausible future assets. Let me now turn to my final four points.

The first point is that aerospace use for the 21st century should focus on new missions as well as thinking about how to do current missions with space assets. Let me put it more strongly, it is not clear to me why it makes sense to migrate missions to space that we can do now unless there is a clear, compelling rationale to do so. Rather in the new world, it makes sense to think about missions that we can barely do now or cannot do now. Let me give you some mission areas, but there may be more. The mission areas that are new are space control (to defend US constellations), national missile defense, global psychological operations and global information operations. There are new things that can be conceived in these areas because of the commercial use of space and the advances in space technology.

The second point is that fighting with aerospace forces in the 21st century has to take account of four new modalities in operations. In some cases these modalities are constraints, in other cases they give new opportunities.

The first modality is that use of space assets is use of assets that are inherently global. These assets move according to the laws of orbital dynamics and we cannot do much about that. This has at least two implications. First is that space assets will penetrate deep into an adversary's region and not be restricted

to the boundaries of a country. This deep penetration and its use forces one to think strategically. The second is that potential commercial applications may arise for information from space assets away from areas of conflict. These potential uses must be managed carefully to obtain benefit for the government without losing control of the asset. An example of an asset that was not managed carefully is the global position satellite (GPS) system where the commercial utility now overwhelms the military utility and the Air Force has effectively lost control of it. Another example that may be coming is ground moving target indication (GMTI) from space. This has vast military utility, but could also be used for traffic monitoring and control in cities. The implications of this dual use need to be considered in any model of future conflict.

The second modality is that all useful space assets are also information assets. Unlike planes which have the brains of the pilot on board, space assets are only useful when they gather, process and pass on information. This means that space warfare and information warfare are intimately connected. One would think of space assets as flying computers. It means that it is possible to conceive of attacking and negating space assets in cyberspace without ever physically touching them. This way of thinking allows a warrior to consider a range of options for affecting a space asset ranging from denial of a service from an asset to temporary degradation to destruction.

The third modality is that many military services with space assets will be provided commercially. This has implications for the individual robustness of space assets since the commercial providers will act in the way to minimize cost and may expect protection from the military. It means that military users will probably have to protect themselves via massive diversity rather than secure links. It also means that the cycle of change will be much faster than the military is currently used to. Thus a culture of continuous learning will have to be developed.

The fourth modality is that space warfare will be warfare surrounded by non-combatants. This will occur in two ways. The first is if an adversary uses services on a space asset at the same time as neutrals are also using the space assets. For example, an adversary uses a transponder on a satellite and neutrals are using the other transponders. The second is when adversary space assets are physically close by neutral assets either in geosynchronous (GEO) earth orbit or if the same

classes of orbit are used. Under this circumstance the physical destruction of a space asset could lead to orbital debris and give rise to large collateral damage. This consideration leads me to conclude that physical destruction of space assets is the least attractive of all options that should be chosen to negate an adversary use of space. To some extent space warfare in the future will be like trying to fight "bad guys" in a crowd of noncombatants as the Marines had to think about in Somalia.

My third point is that the time has come to clearly, and coherently, articulate a position on weapons in space that will add light and not heat to the debate. It is important to think through the long-term implications of all the actions we take in space and think through all the solution strategies.

My fourth point is that we should consider the potential Achilles heel of our growing dependence on space. The one that causes me to pause is a high altitude nuclear burst. In a world of commercial satellites such a burst would be devastating and we need to think through how to protect ourselves against it. Possibly one way to develop "internet like" processes so that destruction of large numbers of satellites would still not be crippling. This could be done by large constellations of distributed satellites in a wide variety of orbital altitudes.

Finally, let me say that we should always be aware of avenues of revolution which may catch us by surprise. Let us not be caught focusing on better horse and buggy harnesses when the car has been invented. In my mind two things that might make for dramatic changes are: 1) substantially lower launch costs, and 2) the successful development of microsatellites to replace the functions of bigger satellites. Either one might lead to new economics, new missions and new ways of operating in space.

Finally, under the recent reorganization of the Air Force space operations and acquisition, the NRO and the Air Force have moved under one person (Mr. Teets). Air Force Space Command now has a dedicated 4-Star officer and controls space assets from acquisition through operations. These changes (a result of the space commission) were intended to allow the national security space community to act effectively to address the challenges of the future in space.

Let me finish by wishing you the best in your deliberations.