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SPACE CONTROL:
THE OPERATIONAL COMMANDER'S FUTURE DILEMMA

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Space systems have rapidly become like breathing for today's warfare commander - a necessity for survival. However, the abundant proliferation of space technology has begun to crowd the air (or in this case space) and balancing the advantages once overwhelmingly in the United States' favor. This paper outlines the current and projected commercial-based space systems that will likely become available to those nations that have limited capability today. Further, it proposes to US operational commanders what this potential offsetting situation means and how this will affect his control of space. It suggests that he may have little capability to control in all scenarios, and if this is the case, offers what options he has to best exploit his own assets and limit the effectiveness of the opposition.

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PREFACE

The majority of sources listed in the Bibliography were from periodicals and newspapers. These provided the bulk of technical and, more importantly, timely decisions on issues that were critical to the paper's topic. The reader should be aware that keeping this paper unclassified may not open all alternatives available. The intent is to disseminate this information as widely as possible. It is difficult to educate those unaware of space issues because too often the discussion escalates to the SECRET level or higher just to identify a program by name.

TABLE OF CONTENTS

CHAPTER		PAGE
ABSTRACT		ii
PREFACE		iii
I	INTRODUCTION	1
II	SPACE POLICY	3
III	IMPLICATIONS OF TECHNOLOGY PROLIFERATION	5
	The Price of Success	5
	Foreign Space Potential	6
	Implications of Proliferation	7
	High Resolution Image Systems	8
	Commercial Communications	11
	Global Positioning System Control	12
IV	MAINTAINING CONTROL OF SPACE	14
	Space Warfare - Rules of Engagement	14
	Space Control	15
	Alternatives	18
V	CONCLUSIONS AND RECOMMENDATIONS	21
NOTES		23
BIBLIOGRAPHY		26

SPACE CONTROL: THE OPERATIONAL COMMANDER'S FUTURE DILEMMA

CHAPTER I

INTRODUCTION

Today the United States (US) enjoys a distinct advantage over most nations with its space systems capabilities (navigation, weather, surveillance, and communications). With the proliferation of technology and commercialization of space, the overpowering force multiplier capabilities and wide technology gap we have taken for granted are rapidly decreasing. As we move closer to a 'balance' in space forces' capabilities, can operational commanders 'control' the space forces of the potential or current threat? If they can, how will they do it, and if not, what are their alternatives?

Operational art has been part of 'traditional' warfighting areas (land and sea) for almost two centuries, and several decades for air.[1] Space, although in its mere infancy in the application to warfare, must quickly be recognized as another area where operational art will play a significant role in controlling that environment, much the same as controlling the sea. The parameters of this newest category are inherently difficult to pin down because it traditionally crosses all three levels of warfare, virtually simultaneously. Therefore, while specifically defining it in theoretical terms may be difficult, the practical application may be the biggest challenge for the operational commander.

This paper will take the reader through today's realities of space control efforts. Along the way, it will touch on space policy, implications of technology proliferation and end with the dilemma of space control for tomorrow's operational commander. The terms operational commander, regional commander-in-chief (CINC), and theater commander will be used interchangeably throughout his paper.

CHAPTER II

SPACE POLICY

The US' National and Department of Defense (DOD) space policies are dated. Even so, the National policy, last clearly spelled out in 1989,[1] *generally* reflects the direction of today's thinking.[2] DOD policy, although dated 1987, supports and amplifies the National policy. Some specific programs discussed in each of these policy statements are not in line with the most current guidance. This should not be a surprise. When you are dealing with an area as rapidly expanding, high-technology based as space, discussions of hardware designs, let alone operational or strategic use of such systems, can become outdated within a few months. Appropriate US government agencies must refocus their emphasis on this area to ensure a clear direction for the country in military space matters.

The current administration has not completely ignored the issues. Several recent decisions have impacted the use of space and space-based technology. Perhaps most significant, the resolution to support a "traditional" view of the Anti-Ballistic Missile (ABM) treaty approved in 1972. This reversed the "broad interpretation" made by the Reagan administration in 1985 that essentially justified the Strategic Defense Initiative (SDI). The Clinton decision in 1993 negated any development, testing, and deployment of sea, air, space or mobile land-based ABM and deployment of sea, air, space or mobile land-based ABM systems and components, regardless of technology used.[3] This created a distinct shift from Anti-Satellite (ASAT) or other strategic research [read SDI] to a focus on operational theater ABM capabilities.

Previously designated strategic assets, such as the Defense Support Program (DSP) satellites intended to detect Soviet nuclear missile launches, were effectively used against the Iraqi Scud missile threat during the Persian Gulf War. These systems continue to be developed for 'theater' defense, without White House objections.

The DOD policy defines four functions as broad objectives of space operations: Space Support-those missions required to deploy and maintain military space forces; Force Enhancement-support functions designed to improve effectiveness of terrestrial and space-based forces (i.e., ground support and satellites); Space Control-operations that ensure freedom of action in space for friendly forces while limiting or denying enemy freedom of action; and Force Application-the conduct of combat operations from space.[4] The first two functions are not under the theater commander's control (the CINC is typically a supported customer of these two functions). The fourth function has been negated by various treaties, in particular, the recent Clinton decision not to support SDI under the ABM treaty.

This leaves us with Space Control. Although not a traditional role for operational commanders, they now have a much larger part in this function than ever before. This will be explored in detail in chapter IV.

CHAPTER III

IMPLICATIONS OF TECHNOLOGY PROLIFERATION

<u>The Price of Success</u>. Many books, papers and articles have been dedicated to the successful contributions of space systems in the Gulf War. Some have called these 'decisive', perhaps as decisive as the contributions of air power. Suffice it to say, we [the US military] will likely never fight another war or conduct any future operations without the use of space-based systems. However, there is a danger in adopting this philosophy. That danger is in taking those systems for granted.

Soon we will expect the uninterrupted, uninhibited use of the Global Positioning System (GPS) for navigation to the target and guidance for our missiles, the same as we have taken for granted the daily weather and message traffic information transmitted by satellite. Space has become well integrated into everyday use for all services. In warfare, the dependence on space as a force multiplier has even more significance in these days of force drawdowns. Maintaining a technological edge over our adversaries has become one of our primary goals to counter the perception of a weakened US armed force. This was clearly stated in the 1993 'Bottom Up Review'.

Space-based capabilities offer advantages of: wide coverage, with the potential for detailed analysis; remote sensing/surveillance; and covert and 'continuous' presence. As our numbers in conventional forces drop, we will look to space more often. Space will need to fill the gaps in intelligence, improve our command and control interface, and more accurately navigate us and our weapons systems. Desert Storm was one of our best examples of these capabilities, although, the US success in the Gulf did not come without a price.

Many nations, including the Commonwealth of Independent States (CIS), took notice of the operational (and tactical) use of space by the US. The price of success for the US will result in increased emphasis on foreign nations' use and access to space in the next 10 to 15 years. The biggest challenge for the US will be how to control that use and access.

Foreign Space Potential. As previously mentioned, foreign interest in space systems has continued to grow. In addition to the US, France, China, Russia, Japan, and India have the largest space programs including launch platforms and satellites. These programs have not come cheap. Japan recently completed a successful launch of its H-2 rocket which cost $2.4 billion dollars to develop.[1] Yet the importance of this cannot be lost in impressive cost figures. Japan's goal was to remove their dependence on US space systems. This step completed a major step toward that goal. Other countries have also made a move away from US systems by using the European Space Agency's (ESA) relatively "inexpensive" *Ariane 4* and the CIS' *Proton* launch vehicles. France (covering 45% of ESA's costs in the partnership with Italy and Germany) and Russia are well ahead of most others in the commercialized launch market. The key appears their use of "low" technology launch platforms which downplay sophisticated engine designs (which the US tends to use) for rugged, reliable, and lower performance systems. The fact is, the US cannot compete using the Space Shuttle alone. Payload launch costs with the French and Russian systems have been maintained at a substantially lower level. This has allowed many countries access to space through non-US launch programs and incentive to develop launch capabilities of their own. One of those ways has been through increasing emphasis on ballistic missile development. China's space program remains an unknown. They have a modest but growing launch capability, however, it remains to be seen what nations they will extend their assistance. Others, including Canada, Germany, Israel, Italy, Pakistan, South Africa, South Korea, Spain and Taiwan are estimated to have the similar capabilities by the year 2000. Brazil and Argentina (and perhaps North Korea) would follow soon thereafter.[2] The list of countries will further increase with the proliferation of high-technology, and there is no reason to doubt the proliferation will continue.

<u>Implications of Proliferation</u>. Access to space will continue to grow with even less influence from US programs. There are three ways a country can gain access (presented in order of increased control and reduced foreign control): receive information or imagery from a second party's satellite; launch their own satellite on a second party's platform; or

launch their own satellite with their own vehicle. The US commercial launch market recognized this situation, yet still must depend on several older, expensive rocket systems such as the Titan IV. A trend toward smaller satellite payloads, strict satellite design limits, and improved reliability of launch vehicles may help the US regain some market share lost to the ESA and CIS programs. Additionally, the US recently decided to open its commercial markets to more customers eager for developing their own satellites, but lacking the resources for expensive research and development. Only a handful of countries (those identified by the State Department that support or encourage terrorism) will be restricted from advanced telecommunications and computer equipment.[3] Of course this is decreed as economic development and promises of more jobs for the US, but who will insure North Korea, Libya, Iran or Iraq does not also gain from this technology? With the commercialization of higher resolution satellite imagery[4], increasingly competitive communications systems[5], and a strong push for civilian control of GPS[6], the ability to control the access to these systems becomes more of a challenge for the US military in the event of an emerging conflict or direct aggression.

<u>High Resolution Image Systems</u>. Commercially, this began as a spinoff from the use of weather satellites. Once its usefulness was apparent, and image resolution increased, more interest was focused at looking through the atmosphere than just

at it. Image resolutions are typically expressed in dimensions (length or area) of an object required to determine its type. For conventional or digital camera-type systems the term is spatial. For example, a spatial image resolution of 15 meters means an object has to be at least 15 meters in length (conventional) or in area (digital) to be 'generally identified' as what type of object is depicted. Table I shows the capability at various spatial resolutions.

TABLE I

REQUIRED GROUND RESOLUTIONS FROM COMMERCIAL OBSERVATION SATELLITES
(in meters)

Target	Detection	General ID	Precise ID	Description	Technical Analysis
Bridges	6	4.5	1.5	1	0.3
Radar	3	1	0.3	0.15	0.015
Supply Dumps	1.5-3	0.6	0.3	0.03	0.03
Troop Units	6	2	1.2	0.3	0.15
Airfield Facilities	6	4.5	3	0.3	0.15
Rockets/Artillery	1	0.6	0.15	0.05	0.045
Aircraft	4.5	1.5	1	0.15	0.045
SSM/SAM Sites	3	1.5	0.6	0.3	0.045
Surface Ships	7.5-15	4.5	0.6	0.3	0.045
Vehicles	1.5	0.6	0.3	0.06	0.045
Minefields	3-9	6	1	0.03	0.09
Ports and Harbors	30	15	6	3	0.3
Railroad Yards	15-30	15	6	1.5	0.15
Roads	6-9	6	1.8	0.6	0.4
Urban Areas	60	30	3	3	0.75
Terrain	—	90	4.5	1.5	0.75

Detection: Location of a class of units, object, or activity of interest
General Identification: Determination of general target type
Precise Identification: Discrimination within target type of known types
Description: Size/dimension, configuration/layout, components construction, equipment count, etc.
Technical analysis: Detailed analysis of specific equipment

Source: Ann M. Florini, "The Opening Skies: Third-Party Imaging Satellites and U.S. Security," *International Security*, Fall 1988. 7

A second type of system uses the electromagnetic spectrum for imaging. Spectral systems (similar to the French SPOT (Systeme Probatoire d'Observation de la Terre), and the US Landsat satellites) use the various wavelengths of light (visible, infrared, etc.) to provide "multi-spectral" images and have been developed more for land study or geological analysis.[8]

Spatial systems are typically the choice for surveillance. However, SPOT and Landsat, easily accessible commercially, have also proved capable for surveillance use. Japan and Norway have demonstrated the ability to blend images from these two systems to gain knowledge of Soviet military bases on the Kola Peninsula.[9]

Previous standards (within the past three years) of commercial "high resolution" systems were thought to be 30 (Landsat), even down to 10 meters (SPOT). In late 1992, an upgrade for SPOT to five meters and talk of a two meter commercial Russian capability began to pressure the US imagery market. Concerns were raised by the Central Intelligence Agency (CIA) and Defense Intelligence Agency (DIA). Firms such as the Lockheed Missiles & Space Company began to tout the availability and inevitable demand for a one meter resolution Commercial Remote Sensor System (CRSS).[10] Debate in Congress heated up, pushing for release and sales of high resolution imagery. Once considered state-of-the-art, one meter resolution has rapidly become the industry standard. The French have also responded with the proposed introduction of *Helios*, a one meter capable system, set for launch in 1997-98. CIA deputy director, Admiral William Studeman, recently warned:

> ". . .Russia plans 'in the near future' to sell remote sensing data capable of resolving objects 0.75 meters across ...the intelligence community views 'widespread proliferation of global reconnaissance means' as a threat. 'Most nations' without such satellites are developing their own or making arrangements to buy imagery. . . .Two other vendors that could be troublesome: China and India."[11]

These developments, combined with the recent US policy decision to loosen satellite export controls, will do little to enhance military control of space.[12] More important, this tends to balance the scales in favor of potential enemy forces.

Commercial Communications. Largely from the outgrowth of cellular phone capabilities, several US and some foreign investors are teaming up to deliver, quite literally, a worldwide dial tone. Traditional communication systems consist of one to four satellites in orbit high above the earth (approximately 22,300 miles above the equator). These provide large coverage but demand high power output and consequently large receiving antennas, bulky ground stations and big expensive satellites. Systems such as *Iridium* from Motorola and Teledisc plan to use a 'fleet' of satellites (106 *for Iridium* and some 900 for Teledisc) which will span the globe in a low earth orbit of 440 to 480 miles. This means low power requirements, compact receiver stations (the size of a cellular phone) and small, less expensive satellites. By putting easily accessible, state-of-the-art technology in anyone's hands, and combine it with potential encryption capability, one needs little imagination to see the potential military applications for these systems. Seem too far-fetched? One does not have to remember very far back when a US soldier used a public telephone in Grenada to call back to his unit in North Carolina for Naval air support that was just off the Grenada coast. US Navy helicopter aircrews used off-the-shelf VHF radios to maintain contact with merchant ships navigating the Persian Gulf throughout Operation Earnest Will and Desert Storm. The point is, commercial systems can and have been used very effectively in military operations.

Global Positioning System Control. The military may lose control of GPS in the name of political relations. Europe, in particular, has put pressure on the US government, with equal pressure from the Federal Aviation Administration (FAA) on the DOD, to release GPS to civil control. The system is currently only certified for enroute navigation and non-precision terminal approaches. If the problems with precision landing capabilities can be resolved, strong indications point to GPS becoming the single, permanent worldwide commercial air traffic navigation system. International concerns of GPS interruption would undoubtedly have consequences on implementing DOD plans to override the system. GPS satellites send two navigational signals, one commercial and one military. DOD can degrade the satellites' signals by creating an artificial error called Selective Availability (SA) mode. Use of the SA mode requires each receiver to have a special computer chip and the correct cryptographic key code to accept the unaltered signals and read accurately. If GPS was degraded by the military, foreign weapon platforms may have already built-in the capability to switch to the Glonass (the Russian equivalent of GPS called Global Navigation Satellite System) or another foreign commercialized system for targeting or guidance. Additional solutions to the degraded signal problem may lie in civil aviation's own answer to increasing the current signal's accuracy - differential GPS. Using land-based stations to compare to satellite location signals, compute the error (differential) and correct it, FAA officials say they have reached accuracies down to ten feet.[13] This is five times better than the reported military accuracy of 16 meters. GPS and other similar systems come to us as a two edge sword. They provide capabilities which can be used as easily for lethal purposes (precision navigated missiles) as non-lethal (civil aviation). The worldwide demand for GPS receivers has quickly outstripped the supplies. The military must ensure all personnel have decoding capable systems. Iraq was unable to use GPS in the Gulf War, next time we may not be as fortunate.

CHAPTER IV

MAINTAINING 'CONTROL' OF SPACE

There is no question that the US has been well ahead of the rest of the world in almost all aspects of space operations. Our technological edge has kept us out front, for now. With the downsizing of the force, and the Cold War threat gone, why do we need to maintain a robust space force? Why indeed! The idea of 'controlling' space is certainly more applicable now than ever.

Space Warfare - Rules of Engagement. Various stipulations to how we can conduct space warfare, have primarily restricted us to earth-bound capabilities. The Outer Space Treaty (1967), ABM Treaty with the USSR (1972), and International Telecommunication Convention (1973) have regulated military use of space.[1] There is room for interpretation in these agreements, however, the 'door' has been closed, if by no other means than political pressure to deny the use of conventional military forces stationed in space.

So why the concern of maintaining our edge? Just as in any land, sea, or air battle, the concept of overwhelming force can apply in space warfare. Taking from Clausewitz; ". . . [overwhelming] superiority of numbers admittedly is the most important factor in the outcome of the engagement. . . ."[2] Putting that idea into today and tomorrow's terms means overwhelming technology, more so than numbers. Certainly this fits well within the concepts of recent US operational warfare doctrine, however, not within current thought of Congressional budget limits.

Space Control. Joint Publication (JP) 3-14, *Doctrine for Space Operations* (Draft), divides space control into three sections: Space Surveillance, Protection and Negation. Within each section are issues that certainly affect operational commanders, but only one of those (Negation) truly falls within the boundaries of their capacity to take action. Space Surveillance is strictly the domain of the US Space Command (SPACECOM). Their mission is to detect, track, identify and maintain orbital data on space objects to ensure safe passage to, in and through space. Currently they are tracking some 7,000 objects and about 300 of those are functioning satellites from various nations. Protection, as it is defined in JP 3-14, also falls within only SPACECOM's territory and is intended to provide for the survivability and endurability of friendly space assets. One counter argument to SPACECOM's monopoly of this area would be the CINCs' ability to protect certain ground segments of space systems. Primarily, though, this area deals with anything from providing current tracking data to launch programmers for a safe trajectory, to calculating the necessary adjustments to a satellite's orbiting altitude to prevent destruction.

Negation is the part of space control which not only requires SPACECOM's supportive role but *must* actively involve the operational commander. Two principles of negation - denial and limitation - are basic concepts from which the operational commander must build his offensive and defensive plans to control the opposition's space forces.

Denial would best be defined as the unequivocal disruption or complete prevention of an adversary's use and access for *all elements* of space forces. Limitation would be anything up to or equaling denial, but for *individual elements* of space forces. This is where the dilemma begins for operational control of space.

The restrictions to operational commanders in managing the control issues readily become apparent when you outline what they are up against. Earlier this paper provided a very small glimpse of military use of commercial systems which the next conflict may present when dealing with opposition space forces. The types of action the operational commanders are capable of carrying out against these will fall into four categories: Direct action - assault on ground facilities/use of ASAT; Indirect action - jamming of signals to or from the satellite source/data-flow interdiction; Deceptive action - decoys or misinformation during surveillance 'vulnerable' periods; and simultaneous action - a combination of all or some of the other actions.

For Direct action, the CINCs' overriding concern must be military readiness posture. Any preemptive, deliberate action taken in less than a wartime condition would quickly bring strong political repercussions and escalation to probable conflict. It would immediately be construed as an act of war. On the other hand, this must be weighed against the strategic and operational objectives, thus creating conditions which may necessitate the use of this type of action, prior to deployment of forces. Specifically, the attack on the ground nodes of space forces more than likely means entering the opposition's territory or possibly a collaborative belligerent's territory. The operational commander must coordinate this effort with strategic level concerns. ASAT was also listed as a direct action. Since the 'demise' of SDI, however, ASAT research has been drastically curtailed due to funding cuts or reallocation. Technology for such systems can be as 'simple' as direct accent missile attacks on mostly low earth orbit satellites (between 100 and 530 miles above sea level)[3] using conventional or nuclear warheads, to sophisticated laser or particle beam weapons to "fry" a satellite's components. With guidance under current US treaty interpretations and budgetary concerns, the progress of ASAT technology, and their use in any near future conflict, are expected to be minimal. ASAT capabilities of other nations are primarily restricted to the CIS.

Indirect action could also involve consequential reactions, but with far less risk. Once established in the theater, the process of jamming would potentially provide denial capability to the CINC. The use of this action provides more flexibility where, when and what operational commanders will target. They could operate much more independently of strategic restrictions. For example, they may choose to provide jamming for navigational satellite information, particularly if this will not impact other operations (assuming self-contained systems will provide sufficient temporary accuracy); Meanwhile, not interfering with the opposition's communication capabilities. Data-flow interdiction may involve Special Operation Forces interfering with deliveries of military useful data to a belligerent from a commercial source.

Deceptive action should be a continuous action, used effectively to counter as many systems as possible. Operational commanders must maintain the link between national and strategic intelligence sources and the tactical forces to gain the greatest advantage against even the most basic surveillance systems.

Simultaneous action requires a sharply higher level of coordination when dealing with any combination of the three previous actions. The coordination effort *must* lie with operational commanders. The capabilities unique to these CINCs (command and control links with tactical and strategic decision levels, 'on scene' perspective, and an experienced, working-level knowledge staff) shall guide the premise of operational application at all levels.

Alternatives. Control of all aspects of enemy space forces will become more difficult in the future with the proliferation of commercial systems and release of technology; 'Turning off' those systems completely will be highly unlikely. Jamming or direct assault on ground nodes will have little effect individually. Future commercialized systems with comparable anti-jam frequencies and portability of receiving stations to those of military systems, may render these actions completely inadequate.[4] Deceptive action could potentially be countered with improved resolution imaging systems. The alternatives for operational commanders to deal with these 'balances' in space forces may best rely on the concept of asymmetrical force actions. This concept requires one or more force applications (air, land, sea, space or special operations) against dissimilar targets. Historically this is the most lethal option when compared to symmetrical force actions.[5] Symmetrical actions (i.e., individual force application to a similar area), typically provided limited effectiveness. Two approaches counter to the asymmetrical action are offered, although both are outside the operational commander's direction. Minus any conventional ASAT capability, the destruction of an enemy satellite could possibly be done by deliberately sacrificing a lower priority friendly satellite (if there was such a thing). This would undoubtedly be extremely difficult and require precise calculations of orbits. The use of the Space Shuttle would reduce the difficulty (seizing an enemy satellite in orbit) however the risks of lethal 'reprisal actions' are substantially increased. Perhaps these are desperate approaches, but assuming wartime conditions exist, and they were reasonably possible, they should be attempted. The asymmetrical solution may best lie with use of conventional air attacks (Precision Guided Munitions (PGM) bombing and stand-off missiles) on command and control centers. Not very original, but effective. The challenges to the operational commander are not insurmountable today because the threat is limited. That will change.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Space control in today's world is much simpler than what can be expected in the very near future, and the future lies only a few years out. As the world watched the US dominate in space during the Gulf War, lessons were learned by nations that are 'space capable' today and those soon to follow.[1] The increasing flow of technology will continue. Access to commercial or military space systems will expand. The challenges for the operational commander to control enemy space forces will begin when what is now viewed as a strategic mission shifts to the theater level. The impact of space counter-surveillance on the commander's ability to operationally maneuver will dictate changes.[2] Those changes have started with words in doctrine. The emphasis now should be on practical solutions such as staffing CINCs with space knowledgeable people, and training exercises with space control problems. Future issues will need to deal with closely managing the assets we have, and facing the strong possibility of highly capable, commercialized systems with open access worldwide, out of our control. The operational commander that engages the next opponent may be faced with a level playing field in space. When current policy guidance continues to limit use of weapons in space (ASAT), operational commanders must use their overwhelming technology. When their technological edge is lost because of increased commercialization of the cosmos, they cannot plan for space as a force multiplier. At this point, conventional wisdom requires operational commanders to work under the assumption their enemies know as much (or more) about them as they know about their enemies. Certainly the entire solution will never reside with the operational commander. They will have to know who can give them the right answers for how much 'control' they have. This is their future dilemma.

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