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EXPLOITING THE NEW COMMERCIAL SPACE RACE

by

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Biography

Dr. Milton (Van) Blackwood is assigned to the Air War College, Air University, Maxwell AFB, AL. Prior to this assignment he was the Assistant to the Air Force Office of Scientific Research (AFOSR) Chief Scientist where he helped ensure that the highest technical content and quality of the Air Force's basic research program is maintained. Previously at AFOSR, he was the Chief of External Programs, where he oversaw research and educational programs for the United States Air Force and the Department of Defense valued in excess of \$150 million, and Chief of the Plans and Budget, where he managed the corporate-level planning and budget process for the entire Air Force basic research funding. Prior to joining AFOSR, he was employed by the Federation of American Scientists as a project director responsible for efforts that sought to mitigate the threat from chemical and biological weapons. He also held an American Association for the Advancement of Science (AAAS) Defense Science Policy Fellowship, where he worked within the Air Force Secretariat on science and technology related issues. Dr. Blackwood holds a Ph.D. (chemistry) from Princeton University and a B.S. (chemistry) from the University of North Carolina.

Abstract

The Commercial Space Launch Act (CSLA) of 1984 facilitated the involvement of private enterprise in US Government space and space technology activities, including space launch. In 1995, the Department of Defense (DoD) created the Evolved Expendable Launch Vehicle (EELV) program to obtain commercial launch services to ensure affordable space access for US national security satellites. The DoD's acquisition strategy anticipated a strong market for launching commercial satellites that would drive down cost for launching government satellites. The commercial market demand failed to materialize. Since 2006, a joint venture created between Lockheed Martin and Boeing, United Launch Alliance (ULA), has provided launches for the EELV on a sole-source basis. Recently the landscape of the commercial space launch industry is being changed by a new group of entrepreneurs motivated by broader interests other than only launching satellites. Despite national and DoD policies that support commercial competition for launching US satellites, the DoD has been cautious to fully embrace the commercial competition in the EELV program. The EELV now faces the possibility of having to move from one sole-source launch provider to another. This paper will examine how the US Government can attract a new generation of innovators to compete for launch service contracts and ensure that US space access is not dependent on foreign-made systems.

Introduction

The Commercial Space Launch Act (CSLA) of 1984 opened the way for the US private space sector to provide commercial launch vehicles to the US Government. President Reagan commented at the signing, “We expect that a healthy ELV (expendable launch vehicle) industry, as a complement to the Government’s space transportation system, will produce a stronger, more efficient launch capability for the United States that will contribute to continued American leadership in space.”¹ A manifestation of this vision was the creation of the Evolved Expendable Launch Vehicle (EELV) program in 1995 by the Department of Defense (DoD) to obtain commercial launch service to ensure affordable space access for US Government satellites. In 1998, the US Government selected Lockheed Martin and Boeing to provide launch vehicles to meet EELV program requirements. The DoD’s acquisition strategy relied on the strong commercial viability of both vehicles to lower unit costs. The anticipated commercial market demand failed to materialize. Pressure also existed from the US Government to reduce overhead costs which drove the merger of a number of defense contractors.² Ultimately, Lockheed Martin and Boeing would form a joint venture, United Launch Alliance (ULA), in 2006 to provide launch services for US Government and other commercial customers. Since then, the Air Force, who manages the EELV program, has procured launches from ULA on a sole-source basis.

The EELV program has demonstrated the viability of utilizing commercial launch capabilities to deliver US national security satellites to orbit but has also demonstrated the limitations associated with having only a single launch provider. The United States is currently reliant on Russian-made engines to deliver some payloads to space and the cost savings associated with commercial competition have not materialized. However, the landscape of the

commercial space launch industry is being changed by a new group of entrepreneurs motivated by broader interests other than only launching satellites. This change could help bring the competition envisioned by the CLSA of 1984.

Despite published policies and rhetoric to the contrary, the DoD and Air Force have been cautious to fully embrace the utilization of commercial launch service. The Air Force has had to balance the need for mission assurance with embracing commercial competition for space launch.³ However, by not fully encouraging commercial competition, the United States now must either continue to utilize Russian-made engines or move from one sole source launch provider to another until another source of US-made rockets materializes. By improving the certification process for new launch providers and utilizing truly competitive acquisition strategies, the US Government could help attract a new generation of innovators to compete for launch service contracts and ensure that US space access is not dependent on foreign-made systems.

Background

What makes a space launch a "commercial" activity needs to be defined. The US Government traditionally used contractors to develop, test, and procure space launch vehicles. Here a "commercial" activity is when a private sector entity puts its own capital at risk to provide launch capability to the US Government and/or to other private sector entities. This definition is meant to be consistent with the definition provided by the *2010 National Space Policy* which included as a principle encouraging and facilitating the growth of a US commercial space sector that supports US needs.⁴ The 2010 National Space Policy defined the term "commercial," as referring, "to space goods, services, or activities provided by private sector enterprises that bear a reasonable portion of the investment risk and responsibility for the

activity, operate in accordance with typical market-based incentives for controlling cost and optimizing return on investment, and have the legal capacity to offer these goods or services to existing or potential nongovernmental customers.”⁵

The *2013 National Space Transportation Policy* elaborated on the *2010 National Space Policy* by describing an overarching goal of this policy is for the United States to have assured space access, from suborbital to Earth’s orbit and deep space, in support of civil and national security missions. The policy states that to support this goal, the US Government will, “Promote and maintain a dynamic, healthy, and efficient domestic space transportation industrial base,” and “encourage and facilitate the US commercial space transportation industry to increase industry robustness and cost effectiveness, foster innovation-driven entrepreneurship and international competitiveness, and benefit the US economy.”⁶ Published DoD policies are consistent with these US Government policies.

The *DoD Joint Publication 3-14 Space Operations* recognizes that military needs cannot always be met with DoD space capabilities alone. The space support mission includes “spacelift” which is the capability to deliver satellites, payloads, and material into space supporting US military operations and/or national security objectives.⁷ *Joint Publication 3-14* explicitly addresses the advantages of utilizing commercial launch vehicles to augment DoD launch capability and recognizes the tie to higher US Government policy by stating that, “this aids the development of the US commercial space industry and supports the intent of the National Space Policy to leverage alternative space capabilities.”⁸ The Secretary of the Air Force had been designated as the DoD Executive Agent for Space. In October 2015, the Secretary of the Air Force position was re-designated as the Principal DoD Space Advisor.⁹ As the DoD Executive Agent for Space, the Secretary was seen as primarily a coordinator of DoD

space efforts. The goal of the re-designation was to enhance leadership of the DoD space enterprise by making the Secretary responsible for overseeing all DoD space matters and for serving as the primary space advisor to senior DoD officials.¹⁰ The DoD's commitment to encourage support for commercial space launch activities within the US private sector also is documented within official Air Force publications in *Air Force Instruction 10-1211 Space Launch Activities* and *AFSPC Instruction 10-1215 Support to FAA (Federal Aviation Administration)-Licensed Space Launch Activities*.^{11,12} The AFSPC Instruction explicitly states that AFSPC's, "support for commercial space launch will be on a basis compatible with accomplishment of DoD and other government agency missions," and that, "commercial space launch activities will be supported to the fullest extent possible IAW (in accordance with) established guidance."¹³

Viability of Commercial Launch Capabilities

Initially the EELV program awarded two contracts one for the Boeing's Delta 4 family of launchers and a second for the Lockheed Martin's Atlas 5.¹⁴ Lockheed's Atlas 5 rockets use a Russian-built RD-180 engine to power the first stage and an American-built RL10 to power its upper stage. The RD-180 was inexpensive by US standards and avoided the cost development of a new large American engine. Utilization of the RD-180 also allowed the United States to engage the Russian aerospace industrial base to support broader non-proliferation efforts.¹⁵ When the dot com bubble burst and the expected commercial payload market growth did not appear, ULA was formed in 2006 and continues to utilize the Delta 4 and Atlas 5 rockets.¹⁶ However, ULA is now faced with the problem that the political situation with Russia has affected US Government policy of the continued use of the RD-180 engine.¹⁷

The General Accounting Office (GAO) has reported significant cost overruns in the EELV programs.¹⁸ ULA has argued that these overruns are based on the EELV program budget baseline from 1998, eight years before ULA was created and that increases in the EELV budget incorrectly cited as overruns by the EELV program's detractors are due to increased numbers of launches and an extension in the period of performance.¹⁹ Determining the actual cost is difficult because the Air Force and ULA do not disclose EELV program costs on a per-rocket basis and a significant portion of the EELV budget is classified.²⁰ Also ULA receives two separate lines of funding: One for launch vehicles and related services and another for EELV launch capability funding to cover services not necessarily associated with a given launch. ULA's competitors have called the EELV launch capability a subsidy that is contrary to fair and open competition.²¹ A recent *Space News* editorial called for the US Government to forcefully split up the joint Boeing and Lockheed Martin venture citing among other things its failure to develop a domestic replacement for the Russian-made RD-180 engines.²²

The move to increased commercial space launch reliance has not been without success. The EELV program has executed 88 launches carrying global navigation and timing, missile warning, communications, weather, and intelligence spacecraft into orbit.²³ On October 2, 2015, ULA successfully launched its 100th mission which carried the Morelos-3 satellite for Mexico's Ministry of Communications and Transportation.

There are also indications of growth in the commercial market as the number of FAA licensed launches has grown over the last four years: 2011 (1), 2012 (5), 2013 (7), and 2014 (12), making 2014 the most active year since the late 1990s.²⁴ From 2011 to 2014 the estimated revenue for these launches increased from \$100 million to \$1,107 million.²⁵ The ULA launches for the EELV program are not included in these numbers. There were 12 ULA launches for the

EELV program and two ULA launches of commercial payloads in 2014, a record for the company.²⁶

The greatest excitement in the US commercial space sector has been the entrance of a number of celebrity-entrepreneurs who seek to disrupt the current market. These potential disrupters include:

- Filmmaker James Cameron-backed Planetary Resources which seeks to mine asteroids for precious metals
- Richard Branson's Virgin Galactic which started selling tickets around the same time for suborbital flights to the general public for only \$200,000
- Amazon founder Jeff Bezos' Blue Origin which is developing orbital launch vehicle.
- PayPal founder and Tesla Motors CEO Elon Musk's SpaceX which is developing space access technologies.
- Microsoft co-founder Paul Allen who is developing a rocket called Stratolaunch with Orbital ATK
- Google chairman Eric Schmidt and CEO Larry Page whose Planetary Resources company is developing asteroid mining technology

Among the upstart companies, SpaceX has emerged as the leading contender to traditional US commercial space companies. SpaceX was founded in 2002 by South African billionaire Elon Musk, with the ultimate goal of enabling people to live on other planets.²⁷

"We're either going to be on Earth forever until some extinction event claims us, or we're going to be a multi-planet species, out there exploring the stars," Musk said adding, "the evidence is pretty clear that breakthrough space flight technologies are not going to come from Boeing and Lockheed."²⁸

While SpaceX's ultimate goal may prove elusive, it has achieved a number of remarkable accomplishments since its founding. These accomplishments include; launching the first privately built, liquid-fueled rocket into orbit, winning a contract from NASA to resupply the ISS,²⁹ and being selected by NASA to provide crewed launch services to the ISS (Boeing was also awarded a contract).³⁰ In May 2015, the Air Force certified the SpaceX Falcon 9 launch system to compete for EELV program contracts.³¹ The Air Force has to certify all new launch systems that are used to deliver national security space satellites to orbit. This certification is to provide confidence that any satellite will safely achieve the intended orbit with full mission capability. Only ULA and SpaceX are certified for EELV program launches.

The emergence of SpaceX is having an impact on ULA which has vowed to become more agile and adapt to the new environment to cut cost and improve how it interacts with the government.³² ULA also intends to phase out the RD-180 engine in favor of an American-made rocket engine. In 2014, Blue Origin entered into an agreement with ULA to jointly fund development of the new BE-4 rocket engine by Blue Origin that will power the Vulcan next generation launch system. ³³The agreement supports a development process that will lead to full-scale testing in 2016 and first flight in 2019. ULA President and CEO Tory Bruno stated, "this agreement gets us closer to having an affordable, domestic and innovative engine that will help the Vulcan rocket exceed the capability of the Atlas 5 on its first flight and open brand new opportunities for the nation's use of space."³⁴ Aerojet Rocketdyne is also developing an American-made rocket engine that could serve as a replacement for the Russian-made RD-180 engines.³⁵ The engine is schedule to be ready for certification in 2019.³⁶

US Government's Reluctant Embrace of Commercial Competition

Secretary of the Air Force Deborah Lee James said at a Senate Armed Services Committee hearing on military space programs, “the competitive space environment, coupled with rapid changes in the landscape, present our national security launch capability with significant opportunities as well as challenges going forward,” adding, “no single organization should monopolize launch services and the good news is, for the first time in almost a decade, our nation has an opportunity very soon to compete launch services and leverage the commercial space launch market to drive down costs and improve our resiliency.”³⁷ Despite such comments and national policies supporting commercial competition, the EELV has been cautious to embrace this competition in reality.

Opening EELV Program to Commercial Competition

When the Air Force awarded an \$11B contract to ULA in 2013 for 36 rockets for military space missions over five years, SpaceX filed a lawsuit against the Air Force arguing the “bulk buy” arrangement kept the company from competing for the launches contracted through the EELV program. The deal was designed to save the military \$4 billion over what it had expected to spend buying rocket launches one at a time.³⁸ SpaceX believed its Falcon 9 rocket could slash the cost of launches, primarily for missions currently utilizing ULA’s Atlas 5 rockets. In March 2015, SpaceX and the Air Force reached a mediated settlement that ended the lawsuit. Specific terms of the settlement agreement were covered by a confidentiality order.³⁹

After the settlement was announced, a joint statement was issued stating, “the Air Force and SpaceX have reached agreement on a path forward for the Evolved Expendable Launch Vehicle (EELV) program that improves the competitive landscape and achieves mission assurance for national security space launches. Under the agreement, the Air Force will work collaboratively with SpaceX to complete the certification process in an efficient and expedient

manner,” and that, “going forward, the Air Force will conduct competitions consistent with the emergence of multiple certified providers.”⁴⁰

Certifying SpaceX to Participate in EELV Program Competitions

While the lawsuit regarding opening competition for EELV launches was still ongoing, SpaceX and the Air Force also struggled with the certification process for the SpaceX Falcon 9 rocket. The two entities had entered into a Cooperative Research and Development Agreement in June 2013 that described the certification requirements (the Air Force and SpaceX have declined to release this document).⁴¹ Despite pledges by the Air Force to complete the certification process by the end of 2014, the process had not been completed in March 2015.⁴² This delay prevented SpaceX from competing for a National Reconnaissance Office launch contract managed under the EELV program. This contract would ultimately be awarded to ULA on the existing block buy contract in November 2015.⁴³

This animosity in the relationship was revealed when Musk commented on the Air Force, “essentially we’re asking them to award a contract to a company where they are probably not going to get a job, against a company where their friends are,” adding. “so they’ve got to go against their friends, and their future retirement program. This is a difficult thing to expect.”⁴⁴ Secretary of the Air Force Deborah James responded that, “I think those are unfortunate remarks and I don’t agree with them.”⁴⁵

Secretary James appointed retired Gen. Larry D. Welch, a former chief of staff, to lead an independent review of the certification process. Her desire was to determine, “are there ways that we can streamline, speed it up, do things a little bit differently, but still, of course, protecting what we call mission assurance.”⁴⁶ The review panel headed by General Welch included Lt.

Gen. Ellen Pawlikowski, the Air Force's senior uniformed officer for acquisition, and Gwynne Shotwell, SpaceX President and Chief Operating Officer.

The report was released in March 2015, when SpaceX still had not received certification, and examines details why the certification had taken so long and how the process strained the relationship between the Air Force and SpaceX.⁴⁷ The report said that the Air Force was slow to embrace SpaceX's innovations stating, "there is a large gap between the perceptions of the partners," and, "there is also a lack of common understanding of some basic objectives and definitions embodied."⁴⁸ According to the report, the Air Force tried to dictate, "conditions to SpaceX in detail without a productive structure or process to resolve issues as they occur."⁴⁹ Ultimately, SpaceX essentially began giving the Air Force what it wanted, the report stated, "this can be the worst of all worlds, pressing the Falcon 9 commercially oriented approach into a comfortable government mold that eliminates or significantly reduces the expected benefits to the government of the commercial approach."⁵⁰

In May 2015, SpaceX finally received certification approval from the Air Force and the two appeared to have moved on from earlier disagreement. Musk called the certification, "an important step toward bringing competition to National Security Space launch" and, "we thank the Air Force for its confidence in us and look forward to serving it well." Secretary James said, "SpaceX's emergence as a viable commercial launch provider provides the opportunity to compete launch services for the first time in almost a decade," and that, "ultimately, leveraging of the commercial space market drives down cost to the American taxpayer and improves our military's resiliency." In the two-year certification process, the Air Force invested more than \$60 million and 150 people in the effort which involved 125 certification criteria, including more

than 2,800 discrete tasks, 3 certification flight demonstrations, verification of 160 payload interface requirements, 21 major subsystem reviews and 700 audits.⁵¹

Going From One Sole-Source Launch Provider to Another

The vulnerability of the US Government ability to launch payload for national security missions due to the lack of a robust national commercial launch enterprise was recently made clear. Russia's invasion and annexation of Crimea prompted the United States to impose sanctions on Russia and Congress voted to ban the use of Russian rocket engines for military satellite launches after 2019. The Russian engines that ULA utilizes are supplied by NPO Energomash, a Russian company that reportedly has close ties to Russian President Vladimir Putin.⁵² The fiscal year 2015 and 2016 National Defense Authorization Act (NDAA) provided some relief from this ban allowing ULA to use nine additional Russian engines during the transition to non-Russian propulsion systems. Current law also does not restrict the use of the Russian-made engines for commercial customers or NASA missions.

In September 2015, the Air Force released a final request for proposal for a Global Positioning System (GPS) 3 launch services to cover launch vehicle production, mission integration and launch operations for one of the military's next-generation GPS 3 navigation payloads.⁵³ The initial three GPS 3 launches, expected to begin in 2017, have already been assigned to ULA's Atlas 5 and Delta 4 rockets. The GPS mission was the first competitive procurement for a US national security launch in more than a decade and consistent with the earlier lawsuit settlement between the Air Force and SpaceX. The GPS 3 satellite launch is the first of nine that the Pentagon has selected for competitive bidding after relying on multiyear deals with ULA to deliver satellites to orbit.

The Pentagon rejected a plea from ULA in October 2015 to grant a waiver on the law banning the use of rocket engines for military satellite launches.⁵⁴ In November 2015, ULA pulled out of the competition leaving SpaceX as the sole bidder.

ULA spokeswoman Jessica Rye said, “under the restrictions imposed by the 2015 NDAA, ULA does not currently have any Atlas engines available to bid and therefore is unable to submit a timely proposal,”⁵⁵ The action of ULA has caused the competition to become wrapped up in discussions about larger national security issues and economic impacts.

The chairman of the Senate Armed Services Committee, Senator John McCain, R-Ariz., accused ULA of attempting to “manufacture a crisis” for military space launch.⁵⁶ Senator McCain wrote in a letter to Senate Appropriations Committee Chairman Thad Cochran, R-Miss, “recent attempts by the incumbent contractor to manufacture a crisis by prematurely diminishing its stockpile of engines purchased prior to the Russian invasion of Crimea should be viewed with skepticism and scrutinized heavily.”⁵⁷ McCain’s letter was in response to efforts by Sen. Richard Shelby, R-Ala and a member of the Appropriations Committee, to add language to the 2016 federal spending bill that would allow ULA to keep buying RD-180 engines from Russia. Alabama is the home of ULA rocket factory. SpaceX has argued ULA could order more RD-180 engines for commercial missions, and use the already-approved engines for the GPS 3 competition. Senator Shelby’s office indicated that the approved engines will be utilized in commercial missions that are “ready to go” and cannot wait the 18 months to three years required to obtain new Russian rocket engines.⁵⁸ Another option would have been for ULA to submit a proposal that would have utilized its Delta 4 rocket; however, ULA has indicated it cannot be competitive with SpaceX’s lower prices.⁵⁹

In December 2015, language was included in the 2016 government spending bill that allowed ULA to continue utilizing Russian-made rocket engines.⁶⁰ Not surprisingly, Senator McCain has introduced to prohibit the use of Russian-made rockets for launching US national security satellites.⁶¹ This decision will not affect the first GPS-3 launch competition as proposals were due 16 November 2015 but will affect future launch competitions. Depending on how the legislative battle resolves, the United States may find itself having moved from one sole-source of EELV launch services to another. Though the DoD has indicated it would consider a sole-source contract to keep both ULA and SpaceX in business.⁶²

Recommendations

The US Government finds itself in a challenging situation as it continues to depend on commercial launch providers for its national security satellites. The market for the launch of commercial satellites that was supposed to lead to increased competition and lower cost that the United States could take advantage of for launching national security satellites did not materialize. This situation led to the creation of ULA which has been providing sole launch services to the US Government since 2006 and relies on Russian-made engines for some of its launches. The good news is that a number of new commercial space companies have appeared. The challenges faced by SpaceX suggest that the US Government has not completely embraced true commercial competition. However, now it is important to look forward and determine how the US military can best utilize commercial launch capabilities given the landscape as it exist today.

Recommendation 1: Do not break up ULA. Despite any ULA shortcomings, breaking up ULA would introduce additional disarray in the national commercial launch market (ULA provides launches to commercial customers as well as the EELV program) and would likely destabilize

the larger commercial enterprise the United States wants to develop. ULA has successfully launched 100 commercial and national security satellites. ULA also has demonstrated a commitment to end its reliance on Russian-made rockets by developing the Vulcan next generation launch system with Blue Origin. Furthermore, ULA has recognized that it needs to adapt to the new commercial launch business environment.⁶³

Recommendation 2: Continue to procure EELV launches through competitive contracts that eliminate the EELV launch capability funding. Sole source contracts would not only likely lead to further lawsuits, they would stifle the very competition envisioned when the CSLA of 1984. After its settlement of the 2015 lawsuit with SpaceX, the Air Force stated that it is committed to conducting commercial competitions for providing national security space launches. SpaceX is unlikely to allow sole source awards to ULA to go unchallenged. The emergence of SpaceX has compelled ULA to make changes in its business practices and provides the competition needed to potentially drive down the costs of space launches. The EELV launch capability funding not only makes it more difficult to calculate actual per launch costs, it also is inconsistent with the US governments definition of “commercial” in the *2010 National Space Policy of the United States of America* which stipulates that the, “private sector enterprises that bear a reasonable portion of the investment risk and responsibility.”⁶⁴

Recommendation 3: Improve the certification process for new potential commercial launch providers of national security satellites. The study led by former Air Force Chief of Staff General Larry Welch highlighted the problems with the SpaceX Falcon 9 rocker certification. Improvements in processes will allow a quicker evaluation of the suitability of future systems to include the BE-4 rocket engine being developed by Blue Origin and ULA and the SpaceX Falcon Heavy launch vehicle. The Falcon Heavy would provide the heavy-lift capability that is

currently only provided to the DoD by the ULA Delta IV Heavy. In April 2015, SpaceX submitted paperwork to the Air Force to begin the certification process for this launch vehicle.⁶⁵

Recommendation 4: Commission an impartial study to examine the impacts of a ban on the future use of Russian-made engines for US national security satellite launches. SpaceX, ULA, and the US Government have too many vested interests to determine the best way forward regarding the future use of Russian-made engines. The DoD should commission a study by an independent panel of experts to determine if the ban truly affects the national security of the United States and make recommendations regarding the appropriate future actions by the US Government.

Conclusions

General John E. Hyten, commander of Air Force Space Command, stated at a hearing before the Senate Armed Service Committee in April 2015 that, “while our combatant and theater commanders have fully realized how fundamental space-based effects have become to every military operation in the world, our potential adversaries have been watching and working to challenge those very capabilities.” He added that, “we must be ready to respond to any threat, and we’re doing just that,” and, “with today’s national reliance on space capability, assured access has gone from important to imperative.”⁶⁶

This access in recent history has depended partially on utilizing Russian-made engines. Now it appears, at least for the near term, this access may depend largely on a relatively new company, SpaceX, which has never launched a national security satellite. This situation would make it easy to be disheartened about progress made toward the goals envisioned by the CSLA of 1984 in the 30 years since the act was signed into law by President Reagan. However, there is reason for optimism—a new group of commercial space companies has emerged in the United

States. While some of the business plans of these companies, such as space tourism and asteroid mining, may never develop, some of these companies to include SpaceX and Blue Origins are making an impact on traditional commercial space companies. By realistically and genuinely encouraging commercial competition, the US Government may begin finally to see the benefits of this competition.



Notes

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