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Good Morning. I would like to thank Mr. Hartmut Müller as chair of the conference program committee for asking me to address this audience today. Special thanks also to Professor Carsten Holze and DGLR for hosting this important conference, and to Dr. Heiner Heseler of the Bremen State Council -- my compliments to you sir on both such a beautiful city and leading center for aerospace in Europe. I always appreciate an opportunity to cross the Atlantic and share thoughts and ideas on the future, and of course it is always a pleasure to share a stage with esteemed colleagues such as Dr. Di Pippo and Professor Wörner.

I would like to take some time today to offer some perspectives on where NASA has been and how NASA fits into the world of space activity today. As we explore the topic of the moon and beyond, we do it against an outer space backdrop that over the first fifty years of the space age has continued to evolve. The ability to access and use space continues to expand at the same time as the reliance and dependency

upon space has become increasingly interwoven into our lives. As this past Friday night showed in Texas, the tragic outcome of Hurricane Ike would have been much greater without our ability to see and use information from space.

As Mr. Muller stated, I'm from NASA, and I work in support of the projects that will return us to the moon. It is very interesting to observe how the moon and the region around it have evolved since the first robotic precursors and voyages of astronauts there during the Apollo era. NASA was born in a very competitive environment, and we accomplished what had been considered by many to be the impossible – sending people to walk on the surface of the moon. International collaboration was not a big driver during the Apollo period. We did, though, get a snapshot of what international cooperation would look like, when Apollo commander Tom Stafford and Soyuz commander Aleksey Leonov shook hands after the successful Apollo-Soyuz docking in 1975. The Apollo voyages were transitory and the region between the moon and the Earth was relatively unexplored.

The moon has been relatively quiet since the end of the Apollo era. As is typical with frontiers, the regions closest to home were developed first. Very soon we will be celebrating the 10-year anniversary of the first element launch of the International Space Station. If I had been speaking to you 20 years ago, when NASA and its partners first agreed to develop this complex systems engineering project, I would have made statements about how the nature of what was happening in space *was changing* -- changing in the context of a sector dominated by government spending and near monopolistic utilization of space-based resources by government.

Today, however, we gather to talk about the moon and beyond in an environment where the relation of space to human affairs *has changed* in a number of significant ways.

One key example of this changed landscape is seen in government and commercial activity in space. For the first few decades of space activity, governments were the pioneers – governments invested in technology, pushed boundaries, and created infrastructure. But for those first few decades governments were also the main customer, if not the

only customer. But, as is almost always the case, the marketplace and the needs of the citizens of government have taken that infrastructure and run with it. Today, NASA is only a small piece of a growing economic pie of global space activity.

NASA's approximately $18 billion annual budget constitutes less than 10% of the world's total expenditures in space. Since 2003, the total revenue of the global satellite industry alone hit $91 billion, the consumption of satellite telecommunications is roughly $1 trillion, and the value of financial transactions conducted through space is incalculable. From Sputnik's lonely beep, we now have about 800 active satellites in orbit.

In the Apollo era there were two countries capable of independently transporting humans to low-Earth orbit, today there are three; and Europe's recent success with the ATV shows that there very well may be more on their way. More broadly, there are at least seven countries with the ability to launch something into space, and several more with the capacity to manufacture all or parts of the satellites above us in orbit right now. In 1972, the U.S. government launched two Saturn

V's, carrying a total of 96 metric tons of payload to the Moon. Note that one Saturn V could send 48 metric-tons to the Moon. Today, the international commercial sector alone launches the equivalent mass to geosynchronous orbit – and it should also be noted that with respect to the energy required, GEO is almost equivalent to getting something to lunar orbit.

I highlight all of this growth of activity in the near Earth orbits of space to provide a modern, cis-lunar background against which our new era's efforts to explore the moon and beyond will be built upon. So, now consider NASA's Constellation Program. Today, NASA once again has a mandate to reach beyond low-Earth orbit -- to stand on the moon and create an outpost there as part of an ongoing journey of exploration into the solar system. But we do not have a mandate to stand alone. In fact, it is just the opposite. The U.S. Space Exploration Policy and the NASA Authorization Act of 2005, which is U.S. law, directs us to work internationally in furtherance of space exploration goals. We already work with international partners on many science missions and interplanetary probes. We are now building on these ties

to share data and fly instruments on each others' spacecraft as a new era of exploration begins. These efforts complement our collaboration on the ISS. The ISS represents a collaborative effort that brings pieces together to form something greater than the sum of their parts. As humanity's first permanently occupied, off-planet outpost the ISS demonstrates what we *can do* together in space. Already over 160 men and women have traveled to the ISS, many remaining for long-duration stays. The ISS provides an analog outpost environment to gain experience living and working in a harsh environment, which will be essential to our ability to live at any follow-on human outpost on the moon or other body. Going to the moon and beyond, to be sustainable and relevant, must be done in a manner that takes into account these geo-strategic realities and the range of collaborations that now exist in space.

Consider this quote from my boss Mike Griffin, from some remarks he made recently to the French Parliament. In reflecting on both the European Space Policy document released last May by ESA and the European Commission, and the report by Senator Revol and the late Dr.

Christian Cabal published last February, Dr. Griffin said we see space as, quote, "a strategic environment that generates multiple advantages for our economy and our people. We see it as a means of promoting peaceful international cooperation. We see that space exploration in general, and human spaceflight in particular, energize and encourage our minds as does no other enterprise. We see that it inspires our children to study math, science and engineering so that they can be a part of this great endeavor." Happily, many nations share this view of space.

What's compelling to me about what Dr. Griffin is talking about here is this shared sense of the value of space – and a shared interest in its exploration and utilization. U.S. interests in space are not stand-alone interests. As I said, they are shared; but more than this they are in many ways interdependent with the interests of a community of nations. I've mentioned already the amount of physical mass that is being placed in orbit just by commercial communications satellite companies. That is the infrastructure of an interconnected world. The applications derived from that infrastructure increasingly blend with our other physical senses

and sensors to enable transactions, communications, management and commerce, shrinking the planet and opening up new opportunities.

That infrastructure, and how it is connected to all of our broader interests, has created the need for a dialogue on the effects of our use and movement into space. This dialogue is complex, and includes the need for coordination on the use of limited resources, such as GEO slots and communications spectrum, and the issue of space debris. This dialogue hinges on the notion that no longer can a single actor engage in space activities without considering the impacts of his actions on all others.

With NASA's Constellation Program, the depth and range of capabilities and interests in space will expand throughout all parts of cis-lunar space. In fact, as Kayuga and ChangE orbit the Moon, Chandrayan 1 is preparing for its October launch and LRO/LCROSS are also readying for their launch early next year. Many other activities and missions are being planned. In the coming years the infrastructure created at the Moon will enable new relationships between human spaceflight programs and scientific discovery, and enable new

commercial products while extending the ability of humans to live and work independently from the Earth – which will open up the ocean of space to future generations.

This notion of shared interests in and benefits from space exploration is at the heart of the direction Mike Griffin has given us for building international partnerships to explore beyond LEO. As we prepare the foundation of extending human presence throughout the solar system, we at NASA will not attempt to prescribe the manner of participation of any of our potential partners. NASA will continue to work with you to define an architecture for the exploration of the moon and other destinations that marshals our best resources and ensures open opportunities to all those interested in participating, based on how you define your interests and needs.

It was in this spirit of openness and collaboration that 14 international space agencies gathered together at NASA's invitation to share ideas and discuss mutual goals and objectives for the exploration of space. We worked hard for several months and produced the Global Exploration Strategy framework document, which articulates a set of

common themes and objectives, including scientific discovery, public outreach, and economic expansion. We followed up this framework document by standing up a coordination mechanism for space exploration – we call this the International Space Exploration Coordination Group, or, ISECG. I will talk about the ISECG in just a moment.

The Constellation Program is a key part of NASA's contribution to this overall architecture that will open the moon and beyond. We recently completed a mission concept review, which we called the Lunar Capability Concept Review, or LCCR. Coming out of the LCCR we have validated our design concept for the Ares V heavy lift launch vehicle and the Altair lunar lander. These systems will undergo a great deal more detailed design and development work over the next couple of years, so let me make sure the point is clear -- NASA is dedicated to the development of a transportation infrastructure to take humans and cargo to the moon and beyond.

The value of this transportation system will be limited if we do not find ways to enable its utilization by our partners. In a context where

there are global players capable of contributing multiple building blocks to an exploration architecture beyond LEO – some of those building blocks as redundancies, some of them as stand-alone capabilities – it is in the interests of everyone to leverage off each other. As an example, it is in the interest of the U.S. to share the Ares V, and its 71 metric-ton capability to trans-lunar injection and 187 metric-ton lift capability to LEO, as an asset for human exploration beyond LEO. I think it will be in the interests of other government space agencies to share their human and robotic exploration assets in collaboration with NASA. We are looking to develop specific commitments and partnerships as we move forward.

Figuring out how best to do this will be difficult. But, we have started down what I think is a fruitful path. For example, in May of this year NASA and ESA concluded a joint study we called a Comparative Architecture Assessment. We all know that ESA is quickly approaching its November ministerial, and in preparation for that Ministerial, ESA considered a variety of futures for its human spaceflight programs. It was our goal to determine, in a qualitative way at this early stage, how

or if our respective lunar architecture concepts could complement, augment, or enhance the exploration plans of the other. It was a useful first step and there were some valuable results; we are currently working together on the next step, and will be ready to work with ESA after the Ministerial.

In a broader sense, the ISECG is getting its feet under it, and we are learning about what our roles and responsibilities are. Even at this early stage though, we are doing good work. Here in Bremen, coincident with this important conference, a small group of ISECG members are participating in a workshop to identify standards for some critical hardware and software interfaces that will help ensure efficient and effective interoperability between systems developed for operation in cis-lunar space and beyond as part of this open and collaborative exploration. Building off of this important activity, I hope NASA and other ISECG participants can hold workshops to discuss potential multinational exploration scenarios to better understand each other's interests and capabilities.

Over the next two years NASA will be working toward another mission concept review – this one for the surface systems we hope to see operating at the moon after 2020. During that time, through our work with the ISECG, through workshops, and through bilateral studies, I am confident we can build on the foundation of a collaborative approach to the exploration of the moon created under the ISS program and our early successes in space exploration, setting our sights for further destinations, and sharing the benefits together, for all of our interests.

Thank you.