Remarks Prepared for Delivery
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Thank you, for that warm introduction. And, thank you, NASA for hosting this conference. There have been many conferences on aviation's future and the Next Generation Air Transportation System, or NextGen … yet, this week's session is especially vital. This conference brings together many people who are crucial to getting us to NextGen.

As researchers, what you do is extremely important. You are the ones who turn "what if" into reality. The research community — you — have helped aviation achieve unprecedented safety levels. Your work developing systems to reduce or mitigate human error — such as T-CAS … Terrain Awareness and Warning Systems … advanced flight management systems … and more — have made huge contributions to safety.

In addition to your work mitigating human error, NASA researchers have contributed immensely to our ability to identify upcoming risks and safety trends. I'm referring to the work you did with FAA and industry to develop ASIAS, the Aviation Safety Information and Analysis System. ASIAS brings together more aviation safety information than ever before. Yet, there is still research needed to develop and implement new data-mining tools to support the full ASIAS vision.

Your work is why millions of air travelers confidently board airline flights every day. It will be your work that will allow millions more to travel more safely and more efficiently in the future.

U.S. aviation needs your creativity … your vision … and your help.
We need it now.
That's what I want to talk about today — the future of aviation … and how you can help us get to that safer and more efficient future.
First, let's start at the beginning. Our "Journey to the Future" starts with today's NAS, which is a mix of old and new. The worldwide fleet of air carrier aircraft totals some 18,000 aircraft, which operate an average of 30 years. Some have glass cockpits. Others have steam gauges. The air traffic control system is a combination of technologies developed around World War II, such as radar and VHF omnidirectional Range navigation, or VOR, and modern technology, such as the global positioning system (GPS). Today's NAS relies upon more than a few "band-aids" and workarounds.
More important, today's NAS is woefully incapable of handling the two-to-three-times growth that is projected over the next 20 years. Yet … most important … today's system cannot handle the greater volume and complexity at our current level of safety and that is what we must have in the future.
Thanks to the work of the Joint Planning and Development Office, we know the

destination on our journey to the future.
Over the next 10-15 years, the Next Generation Air Transportation System will leverage aircraft capabilities by implementing performance-based navigation, surveillance, and communications. Moving to a performance-based system advances the key role the aircraft plays in integrating air/ground operations and establishing a solid foundation for the future.
With technology we know today … with research you have done to prove out Required Navigation Performance and ADS-B, for example… NextGen moves us more surely to an aircraft-centric National Airspace System (NAS).
Within a generation, we will be using technology in a more robust way with better navigation and landing capabilities … and thorough, accurate, and real-time knowledge of traffic conditions.
NextGen will be built on a far more comprehensive information network than anything we have ever seen … ensuring the right information gets to the right person at the right time, while keeping traffic running smoothly.
With precise performance-based navigation and internet-like access to critical information — including nearly real-time weather — pilots will make precision landings at airports that do not have control towers … or radar … or ground-based landing systems.
Within the next 10 years, Boeing 787s will fly a negotiated four-dimensional arrival procedure to airports such as San Francisco. Gulfstream 5s will land at airports like Teterboro using hybrid vision for an equivalent visual approach. And, many general aviation aircraft will have an instrument approach capability, with lateral and vertical guidance, to every runway.
That is the near-term future we see — a NextGen system that is safer, more reliable, more flexible, and will offer greater capacity to meet growing demand.
How do we get to that future? We will get there … one day … one step … and one decision at a time.
Every decision we make today must be made in the context of the future. For every decision we must ask — does this lead to the future we envision? How will this choice interact with other technologies and affect other decisions? What roles change? How can these changes be integrated into the NAS? Can we afford them?
No one said it would be easy.
Our journey to Next Gen will require attention to costs, but even more attention to consequences. At every decision point, we must know how the decision will affect every other part of the system. We must know how every change will affect safety.
Whatever we do … with advanced technology … with new equipment … with different procedures … we must take a systems approach and ask, “Will this make the system safer?”
Safety is the ultimate arbiter of success.
The JPDO — the aviation community’s “change agent” — is developing the strategic plan that identifies the actions across government and industry that will get us from “today” to the “future.”
What I have described thus far is the near-term future … where we are implementing available technology over the next 10 – 15 years to enable greater safety and additional capacity across the NAS.

Yet, NextGen is a journey … not an end point. We need your help to look 20 and more years ahead to explore … analyze … and prove out the technologies that will move us even more certainly to an aircraft-centric future.

To paraphrase the old Army recruiting slogan, for the future NAS to be all that it can be, it must be aircraft centric. Aircraft will be the focal point of where new technologies are developed … applied … and integrated across the NAS. In the future, aircraft will enable new information and communication strategies to be used that improve safety and efficiency.

I know we can do this … as researchers, you have proven many times that there is truth in what every football coach knows: "When the going gets tough, the tough get going."

When I think of the future … this is what it looks like. The future is a NAS characterized by widespread use of 4D operations and trajectories … by delegated separation … by super-density operations … and by net-enabled operations.

In the NAS of the future — aircraft … based on what we know today … will range from a five-pound unmanned aircraft to the 600-ton Airbus 380 … and from the well known, but rather slow, Piper Cub to the supersonic business jets that will be developed. Each of these … and aircraft designs still to come … must have the onboard capability to handle — and to handle safely — the task at hand anywhere … and in any weather … in the world.

How can you help us get to that safer, aircraft-centric future? What is your role?

NASA's role is what it has always been — pioneering — leading the way through foundational research. We need your expertise. We need your imaginations….

We also need the fruits of your current work under the Aviation Safety Program. Your work on advancing the integrated vehicle health management concepts and pursuing design practices that enhance aircraft durability will pave the way to safer and more reliable future products. Also your work addressing integrated, intelligent flight deck designs will enable better and safer future designs … designs which are able to recognize and address system failures and situations that we as humans aren't able to identify or respond to appropriately. These activities … all of them …are foundational to a safer future.

Now, lets think about that future NAS starting with the benefits from 4D operations … the benefits from adding "time" and adding the ability to precisely predict and follow established arrival and departure times within the system to our conventional 3D spatial parameters. Your research can determine what "information" is needed to enable these more precise operations.

We need to know how and where throughout the system this information is shared. How do 4D operations change the roles of pilots and air traffic managers? How can this capability be incorporated into advanced flight management systems compatible with today's — and tomorrow's — aircraft?

Research in this area will build upon NASA's good work. You have already played a significant role in developing automation tools to manage arrival and departure practices at busy airports … as well as your foundational work in conceptualizing how to manage air traffic differently, including 3D and 4D flight paths … looking at integrated traffic flow operations … and metering and spacing practices. Now it's time for the next step — with 4D operations.

Are you interested?

What about autonomous self separation?
After you've solved 4D operations … first with a single aircraft … and over time with more aircraft … then look beyond, to how that capability can be used to improve conventional operations to where we can be confident that aircraft can identify and react appropriately to surrounding aircraft.
Under autonomous self separation, aircraft would have additional capability to know when and how to resolve potential conflicts with other aircraft / by knowing the precise position of other aircraft. Much research is needed to delineate the systems that would have this capability and where this enhanced capability would be needed.
What are the human factors issues that must be addressed for those in the air and on the ground? What types of back-up systems are needed? What level of automation could be achieved?
Here's your opportunity to move a big idea from concept to reality.
Or, perhaps you would be interested in tackling the research challenge of super-density operations?
As we see it today, super-density operations would build on the capabilities of 4D operations and autonomous self separation. How do we ensure all players … all parts of the system … are aware in real time of this information and are making real time adjustments? It is all about eliminating uncertainty about aircraft positions and movements and being able to then take advantage of this to enable more operations.
Again, this is a great concept but what "information" would be needed to take full advantage of this potential? How would this information be used for better planning and decision making?
What additional technology is needed to ensure that in our effort accommodate additional traffic we don't compromise safety?
Each of the items that I have spoken about revolves around a potential for very different types of operations that are enabled by having available different types of information.
"Net-centric" recognizes the need for different information to be available in the future that can allow all of the system users to have immediate access to vital system information and to have confidence in the validity and the security of information they are using.
Real time and accurate information on how every aspect of the system is performing will allow greater efficiency across the system and hence additional capacity. A major component of the "information" we are talking about is real-time weather and greater confidence in our predictions of how the weather will change.
Just look at how fragile our current system is and the system's performance over this past summer. We need your research to identify practical ways this information can be acquired … analyzed … and shared across the system to enable greater efficiency.
In all this talk of more information … more capable systems … and aircraft-centric operations, we must realize that there will always be people within the system. All of the big changes we may make in the future will have profound human factors implications. The more we can do now to understand and address these issues will better enable this research to transition to reality.
We're not going to the moon. We're going to Minneapolis … Memphis … and Marysville. It may have been easier to put a man on the moon more than a generation ago.

Yet, getting to Marysville and Memphis is just as challenging because of all the people and planes that are going to Milwaukee and Miami … and more.

The sky is the limit — the opportunities are there because we have you … and your track record for ingenuity and problem solving. You can provide the key research so that we in aviation — which is so vital to our economy and to our way of life — can follow the advice of Peter Drucker, who said, "The best way to predict the future is to create it."

I look forward to working with you — as we create aviation's safer and more efficient future.

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