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Related to that, probably you have read the daunting challenge that I think we all share. If you look at the second bullet, one of the claims that we want to emphasize or we are making is that the science to ensure this greater capacity in safety and understanding how to achieve those objectives has really not been developed yet.

So this effort is going to require more than just connections of tools to evaluate technologies that may be in the horizon, but really how do we understand this thing called NextGen which is a collection of independently operating heterogeneous systems that have policy and technology and operational considerations as all part of their dynamics. So it is certainly a challenge.

We have been doing some efforts that, again, briefly I will just be able to talk about. Without that new analysis, systems analysis capability, we probably won't be able to ask the right questions, let alone even

coming up with some of the solution trajectories.

Again, the second point then, if that is the problem and challenge we have, in the short amount of time, I can't go into all this approach, but really the System of Systems concept, we have been trying to move beyond buzz words and actually develop a way to describe different types of these problems that involve interactions of heterogeneous systems that have their independent purpose, but also should work together in some environments or operational context for the greater purpose of the whole system. So this is the challenge of analyzing and understanding these interactions which are both dynamic, directional, uncertain, time-varying, all those challenges that go along, and we list the things that you know, of course, are constituents in the system from airplanes to airports, et cetera.

We have some related research going on with NASA.

So we just pointed out some of that, and I do want to highlight that there was a pilot study on the System of Systems approach that we were able to conduct about a year and a half or 2 years ago that really was extremely important, and very grateful at Purdue for that opportunity

to sort of pilot this approach using some quantitative methods to capture this kind of very complex problem.

I am sure I am getting close to my time. I haven't seen the 1-minute mark circle yet, but I am getting close.

I just wanted to give you a flavor. Of course, I can't talk about some of the actual tools and techniques we are developing here, but this is kind of the good news and the bad news chart. The good news is we have started to think about describing all of these components and the categories of resources, operations, economics, and policies that are relevant. The bad news, it should strike you as a very complex set of layered networks, which is actually what this is, and also, the dynamics in each of those four columns have to be understood if we are actually going to try to get at some of these emergent behaviors that we think may develop in the NextGen system. So that is really the point I want to make here is the scope has to include those four categories, and the layered network modeling I think is very crucial.

As I wind down, I have one more detailed chart of some stuff we have already been working on. This is an

example. It is a little picture actually that helps you more than the words. It is actually looking, for example, at an airport and how it actually persists in several different networks, and the dynamics in those networks have to be analyzed over time in all those categories, including, ultimately, multi-modal and ground transport issues.

Thank you very much.

DR. CAVOLOWSKY: Thank you.

[Applause.]

DR. CAVOLOWSKY: Next, we will hear from Pauline Froemberg from Raytheon.

**Raytheon, Airspace Management and**

**Homeland Security Business Area**

MS. FROEMBERG: Good afternoon. I will wait for my first slide, I guess. I will just tell you that I work on a program as a program manager on Advanced Programs in Raytheon's Airspace and Homeland Security Business Area.

I started this slide just to show you some of the programs, some of the programs in Raytheon's portfolio that relate to transportation, and it covers the radars and the airplanes and the airports, and you can't really see the

highway system, but it is up there in the left in a kind of grayed-out fashion. We cover all of those in our portfolio.

Raytheon has worked with both the JPDO and NASA on several programs. On the JPDO, we were an early participant and an active participant in the architecture design and in the IPTs. With NASA, we have worked on several of their programs. In fact, Raytheon has invested in some of NASA's programs. We have done it. We know what we need to do, and we would like to continue doing that.

This starts out with Raytheon is taking the "A" out of NGATS. It is not because we don't think the airports are important. The airports and the airspace is very important, but it is not the whole of NGATS or the whole of the transportation system. Raytheon is looking at it as a system of all the transportation systems that take into effect, with an emphasis on the airspace and the aviation, but with everything that is there. We look at all transportation as the solution in our system.

We feel that you need an integrated system. You need all the stakeholders. You need everybody there, and the solution needs everybody to participate. Then you need

NextGen as the center with all the various pieces fitting in.

The most difficult and the most critical is the future concepts, those that we don't know. Raytheon has integrated a number of systems, a number of systems with many components, but with unknown components, that is critical. So we need to know what those are going to be, so we can then specify how those are all going to fit into the system.

My final slide is your success, NASA, JPDO, and all of the Government agencies is our mission. We understand the critical issues and challenges that we are going to face. We have several core competencies, but it is not a Raytheon. We have worked with a number of you already. We have involved you in our teams, and we involve all our team members in collaboration. So, as part of our team, you will be doing a lot of interesting work. We look forward to working with you. We can make this vision a reality together. We must work it as a team, taking in the Government, the academia, all the businesses and industry, and all our stakeholders.

I look forward to meeting with you and working

with you. So please come and talk to me today as a way of building a team.

Thank you.

[Applause.]

DR. CAVOLOWSKY: Thank you, Pauline.

We will follow on next with Demoz Gebre from University of Minnesota. My apologies, I am afraid I have butchered that.

**University of Minnesota,**

**Department of Aerospace Engineering and Mechanics**

MR. GEBRE-EGZIABHER: Thanks for giving me the opportunity to talk here this afternoon. I am Demoz Gebre, and I am here with two of my colleagues, my department head, Gary Balas, and Yiyuan Zhao. We are keenly aware that 18 months is a short time span for a university's work. So what I want to do today is show you some of the things that we have done, some of the capabilities that we have that we think will fit into being able to contribute to working on this project and the time scales that are involved.

A little bit about us, the University of Minnesota, we are located in the Twin Cities. Our

department is within what is known as the Institute of Technology which, unlike other schools -- I guess it would be analogous to a college of engineering, but we have the hard sciences, math, chemistry, and those things also in the Institute of Technology.

Within that department, Aerospace Engineering, we are broken up into three groups: Aerospace Systems, Fluid Mechanics, and Solid Mechanics. What I am going to talk about today mostly is what the Aerospace Systems group does, and faculty members, about 300 undergrads, and 85 graduate students.

Some of the research that we have done and are doing right now, here is a sample of them, high-integrity aircraft navigation. Basically, what that involves is -- it is mostly my work there -- where we were looking at the next generation of navigation systems, GPS-based systems, and how do you design, look at the integrity, the safety aspect of them, so worked on things like WAAS, the Wide Area Augmentation System, and what you see here is some of the work we did for the Navy and for the Air Force having to do with the joint precision, approach, and landing systems, the next generation navigation and guidance system

that the military is looking to develop for aircraft operations.

Other stuff we worked on, there is some work on micro aerial vehicle control, looking at advanced ways of controlling them and operating them. Airborne networks, again, Yiyuan Zhao is here, he does work on that, and then advanced concepts and ways of looking at how you integrated unmanned aerial systems into the airspace, and in this case, we are looking at using these vehicles for inspection infrastructure, highway infrastructure and things like that, and what does it take to integrate them into the national airspace, what kind of technologies and what kind of things you have to think about.

So we do have, again, background experience in working on problems that are relevant to this project. Again, I am just listing them here as bullets, fault tolerant design, sensor integration navigation, high-integrity sensor fusion, and then the big part there, optimization of System of Systems, and that is the type of work that, again, Yiyuan Zhao, who is here today, does, and again, I think it is very relevant to what we are talking about here today.

We have had, again, just as an indicator that, again, we have worked on this, and we continue to work on this. We have had several projects, including stuff that has been funded by Government agencies, but we also have very close ties and we have worked very well with a lot of industrial partners. I am just listing two of them that have a pretty big and strong presence in the Twin Cities area that we work with closely, Honeywell and Lockheed Martin.

That is really all I have. Thank you very much for listening.

[Applause.]

DR. CAVOLOWSKY: Thank you.

Natasha Neogi from the University of Illinois will follow.

**University of Illinois**

MS. NEOGI: Hi. I am Natasha Neogi. My title slide looks a lot more bare than everyone else. Simply, I am representing a center-scale effort, which is a collaborative initiative between the Massachusetts Institute of Technology and the University of Illinois at Urbana-Champaign, along with several other industrial and

governmental partners dealing with developing a multi-scale, multi-objective engineered systems approach to looking at things like the next generation air transportation system, and I am going to just show a little bit of our capabilities in terms of the safety, security, and reliability portion of the work and the model techniques we are developing.

Of course, very controversially, we raised the idea of what does it mean to be safe and secure in terms of a next generation air transportation system, and so everyone has kind of seen this slide. One of the big things to keep in mind is all of these properties, safety and security, at least for sure are emergent properties as we know. So, thus, if we are giving a system or if we are giving a component in which we consider to be safe or secure -- and I am not even sure what metric you would use to define it -- composing it with another safe or secure system or even with an environment you have not characterized -- by environmental, I mean humans, operational procedures or operational concepts, or even new technologies which we don't have any historical data on -- it may not give you the results that you would probably

expect. So it is with a great deal of trepidation that you wish to apply old techniques or techniques perhaps that were used in the 1960's to validate or verify the national airspace system at the time in order to come up with these new metrics or declarations of safety, security, reliability for these new systems.

We all know that the reasons why we are looking forward is to deal with capacity, and of course, this is a problem with not only national, but international significance.

So current practices that we are looking at today have this caveat of being centralized, and of course, the air transportation system is extremely voice communication-based. These will probably change when we are ready to deal with capacity and conformance concerns. However, in the framework of safety, security, and reliability, often safety and security are competing in terms of whether or not you generate a protocol for the interaction of components which is extremely secure, but then this impedes your performance or does not allow you to come to safety guarantees.

What we are looking at or interested in

developing or have some experience in developing are frameworks which help to quantify tradeoffs between these two qualities. When I say quantify, I mean in a very broad sense. We cannot assign numbers like 10 to the minus 6 or 10 to the minus 9. We just look at one set of operational concepts and say, well, this is more safely or less safe than another set of concepts.

So this is in the context of these future trends which essentially deal with this partially distributed and collaborative environment that is going to encompass this next generation system, which will allow for heterogeneous or mixed equipage aircraft or vehicles to interact. So defining interfaces between components will help you be able to quantify any sorts of qualities you wish to assure, and something to keep in mind is there is a very incestuous relationship between cost and the rest of the qualities we want to assure, like environmental impact, reliability, et cetera.

We have got a pretty good movie here which essentially lets us talk about what are the verification and validation approaches we want to use. So, if you have an aircraft which is allowed to do adaptive altitude

management, perhaps to avoid weather effects, we all know weather effects account for about 60 percent of delays in today's system, how do we make sure the architecture in which this aircraft can live allows it to behave in a safe, secure environment and yet increase capacity. So we have to come up with different ways of having these vehicles interact and then perturbing them incrementally and seeing whether or not there are hazards or attacks or possible holes or levels of uncertainty that we have not quantified or identified yet. In that way, we can gain some idea of the adaptiveness or the resilience of the system with the operational procedures we are engineering for these extremely advanced vehicles and operational concepts to interact.

We also have to keep in mind we are dealing with human-centered automation. We cannot design and then hope for the user to learn. These are user-centric systems we are hoping to build, and as well, they are agile systems, which means they are extremely adaptive as well as being extremely reconfigurable. Obviously, we want to make sure the environmental impacts are minimized.

So, finally, to finish up from some preliminary

analysis that we have been looking at or doing, some of the issues we have seen raised in the building of these complicated systems that are different for air traffic control involve the fact that while security is everything, of course, but other people, of course, will disagree. However, if you take my point of view, there are a few extreme concerns, such as denial of service is not allowed, and of course, highly complex interactions cause accidents.

So we have to be very careful when quantifying safety and security in next generation air transportation systems.

Thank you.

[Applause.]

DR. CAVOLOWSKY: Thank you, Natasha.

Kevin Jordan from San Jose State University is up next.

**San Jose State University**

MR. JORDAN: Thank you.

San Jose State University has a longstanding collaboration in aerospace human factors research with the NASA Ames Research Center that involves university faculty, senior research staff, and graduate students in our Human Factors and Ergonomics Programs and Experimental Psychology

Program.

Our longstanding collaboration and our history of conducting far-term research on advanced concepts such as the Free Flight Initiative of the 1990's has prepared us to look out to 2025, we believe. It also allows us to address more near-term requirements of NextGen for emerging in spacing operations and continuous descent arrivals, the goal, of course, being to increase capacity while increasing safety and security and decreasing the environmental impact of air transportation.

We believe that some of our recent accomplishments point to our capabilities to conduct research and analysis in air transportation management concepts, and I list some of them here. I would like to step through them.

The first three are more research-based, and the final bullet is really a point of pride that we are here and participated in the JPDO-sponsored NextGen down on Capitol Hill for both the House and Senate.

First, Dr. Thomas Prevot of our staff has developed a Multi-Aircraft Control System. This is a JAVA-based program that emulates and simulates current and

future air traffic operations in the national airspace. It is a comprehensive environment for both large- and small-scale, real-time integrated air-ground simulations that allows for a rapid prototyping environment, and it also serves as a test bed for future ATM concepts and inclusion of a wide range of vehicles.

At the recent USA/Europe ATM R&D Conference in Barcelona, San Jose State staff had two presentations. My faculty colleague, Dr. Kevin Corker, along with Paul Lee and Tom Prevot of our staff presented their multi-sector planner research where they compared the multiple DSIDE [ph] controller with traditional controller teams, and we provided a sample result there that the multisector planner configuration produced reduced vectoring, brought it to the baseline configuration in the weather scenarios. This paper, I will brag for Dr. Corker, was named Best Paper of the Seminar.

Dr. Thomas Prevot of our staff also presented a paper at the conference in Barcelona in conjunction with several of his San Jose State colleagues and their NASA colleagues, E. Palmer and Nancy Smith, where they examined the [inaudible] concept involving arrival and emerging

spacing information during continuous descent approaches into a high-density environment. They looked at different levels of ground automation with or without airborne spacing, and as a sample result down in the lower right-hand corner, you see the airborne spacing reduced the mean and the variance of arrival spacing at the runway significantly, which, of course, has the potential to increase capacity.

The final research program I also want to present is work headed up by Vern Baptiste in San Jose State along with several San Jose State colleagues and Dr. Walt Johnson of NASA Ames that was presented at the 12th International ACI Conference in Beijing last month. The CSDS they have developed provides voltaic conflict detection and resolution capability. It can display aircraft state for the intent information. As you can see on the left-hand side, it has a manipulable 3D viewing angle, including the traditional top-down view, and it has a variety of other abilities such as integrating weather and terrain information and provides emerging and spacing tool.

A couple of sample results where the pilots using this display were able to meet their meter-fixed

restrictions while maintaining separation, and the pilots who participated in the work assigned particularly high ratings to the display range and path predictors.

To close, San Jose State University has been a long-term partner with NASA, conducting world-class research on advanced concepts in air transportation management. We have capabilities in systems engineering, computational modeling, human factors and cognitive science. Our recent accomplishments, we believe, demonstrate that we are capable of contributing to both near- and far-term NextGen milestones, and we hope to do just that.

Thank you very much.

[Applause.]

DR. CAVOLOWSKY: Next up from the FAA, Maryalice Locke is going to talk to us about the collaborative efforts from the teaming associated with the environmental working group.

**FAA, Office of Environment and Energy**

MS. LOCKE: As John mentioned, I am from the FAA, which makes me a little bit different from the rest of the panel because I am really representing the Government here

as opposed to a direct teaming partner.

I am from the Office of Environment and Energy, and my office also chairs the environmental working group of the JPDO. From that standpoint, we are here to help you all ensure that environmental protection is addressed in NextGen development.

Motivation behind our work on the environmental tools program is that, historically, the tools really focused on just a limited area. These are obviously complex interdependencies, but our historic tools just focused on noise or emissions and local air quality emissions. By focusing just on one subject area, you are really creating unintended consequences elsewhere.

So we recognized this, and we focused our efforts for the last several years, 5 years, on developing a tools suite that works interdependently. I must apologize in shortening this to five slides. I realized that the fourth bullet doesn't make a lot of sense, but from the fourth bullet up, we are talking about history. So the tool processes do not support recommended practices means the old tools don't support the recommended practices to look at things interdependently and to look at the economics.

That last bullet is really talking about the desired characteristics of our future tools suite which are currently developing. While they are built on existing capabilities, so we are building from the historical tools, we are building them to work together independently. We are very focused on having the tools suite internationally accepted. Our program is not meant to be exclusive, including all stakeholders, and not competitive. Our work is transparent. That is one of the key points that we have that we are not working with black-box systems, and we want our tools to represent a variety of viewpoints.

Another point that we wanted to make, because I am speaking for the FAA, I wanted to let all of you know that there are partners out there. We have a lot of participants in the development team, and these are just some of the logos of the various groups that are participating.

A key element of our effort is the Partnership for Air Transportation Noise and Emissions Reduction, and that is a consortium of universities. You will be hearing from one of them a little bit later. That would be Georgia Tech, but we have many universities involved in this, and

some of the key players are MIT, Georgia Tech, and the Volpe Transportation Systems Center.

This is a diagram of our tools suite effort, and for those who have seen different versions, it is slightly varied. It is supposed to be popping something else up, but it doesn't seem to be doing that at the moment. Basically, we refer to three main tools within the tools suite, the environmental design space which you will be hearing about in a few moments from our speaker from Georgia Tech, the aviation environmental design tool, which really addresses what the noise and emissions characteristics are, and the aviation environmental portfolio management tool. AEDT is the element where the lead group on that is the Volpe Transportation Systems Center, and the APMT element is primarily led by MIT, but there are many other people working on that effort. The APMT element addresses the economics both from partial equilibrium block, but also from impacts.

Then finally -- there is that button that popped up -- I wanted to just remind everybody that environment is a key constraint on the capacity to grow aviation's future, and FAA has made a commitment to use these tools. They

simply provide a framework for analysis.

So thank you very much.

[Applause.]

DR. CAVOLOWSKY: Thank you, Maryalice.

Steve Waslander from Stanford University will provide you a few comments now.

**Stanford University,**

**Department of Aeronautics and Astronautics**

MR. WASLANDER: Hi there. My name is Steve Waslander. I am a postdoc at Stanford University, and I am currently working under Professor Claire Tomlin. I have been with her for the last 5 years, and yes, it is official. She is moving to Berkeley. We are losing her from Stanford University.

So, just briefly, I am going to go over the work that we have been doing in the systems lab over the last while, and it falls into four main categories, many of which are very applicable to the concepts we are talking about today.

The first is optimization of air traffic flow. Here, we are looking at both the entire mass level as well as the sector and center-type control problems, trying to

manage air traffic control decision-making to manage the capacity restrictions in the airspace subject to weather disruptions and unknown disturbances.

The second area, real-time strategies for aircraft conflict resolutions, this looks very much at the individual aircraft and how we guarantee that safety can be ensured when there are conflicts on the horizon.

The next initiative control, critical aviation systems, this looks at sort of a hybrid systems modeling approach to cockpit displays and these sort of situations where you want to know what this set of possibilities are and whether or not those outcomes are actually safe and to avoid any situations that are undesirable.

Then finally, UAV design and tests, where we are developing various UAVs in order to be able to see how to operate those in the air traffic control system.

So I will go into three of these in a bit more detail. First off is air traffic flow control, which is the focus of a lot of my work. So here, we are looking at abstracting the airspace in such a way that we can still make useful decisions without running into the issue of computational complexity as the problem is varying very

quickly and is on a scale that is really hard to solve in real time.

The work that I have been looking at in this regard is to try to bring into the optimization process, the user perspective. So here, I was looking specifically at the airlines and how we get them involved in the optimization process for air traffic flow control, but this concept wants to be extended to all of these new types of users that we are discussing today. So this would be an area of excellent development for future work.

So the work here was involved in incorporating the specific costs of the individual airlines and looking at the theoretic considerations that might result if you have these individual users working in the system together, fighting over resources and that sort of thing, and how you manage those to ensure that you get the proper outcome.

The second area is the collision avoidance using regional sets. So this is the conflict resolution, and we have been working here for the concept of trying to guarantee safety in some sense. So we are using the notion of regional set where the evader knows exactly what the possible control inputs are, the boundary control inputs of

some pursuer, and we literally treat it as a game where one aircraft is attacking the other. So it is doing the worst possible at all points in time.

So we can define from this a set of states from which it is actually possible for that pursuer to enter the conflict region of the evader. So we know if we define those states as unsafe and know that for any of the states outside that region, there remains a control decision that can be taken by the evader that will guarantee safety, and so this can be seen as sort of a last-resort type of control situation.

This algorithm has been implemented already on the Dragonfly UAVs, which [inaudible] and were able to avoid collision with one of the UAVs blundering in the path of the other, and it was also demonstrated on an F-15 and a T-33 using [inaudible] Boeing [inaudible] demonstration where the T-33 was running [inaudible] off the same software on the laptop, literally sitting in the cockpit and manage to again avoid the errant maneuver by the F-15.

Finally, I would like to describe our most recent test bed, and this is a multi-vehicle test bed where we are now looking at focusing on interactions with more than just

two vehicles. So we have these, the Starmac Quad, we call them, and they are now flying autonomously. We have built six of them. It is our second design iteration. They weigh less than 2.6 kilos, but have enough computational capacity on board to fly fully autonomously and to plan in real time for collision avoidance, and that is exactly what is going on this summer. So we are hoping to have four more of these vehicles flying autonomously working together to avoid collisions, and in the worst case, avoiding each other if they have to without interaction.

So thank you very much.

[Applause.]

DR. CAVOLOWSKY: Thank you, Steven.

Next, Fred Wieland from Sensis Corp.

**Sensis Corporation**

MR. WIELAND: So, John, I have been dying to ask this question all day. Who is this young lady who keeps showing up here?

DR. CAVOLOWSKY: My daughter would be mortified if she knew that her desktop has been broadcast here.

[Laughter.]

MR. WIELAND: I was wondering if she had the

inside track on me as --

DR. CAVOLOWSKY: No. It is just my girl.

MR. WIELAND: My name is Fred Wieland. I am representing Sensis Corporation. I want to thank the NASA leadership here for allowing us to speak. Greg Carr is also here from Sensis out in California. Greg is in the back left there.

So Sensis Corporation basically has a variety of different analysis and modeling tools that we use to analyze mass. One of them is called ACES. It has been talked about earlier today. Sensis Corporation is the primary technology integrator for ACES. That means we have on our staff, people capable of configuring ACES, running ACES, changing the internal algorithms of ACES in case something needs to be changed for the future of the mass, but it is a NASA-owned model. It is a model that is owned by NASA.

The rest of these models that are up here are basically Sensis proprietary models. Av Demand allows us to generate future flight schedules and flight plans, and that includes future flight schedules for different types of aircraft, for different aviation business models, like

point to point or hub and spoke or SATS-type business models.

Av Terminal, which allows us to model in detail the terminal area, this is an area that ACES doesn't model too well in detail. So we filled it in with that terminal, and Av Analyst is a tool that allows us to analyze the output of ACES. So we have a bunch of tools and a bunch of analysts that basically can use and run this ACES product.

Now, let me talk about ACES really quick. ACES is a physics-based model of the national airspace system. That means it is not a queuing model. It is a physics-based model. It has a full degree of freedom flight trajectory model in it. We have run it successfully with over 100,000 flights, 2X and 3X type of mass, and it has embedded in it, both flow control algorithms and air traffic control algorithms that replicate pretty faithfully the way the system operates today. We can reconfigure these to represent a future configuration of the system as well.

Internally, it is structured as an agent-based simulation. It has got thousands of agents or hundreds of thousands of agents because each flight is an agent, and we

model the flight from gate to gate basically. So we are modeling the whole path of the flight.

Now, this is one of the projects that we have been doing in advanced vehicles. This is for NASA Ames. We are looking at extremely short takeoff and landing vehicles. This is a vehicle that can take off and land on the runway. It is only 2,000 feet long, carries 120 passengers, flies cruise and Mach.8 and has a range of about 2,000 nautical miles.

Such an aircraft can use Runway 11 at Newark. This is Newark Airport here. So this runway is virtually unused today by the major carriers. So we basically used out Av Demand and other tools to model the terminal airspace. The arrival and departure routes change with such a vehicle type, as well as the [inaudible], the trajectory in and out of the airport, and the trajectory parameters of such an aircraft also change. So we have used our models to model all the different parameters of such an aircraft to look at its impact at Newark and also using ACES to look at its impact system-wide. So we have some experience in these new terminal types.

This is an excerpt from a presentation that I

gave in Barcelona, Spain, about a month ago at the ATM conference in which we used basically ACES. I work under contract at the JPDO. We used ACES to analyze the performance of NextGen. So we are actually able to configure ACES to look at what we call the Segment 3, which is an intermediate state, and Segment 7, which is the final state of NextGen, and we looked at that not only in good weather, which is what most analysts do in benefit analysis, but also in several configurations of bad weather. In the bad weather, we looked at bad weather, convective weather, not just at airports, but also in the enroute airspace. In the enroute airspace, we did a relatively novel technique. We basically used time-varying sector capacities in the end route airspace to model the movement of fronts through the airspace. In order to do that, we had to change the internal algorithms of ACES. NASA has asked us for that change. So we are wrapping it up and packaging it up and giving it to NASA.

So that is all really I have to say. To summarize, we are the primary technical integrators of ACES. So we have a lot of experience using that model. We have used it to look at new vehicle types, and we are fully

integrated in the JPDO NextGen Performance Analysis Environment at JPDO.

Thank you.

[Applause.]

DR. CAVOLOWSKY: Thank you, Fred.

Wrapping up our list of speakers this afternoon, Michelle Kirby from Georgia Tech.

**Georgia Institute of Technology,**

**School of Aerospace Engineering**

MS. KIRBY: What is better, going first or last in the day? Wake up, more coffee.

I am Michelle Kirby. I am a research engineer at Georgia Tech. I work with Professor Demetris Mavris, who could not be here today. Dr. Peter Hollingsworth is also with me.

I wanted to show to you today a few of the capabilities that we have internal to our lab. Our lab is the Aerospace Systems Design Lab. We have been around for about 15 years now. We have got 30 research staff on full time. We have got 150 to 175 graduate students on a yearly basis and about 50 undergrads usually that we bring in to filter through. So we are a pretty large organization. We

kind of call ourselves the "Rapid Deployment Force." So, when I saw 18 months, I got very excited.

The hierarchy of our research at our lab is really kind of tiered towards the system at NASA. We work collaboratively with a number of industry partners. This is one we have matured different processes and methods that we developed usually from our Ph.D. students on the very basic level. Typical funding is coming from Air Force or NASA, FAA, and Office of Naval Research. We transition that methods through a different proof of concepts, and once we [inaudible] it enough, then it is prime time, ready to handle for industry partners.

The number of research areas that we are involved with is extremely diverse. You have got a large organization. You need to be diverse as various funding waves come in and out.

We have really focused a lot of effort on developing and advancing techniques and start doing risk analysis. We are looking at design space exploration for both vehicle concepts, torpedoes, ships, whatever, you name it. System of Systems, both from a commercial and a military aspect, robust design in terms of looking at how

your system can respond to various uncertainties, and really, probably one of our key efforts was being able to looking at infusing technologies, technology assessments, looking at vehicle concepts and vehicle designs.

As Maryalice mentioned, we are also the key developer for the environmental design space, which is just one of the tools of the FAA tools suite. The work there really built off of all the technology work and technology assessments that we had done for NASA over the past 7, 8 years. We took all the NASA tools that had been developed at its different centers, and we have linked them together and enhanced them in a capability such that we can do various technology concepts, advanced concepts.

We have been going through a rigorous process with international community on the acceptance of EDS within the policy-making decision-making. We are getting a lot of good feedback on enhancements and feedback capability for the NASA tools sets, but it is a mature environment that we are using to address different types of technologies and concepts of the future.

One specific effort that we are working that actually Dr. Alonso alluded to earlier was an analysis of

the fundamental aero technologies and how that affects different concepts and propagates into the airspace.

We have teamed up with Sensis, and Sensis just described all the tools that we are using of theirs. We are also working with the Air Transportation Laboratory at the Georgia Tech Research Institute, MIT, Boeing, and IOTA [ph]. Effectively, what we are looking at here is what are technologies on the vehicle and the different types of advanced concepts in terms of supersonic platforms, very light jets, and the like, and how is that going to affect performance, environmental impact in and around the community and also on a global scale.

We are hoping this will end up on a 2-year study.

It is leveraging a lot of work that we have already done over many years and bringing in the appropriate people.

In hearing what I have heard today, I think this could be a good starting point as a jump forward for the study.

So, with that, thank you.

[Applause.]

DR. CAVOLOWSKY: One final round of applause for all of our speakers. Thank you very much.

[Applause.]

### **Next Steps**

DR. CAVOLOWSKY: Apparently, I was a bit more intimidating than I thought when I gave them the riot acts of five slides and five minutes. We finished a little bit earlier than I had thought, but thank you again for the fairness to holding to the restrictions that I had placed upon you.

What I want to do at this point, we are about to head to our final Q&A, and I am hoping there are some more things in some of the presentations, over the discussions in the hall and break, but I would like to go to actually the next steps. Some of the questions that we were addressing earlier in the process actually hit upon the last slide that I want to put up. So, before we get into Q&A, let me put this up. I will talk that one last slide, and then we will open the floor.

As mentioned, the way that we manage the solicitations is through the NSPIRES process. We give you as much information as we can on the way to access and to register there through our NASA website, again, which you have seen multiple times now, but I need to encourage you

early in this process just to register. You will get all the information you want in terms of the specifics of this NRA and as a way to stay on top of things and a way to be able to respond to our proposal.

In NSPIRES, you will find that the ROA NRA 2007, again, which stands for Research Opportunities in Aeronautics and the NASA Research Announcement, is going to be referenced by this particular number, and what you are going to find is that this topic will shortly be an amendment in our NRA 2007. It will be captured in the appendix.

Frankly, right now, you can get in and read. We have material which explains and puts all of our NRAs in context, as well as seeing other NRAs, other opportunities that you may not have otherwise have been aware of. So, please, we encourage you to register and go to our NRA.

The schedule, I outlined this briefly, but let me point it out now in black and white. The release of the NRA is pending in the next several weeks. Sometimes we hear it takes long for you, NASA, to get these NRAs out, but frankly, we want to make sure we get it right. The whole purpose of this conference is to make sure we get

this right.

So, as Karlin pointed out on one of her last slides, we are looking at last August, early September. It will be as soon as we can do it right, but expect it in that time frame. Please check the website on a regular basis over the next few weeks to make sure you don't miss this time frame.

The street time for the NRA is going to be approximately 45 days after the release of the NRA, and there are always vagaries on exactly how long it is, but then that is our anticipation of minimum time. So the proposal will be due in early to mid October time frame, allowing ourselves proper review and evaluation period for that, and actual selection, we will put the selection date in the November or early December time frame, and then obviously allowing enough time to do the proper negotiations and making the award, we anticipate the early part of 2008, January, February, as when we are going to be doing this.

So that, hopefully, should set the time frame for you, the expectations, and response period in which you have.

As stated earlier up front, this entire process, this conference hoping to make that entire effort more efficient. It is better from our perspective. We have better confidence that we are going to get what we want from you, and also for your purposes, you have at least a cognizant head start on what we need, what our requirements are, and can respond sufficiently.

**Question and Answer Session Follow-up**

DR. CAVOLOWSKY: Let me open the floor again to any questions that may be residual. The doors are locked for the next hour.

[Laughter.]

DR. CAVOLOWSKY: Again, we are committed to making sure that any questions that you have will be posted and shared as Frequently Asked Questions as part of our website management of this, although you have an opportunity right now to share that with the community and to get some response from us.

MS. KIRBY: John, just to be clear, the information and the release of the NRA will be on NSPIRES, but DVD with request for materials from this will be on the Aeronautics website. Correct?

DR. CAVOLOWSKY: That is correct.

As I mentioned in one of those earlier slides, we are going to be taking a few days, a little time as we can, to gather all this information and have it burned on a DVD, and within a day or two, there will be a request process that you will see on the website. I encourage you to get on that. If you do want to have copies of all of this material, ask through the website process that we will set up in the next couple of days, and we will be happy to get it out to you.

We appreciate this information certainly from the context of these proposal time frames has a short shelf life. So we are going to do this as quickly as we can, so that you have access to it, but you have to ask.

PARTICIPANT (Ella Atkins): I feel like a plant here -- not really.

There were a certain group of people that due to late registration and so forth didn't get to give 5-minute presentations. Would it be possible for people to send slides, so that they can be included on this website along with the people that did have time to talk?

DR. CAVOLOWSKY: Managing a Federal website is

always a challenge with respect to access to everyone. Part of the reason we are going -- I don't think it will be possible, only because of the 508 compliance concerns. We need to be respectful of that. So I am afraid that is going to be too awkward, but thank you.

PARTICIPANT: Chris Wargo, Computer Networks and Software.

Oftentimes on acquisitions, they have interested parties lists on the website or people that have announced themselves to be prime, so you know who to go look for. Is that going to be possible?

DR. CAVOLOWSKY: What we are doing is making available every registrant that didn't request their information not be released be provided. So everyone that is here and is registered is available to you by name and contact info. Is that what you are asking?

PARTICIPANT: You have mechanisms of ways of people announcing that they really are a prime? Because some of the time is short here, although, yes, there is still 45 days between now and when you release. I was just asking. Thank you.

DR. CAVOLOWSKY: I am not sure I understand.

DR. PORTER: You are looking for beyond who attended here? Is that the question?

PARTICIPANT: I am trying to assist the teaming process. If certain individual companies want to list themselves as potential prime bidders, then the smaller ones will know where to go. The list becomes finite instead of 200 sort of.

DR. PORTER: Right. The challenges on the Government side, while we encourage teaming, we have to certainly be careful not to appear that we are forcing it or providing an advantage to one company -- Do you see what I am saying? -- or another.

So, for example, here today, everybody who registered, we can easily provide that information of who is here with their names and contacts, but there is a caution that we have to take as a Government not to appear to be forcing certain relationships.

I don't know if Gene -- our procurement officer is here, and he can probably comment on that. I don't want to misspeak.

Thanks, Gene.

MR. JOHNSON: Actually, I do understand the

question, but I think the gentleman probably would benefit from the fact that for this particular procurement, we have to understand that the NRA is already out there. It is on NSPIRES. This is not going to be a separate solicitation where we have a list of bidders and a list of companies that are going to be interested and they are brand new to the process.

What we are going to do, as John said, is that we are going to list the people who showed up here, and the way that the teaming is going to work out, it is going to be worked out amongst those folks who want to get together.

They will figure out their own arrangements, but we will make at least a list of those companies available and the people who showed up. I think that is the key.

Did that answer your question?

PARTICIPANT: Yes.

DR. PORTER: Thanks, Gene.

DR. CAVOLOWSKY: Thanks, Gene.

PARTICIPANT: Hi. Ed Stevens from Raytheon. I just wanted to announce, we are interested in priming.

[Laughter.]

PARTICIPANT: So if people want to send us

materials they did not get, we would be very interested. Ed Stevens. You have my e-mail. Pauline Froemberg and Danielle Finkelstein [ph] are here today.

DR. PORTER: Earlier today, I made the point which is completely another avenue for you, and again, it doesn't identify primes and non-primes, but we do list all of our current NRA awardees on our website.

So, for example, I think here today, we have a little bit more on the ATM side than we do perhaps on the advanced vehicle concepts side, but we do have on our website a list of all the folks who are currently being funded under Juan's program and Herb's program and Karlin's program. So you can get a sense at least of who is out there and who is doing what by the titles of their awards and where they are at. So, again, if you are looking for a way to complement a potential team with a little bit more on the vehicle side, the safety side, I recommend you at least look there to get ideas. So that is certainly available to everybody as well.

PARTICIPANT: Greg Carr, Sensis.

This is more a technical question or process question on solicitation. We are assuming the ConOps from

JPDO is the starting point that we are looking at as a baseline to assess or do trade studies against. Is there a plan or a process or something in place, or is it safe to assume that you would want some of the outcomes of the research to feedback into the JPDO ConOps? Do you anticipate modifying the ConOps, or is it frozen?

DR. TONER: As Bob described to you earlier today, the ConOps is a description of what NextGen is going to look like. It doesn't tell you exactly how it is going to operate. So, from my point of view, it is open to some interpretation.

Now, all of NASA's research for NextGen really does feedback up to JPDO. We really do want that to transfer. So, yes, it will go back to JPDO. Yes, it will help inform the ConOps as well as help to inform our own research portfolio.

DR. PORTER: This is a wonderful psychology experiment. We will just keep waiting.

[Laughter.]

PARTICIPANT: I am Sheila Conway from Boeing.

We talked a lot about safety, and one of the things that has become very clear to me from a Boeing

perspective is the concept of certification. So one of the things -- this is more of a comment than a question, really -- is while you are looking at trade space between different opportunities in NextGen, we need to consider certifiability of any of these systems that we are talking about as well. Maybe you have some comments to that.

Thanks.

DR. PORTER: Herb, do you want to take that?

MR. SCHLICKENMAIER: Noted. Thank you.

DR. PORTER: John really doesn't have the doors locked, but --

[Laughter.]

DR. PORTER: In all seriousness, we have had some good discussion. Is this experiment in quietness indicative of we are done for today?

John, would you do me a favor, just in case anybody was sleeping, put up your POC information one more time, your e-mail address, just so people know?

DR. CAVOLOWSKY: That is one of the last slides. I call it the last slide.

DR. PORTER: Yes. I just want to make sure everybody knows, this is the person.

DR. CAVOLOWSKY: While this is coming up, Gene reminded me of a good point that the e-mail address that is listed under my name is an e-mail address that you can use to get the information about any NRA. We use that as a way to take in our information on this. So you can come to me, and I will respond to questions and things that come through on this regarding this particular NRA, but you can also use this to get to any question you have on any of the NRAs associated with the ROA 2007 for NASA. So I am just making that clear. I will get it, and I will get back to you as quickly as possible.

DR. TONER: Before we close, I want to take just a minute to thank the Mission Support staff who have really helped us put on this event today.

[Applause.]

DR. CAVOLOWSKY: Thank you, and we look forward to hearing from you all soon. Thank you.

[End of NSA Pre-Proposal Conference of August 9, 2007.]

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