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We find ourselves at an important juncture. With the publication of key planning documents over the past several months, both NextGen and SESAR have achieved a level of definition that allows us to take next steps. Substantial resources have been planned and budgeted in both Europe and the United States. So, I think it is critical to turn the problem on its head and really come to agreement on how we are going to achieve these very complex undertakings. I'll focus my comments on NextGen, but I certainly believe there is applicability to SESAR.

Complexity is a key concept here. NextGen is by no stretch of the imagination a well-bounded system and no amount of effort will make it one. For example, the scope of NextGen spans multiple public and private enterprises – such as FAA's air traffic organization and FAA's safety oversight organization, the airlines, military aviation, general aviation, and airport operators. We have new entrants, such as military and civil sector UAV operators, and on-demand air taxi operators. And all of this interacts with constantly evolving US and global economies. So drawing a line around a specific set of things and organizations and problems that is NextGen and a specific set of things and organizations and problems that is not NextGen is impossible.

From a capability perspective we want to build new functionality, such as trajectory-based operations, that span system components; near to long-term time scales; and, from individual aircraft operations to the patterns of aircraft flows

across the NAS. And these capabilities interact with policies, such as “rules of the road” – is it “first come, first served” or “best equipped, first served?” This implies complexity and non-linearity in system interactions and emergent system behaviors. Airlines will interact with the system based on their own proprietary business needs. So, for example, the best trajectory solutions to route around weather or the priority of the aircraft will likely vary from airline to airline making the system behavior difficult to predict in advance.

In our world, as the system evolves, the environment within which the system exists will evolve as well. For example, issues such as noise, local air quality and global climate change will evolve and therefore the constraints associated with those issues will evolve. In fact, we are having a spirited debate within the JPDO as to how to handle environmental constraints. I think we all agree that environmental constraints will increase, but there is no agreement what those constraints are going to be and how they will be imposed. At the same time drivers such as technology will advance. For example, according to a recent forecast by Scientific American, by 2020, the average $1000 computer will have the equivalent processing power of the human brain and by 2030 it will have the equivalent processing power of 1000 brains. So, conditions within which NextGen will operate will change in ways that cannot be predicted in advance and therefore it is not possible to have a set of unchanging requirements.

That last example of the computer forecast reminds me of Thomas Watson’s famous forecast that with the growth in processing power, one computer would be all we needed in the future. He had no idea how many future uses would be made of the computer and how computers would be embedded in nearly every part of

our lives. The lesson here is that until users start using new NextGen capabilities, we can't know all the ways the capabilities will be used.

So, because of the inherent complexity of NextGen, it is simply unrealistic to believe that system needs, alternatives or solutions can be fully anticipated in advance or that they will not change in substantial ways over the lifecycle of implementation.

But there is good news as well. The starting point for NextGen is already built so we don't have to predict, model and interface every component as if you were building a new aircraft or spacecraft. For all the reasons I just gave, that would be impossible for NextGen. However, we can scope the approach to key functions and interfaces and model the macro impacts those changes make. This is a manageable approach, but still very challenging.

This is the approach JPDO has taken. The Integrated Work Plan that you will hear more about is not a plan in the traditional sense of the word, but rather a database of operational improvements or functional components that can be configured to meet the implementation strategy.

The big burning question then is "what should our strategy be?" "How would it be prioritized?" As I've said, even a simplified scope approach is still a challenge in a system that is inherently as complex as NextGen. So, let's take a page from Laurence Peter – he's the guy that came up with the Peter Principle as well as many other insightful ideas. He once said "some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them." Knowing that the people in this room are both highly intelligent and well informed,

I'm going to ask that if you have made up your mind as to the right implementation strategy for NextGen, to become undecided for a little while. I'll come back at the end of the plenary to suggest a strategy going forward.

Closing

Now, let's step back and take up the question of where to go from here. You'll recall from my opening comments that one of the things that makes NextGen complex is that there are multiple organizations with their people, cultures, needs, objectives and ways of looking at problems wrapped up in NextGen. And we often look at this as a problem, but the reality is that they – we – are all parts of the system. And each organization has a legitimate perspective that must be considered.

So, let's start with the FAA. First, let's recognize that FAA comes at this from a safety and operational perspective. They see the system as it is today and the next incremental improvements. These incremental improvements are managed separately within the overall FAA organization to keep the development close to the operation. Within this context, they have had very good success with their OEP process to coordinate these changes across the total FAA organization. So, for example, the opening of new runways is coordinated with airspace and procedure design and CNS infrastructure installation. Because of this worldview and success, FAA is naturally looking to apply the OEP approach to NextGen implementation. Unfortunately, OEP has not been tested on something with the long time horizon, scale and complexity of NextGen and therefore there may be substantial risk.

Next, let's look at the manufacturing community. Their inclination is to look at NextGen as a system with fixed requirements to be engineered, using systems engineering and integration best practices. They advocate for a special program office that has the resources and span of control to manage all of the major development and implementation activities, including developing and controlling requirements, synchronizing resources and schedules, specifying and managing interfaces, and integrating systems. Using this approach, the DoD has fielded systems of incredible capability such that the US military is unsurpassed globally. Unfortunately, this approach has also come up short nearly every time it has been applied to very complex military systems. A March 2008 GAO report shows that substantial cost growth, schedule slips and reduced functional performance are the norm.

Finally, let's examine the user community. Perhaps their view is the most straightforward. They view NextGen through the lens of benefits and costs. They want to operate in the most efficient and safe manner possible for the minimum cost, whether that is a commercial aircraft flying passengers from point a to point b, a military aircraft flying to and from special use airspace for training or a general aviation pilot doing some recreational flying. Unfortunately, user investment horizons are by and large short-term, but the implications of their investments are very long-term as vehicles and avionics have multi-decade lifecycles.

While these are clearly different world views, I believe there is a path forward that can satisfy all of these legitimate perspectives. There are four elements: first, a set of prioritization criteria designed to be responsive to complexity of NextGen; second, let's develop and execute an integrated CNS plan; third, let's establish a

development and demonstration environment and process; and fourth, let's incentivize public-private partnerships around creating real change and delivering benefits.

I'll briefly address each of these elements. First, in order to deal with the inherent complexity of NextGen, let's adopt a set of architecture criteria to drive prioritization of our solution sets. They would be: scalability to varying levels of demand; flexibility to implementation at different locations and times; robustness to a wide variety of interfaces; resilient to considerable pressure before failing; and, highly leverageable and adaptable to many different uses and applications. I know a pretty challenging set of criteria.

The second is apropos for an ICNS conference. And that is, let's develop and execute an integrated CNS plan. Integrated CNS provides the enabling infrastructure for NextGen and hence an important foundation for supporting an evolutionary development process. There is consensus on the components – GNSS for position, navigation and timing with ground based augmentation for specific high performance applications, ADS-B out and in for surveillance and aircraft-based separation applications and a combination of voice and DataComm for communications. System-wide information management provides the backbone for a net-enabled operations construct. Obviously there are a lot of other details – many of which will be discussed at this conference. The primary challenge is that this infrastructure crosses Agency lines and will therefore require inter-Agency cooperation. But I believe this part of the NextGen challenge can be sufficiently well bounded so that it is suitable to a large-scale, integrated systems engineering effort. This will also provide a substantial basis for an integrated, long-term perspective for avionics that the user community needs to put near-term

investments on a long-term timescale. As a note, the JPDO has a Senior Policy Committee meeting tomorrow that will be chaired by Deputy Secretary Barrett. The three major interagency issues we are taking for decision are around CNS and information sharing.

The second element is to establish a NextGen development and demonstration environment and process. This gets to the heart of an evolutionary approach that integrates developers, operators and users. The idea is to create an experimental environment that is based on real systems, real software and real operators and users and couple it with a rule-based process that allows developers to competitively, but fairly, integrate, evaluate and ultimately be rewarded for real solutions. Evaluations would occur in virtual and real operations. NextGen capabilities define the target vision. The architecture criteria fully defined from each stakeholders' perspective would support a set of objective metrics. Other criteria would include the ability to spiral out near-term improvements that deliver operational benefits. This changes the model from specifying the solution to guiding the evolution. Experiments and demonstrations that integrate various policy and technical changes to evaluate predicted and emergent system behavior and performance can guide higher confidence decision-making for policy makers. Again, real feedback is driven by real performance, not the plausibility of predicted performance.

The third element is public-private partnership. Because of the complex relationship of stakeholders within the system, we should incentivize organizations to work together toward system solutions. Think of the UPS CDA and ADS-B trials as one example. This approach would be especially useful when cooperation is required to achieve a capability or policy, such as methods for allocating

trajectories across many users in constrained conditions such as weather events. In conjunction with a NextGen development and demonstration environment, this could provide a workable approach to making difficult decisions in this complex system. Public-private partnerships can also provide balance between competition and cooperation within the system.

These are some specific proposals I believe will capture common ground and address key needs and perspectives of the various stakeholders. The important point is that to be successful, we must integrate the legitimate perspectives of the stakeholders in NextGen. The bottom line is that it is impossible to separate the development of NextGen from the definition of NextGen. In such a complex system, they are inextricably linked through the evolutionary process. Perhaps the biggest culture change we are going to go through is not to the role of the controller or pilot, but to create a culture that blends the planning, development and implementation communities. If there is one message that you take from this talk, it is as we collectively embark on this journey, let's start a real dialogue around finding a shared implementation strategy for NextGen.

Thank you.

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