Assuring the Transition to the Next Generation Air Transportation System

A New Strategy for Networked Governance

Findings and Discoveries of the Executive Session on the
Next Generation Air Transportation System

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I. Executive Summary

On November 4–5, 2009, Harvard's Kennedy School of Government, in collaboration with Booz Allen Hamilton, convened the Executive Session, *Assuring the Transition to the Next Generation Air Transportation System.* The Session invited a "cross-boundary" group of senior government and business leaders, organization and association executives, and researchers to meet in closed-door roundtable discussions with peers and faculty, and to consider the future of the Next Generation Air Transportation System, also known as "NextGen."

NextGen is among the most significant efforts at cross-boundary transformation ever undertaken by the United States Government, in collaboration with the aviation community. Such moves are always fraught with challenges, opportunities, and possibilities. Success across the many stakeholders requires that all align on strategy; that all see value and understand risk through the same lens; that authorities and resources converge on shared interests and goals; and that leadership keeps all moving forward while providing governance to resolve conflict, confusion, and obstacles.

NextGen relies heavily upon investments by both government and industry, including in technical infrastructure and data systems, new rules, procedures and training, and significant operating changes. Investments in technologies, such as flight management systems, precision navigation systems, and data link capabilities in particular, are expensive and require a raft of collateral investments for their value to be fully realized.

This meeting explored critical issues in accelerating the uptake and adoption of NextGen capabilities. It investigated whether and how best to "incentivize" such investments; governance and leadership requirements for making such significant cross-boundary improvements; and prospects for broadening "best equipped, best served" strategies.

Findings and Discoveries. Significant progress has been made, but there is still distance to go. All share a passion and commitment to the success of NextGen, but disagree on how to get there.

Issues remain, for example, regarding who should pay as infrastructure moves from the ground to the plane, perhaps challenging the long-established practice of "government pays for infrastructure, airlines for planes." Although the nation's cupboard may be bare in such dire fiscal times, the airlines too, are stressed. Moreover, they are skeptical of the government's ability to move fast enough to undertake needed reforms sufficient to generate the returns industry needs on any NextGen investment it might make. There is a prospect that government could demonstrate its resolve and prove the benefits by

implementing elements of a new best equipped, best served strategy; but, such a roll-out itself raises thorny issues of handling mixed equipage operations, altering flight paths, and changing procedures. It is by no means assured, either.

These issues are among the complexities confronting NextGen—a series of "Yes….but" dilemmas that seem to thwart every good move forward. How then to make progress?

Some argue that what is needed is a new strong central authority directing traffic on NextGen—clarifying and resolving governance issues internal to the Federal Aviation Administration (FAA), and clearing the path ahead for the tough choices that must be made.

Others suggest that the challenges are greater than a single set of internal alignments can address and that a different path of governance might be considered as well—one of networked governance.

On this model, rather than expecting top-down hierarchies to resolve and break through all the complexities of NextGen's dilemmas and problems, the group of interested participants could instead foster a *network of networks* where the solution prospects might be diverse, and even superior.

If the conundrum is "*Who shall pay?"* for example, clearly a top-down approach has run into significant headwinds: neither government nor industry has yet shown full and joint commitment to do so.

However, various municipalities or regions might well find a compelling business case to support the introduction of NextGen to their areas—for jobs, economic development prospects, and related commerce. Similarly, local networks might manage the issues and risks of airport expansions, flight path changes, noise, and related matters where Federal leadership would be less availing.

The role of the group meeting—perhaps expanded and formalized as a consortium— might be to sponsor the formation of a network of such networks, providing overall governance, standards, and models and taking on clearly national issues—but chartering the network of networks to craft a wide range of potential solutions to NextGen's conundrums. They would provide a compelling business case and rallying cry in each of perhaps five or six different areas for further NextGen design, development, and implementation.

The members of the Executive Session resolved to explore such issues of governance, financing, incentives, and related matters in a series of follow-on work streams.

II. Aviation at the NextGen Crossroads

American civil aviation hovers at a crossroads. NextGen—the Next Generation Air Transportation System—offers the promise of a new universe of flight efficiency: reduced delays and carbon emissions; smoother in-flight and on-ground operations; and far less vulnerability to the vagaries of airport congestion, weather, or human error in air traffic control. Properly and widely implemented, NextGen could remake civil aviation and save billions.

FAA's NextGen is thus one of the most significant efforts of cross-boundary transformation ever contemplated by the United States government and its industry partners. NextGen's goal is to make civil aviation safer, more efficient, and better able to support the likely demands of air transport in the new century. NextGen calls for the introduction of a variety of advanced technologies and related, supporting changes to the operations and business processes of the national airspace system. To that end, Congress and FAA have committed to a 20-year, $20 billion NextGen effort.

The future of the sky has arrived, yet it remains slow to realize, complex to move forward, and has much distance to go before it can be implemented and its benefits realized.

The frustrations are palpable. "If I had a magic wand and I could wave it," an industry executive told colleagues, expressing a widely held view, "I would ask for the President of the United States to make a declarative statement—and to back it up with the full force of the administration—that NextGen is a major national and international priority."

There may be such silver bullets ahead. But NextGen's implementation is complicated by its significant reliance on advanced aircraft technologies, such as new flight management systems, precision navigation systems, and data link capabilities. While technically feasible, the investments are costly, and until now operators have principally been expected to bear them.

Moreover, much of these investments' value relies on significant, collateral changes in operating and business processes that others must take.

How might the aviation community best address and manage this risk to "incentivize" equipage investments, assure the needed changes to operations and business processes, and ensure that all realize value of the promised returns? Further, what are the governance and leadership requirements for making such significant cross-boundary improvements and the prospects for broadening best equipped, best served strategies?

"The struggle of NextGen," one analyst has observed, "has been how do you build a path from evolution to transformation?"

With myriad fiefdoms—competing and collaborating by turn—aware of their own interests and yet determined to make the complexities of NextGen a reality, how to proceed? How to balance the roles and interests of government, business, public interest, and private profit? How to modernize procedures? How to determine metrics to measure NextGen's success? Where to find the funding? How to frame and make the *best next move?*

In short, how to transform civil aviation?

III. The Executive Session on NextGen

To gain insight into obstacles and the path forward, we gathered leaders over the period of November 3–4, 2009. Those with us represented the highest levels of government and administration, trade, industry and labor groups. We were joined by university and Massachusetts Institute of Technology faculty. A full member roster is found in Appendix A of this report.

We took as our starting point this observation from a participant: "We're all developers and consumers of this," she said, "and that makes it much more difficult to have a conversation. Everybody knows exactly what the future should be, but none of our conclusions match."

Under this research umbrella, we welcomed all. This is a report of that group's deliberations, its findings and discoveries, and its sense of the next best steps to bring NextGen forward faster and more assuredly.

IV. Progress and Next Moves on NextGen

FAA has been highly active already, envisioning the future, seeking consensus,[1] building plans,[2] and launching cornerstone projects.[3]

In particular, FAA formulated a new concept of operations. Currently, FAA largely provisions air traffic services on a "first come, first served" basis. That concept has long prevailed; is easily understood; and is deeply embedded in architectures, operations, and thinking. Forming bedrock policy since the first days of aviation, first come, first served has served global aviation well.

As any air traveler can attest, however, today's air traffic system is at constant risk of congestion and delays, especially in metroplex areas or when demand regularly exceeds

capacity in certain airspace regions. NextGen promises to alleviate these pains. Yet transitioning global aviation to the equipage, business processes, policies and procedures, and governance of the NextGen future is complex.

FAA proposed a fundamental strategic shift in the provisioning of air traffic services, embracing the concept of best equipped, best served. Under this new rubric, the provisioning of air traffic services will favor those making the first moves to NextGen capabilities. This shift, it is argued, will accelerate the uptake and adoption of NextGen equipage and help all realize the full benefits of NextGen investments and improvements.

The introduction of best equipped, best served will depend on numerous factors, such as location, airspace environment, airport configuration, level of equipage, level of training, and possibly even time of day. It is likely that first come, first served will remain in effect across the majority of the national airspace system, particularly in areas where excess capacity is the norm.

In the congested metroplex areas, however, where change is essential, a best equipped, best served world must co-exist with first come, first served in an ever-changing mixed equipage environment as the evolution to a fully NextGen world takes place.

V. Assuring the Future

The *RTCA NextGen Mid-Term Implementation Task Force of September 9, 2009,* has become the context for all future discussion. Its core conclusions form a comprehensive overview of the challenges ahead. They include, for example, that users will support FAA Communication-Navigation-Surveillance (CNS) infrastructure investment only when they have a "clear and unambiguous" path to immediate and tangible benefits, established in a solid business case. Moreover, to build more confidence in FAA planning and to encourage users to invest in NextGen equipage, FAA should focus on delivering near-term operational benefits rather than delivering infrastructure.

Yet, as industry and government seek common ground and accelerated transformation to NextGen, critical questions arise.

- How can the move to NextGen equipage best be *incentivized* and assured—whether by strategy change, change in policies and procedures, financial incentives, or other means?

- In the move to mixed-equipage operations, what are the critical issues and areas for collaboration between parties so that they may effectively address their shared operating, business, and technical risks and opportunities?

- What new forms of cross-boundary *governance* might best serve the requirements and arrangements of all?

- What are critical elements of strategy and the roadmap forward that can best ensure the smooth transformation to NextGen?

- What is the role of leadership and its imperatives in framing policies and moving forward?

- How can progress best be tracked and issues resolved across multiple stakeholder communities?

VI. Lessons—and Lenses—of History

The lessons of history can exert powerful force on how the many parties involved view the path forward. Because the nation has grappled with airspace modernization and NextGen for some years now, these lessons abound—many being the lens through which decision makers now see their current choices and likely futures.

The hegemony of first come, first served has been paramount. We have a long tradition of successful, egalitarian coexistence in self-managed airspace. An airline executive spoke of "the decades when businesses represented many different customers with divergent needs, resources, operational priorities and models, and all managed to coexist in American airspace"—this, on a first come, first served basis.

Many are skeptical of FAA's ability to execute large transformations, even once funds have been appropriated. "There is little point," said one respondent, "in trying to move toward a day when everyone can simultaneously flip a switch." Cited, for example, is the failed Advanced Automation System program; some say it has branded FAA negatively and left many people "very, very skittish about any major transformation in the system for quite a long while." Described as "the big bang theory" in that the system might be changed overnight using a lead system integrator with a great deal of authority, AAS stumbled. Yet AAS was not nearly so ambitious as NextGen.

Evolutionary change requiring investment by both industry and government cannot proceed without delivering its stream of promised benefits. History suggests that aviation must evolve and gain benefits during its evolution to NextGen. Yet there is deep skepticism that benefits delayed might ever be realized. A cross-industry willingness to accept evolutionary progress requires that aviation leaders be definitive about direction, set specific goals and objectives, assure interim benefits, and meet those goals on time. *Whether transformational or evolutionary, leadership is essential.*

Government pays for infrastructure. Government has always underwritten air traffic control infrastructure—towers and runways, for example—as public benefits. The airlines have been responsible for cockpit investments. Yet these paradigms blur in the NextGen future: the very essence of NextGen is control features built into cockpit avionics. When infrastructure moves to the cockpit, who pays?

The National Highway Administration is a potential paradigm for change on a similar scale—and points to potential leadership requirements. Some invoke the time in the 1950's when transportation became a national priority, when the government appointed an Administrator to oversee the creation of the National Highway System. They view the scale and necessity of NextGen as comparable to the challenges requiring such an appointment.

VII. The Blue Sky of NextGen

There is an indisputable consensus about the future—both its imagined realization in 20 years and its tactical execution in 5 years. "For the first time in the history of aviation," one participant observed, "the aircraft is becoming the center of the system around which all planning must be made."

20-Year Vision

The shared long-term vision is offered concisely here:

Airspace would be managed in a real-time environment with labor and industrial issues satisfied. All logistics of demand, capacity, air routes, and scheduling and block times would be computed well in advance of flights. The widely hoped-for grail of better managed airspace is reduced separation, both horizontal and vertical, with no loss of safety. Aircraft will monitor and control separation with little help from the ground. A blue-sky environment would allow regulators to "tear down walls like artificial airspace boundaries that force airplanes to stay high or get low and thus make flight inefficient, less safe and less green," as one participant stated.

5-Year Vision

A shared 5-year vision starts with this construct: "We have the technology, the know-how, and the capability to make all of the major transformations that we need to make. Everything is possible in five years if you have that and are free from some of the logistical and financial issues."

- *Deliver the Capabilities Articulated in the RTCA Task Force 5 Report.* "We can do a tremendous amount with the current technology we already have by implementing a lot more RNAV/RNP operations that are designed from the start to improve capacity efficiency and balance environmental aspects."

- *Push Ourselves for the First Retrofit Airplanes and First Approvals.* In 5 years, the first retrofits, the first satellite ground control systems, and the first approvals should be occurring for all feasible technology. Even with some of the hardest problems to solve, like closely spaced parallel approaches to 800 feet and IMC landings, "we have the technologies and hands to do all those things," a respondent stated. "With the right attention and focus, we could get all of that work done so that the first two airplanes, and maybe it's only two, but the first two airplanes could actually conduct that operation in five years."

- *Make Available Performance-Based Procedures for Those Aircraft That Are Suitably Equipped.* Without denying access to others, the norm would be to provide the best benefit to those that are on the right equipage.

- *Prove Trajectory-Based Operations.* At the higher altitudes, demonstrate more trajectory-based preference and start making that flexibility, and more autonomous operations, available—not limiting access for those that are not equipped, but providing real and measurable benefits in key areas to those that are.

- *Install Crucial New Technology.* A consensus vision includes delivering the ground infrastructure for ADS-B by 2013 and having digital data communications operating. This would include a fully integrated system of satellite-based navigation for improved trajectory operations.

- *Achieve Rapid Certifications.* The system will maintain safety and increase efficiency by rapidly certifying airplanes and allowing new technologies to operate at full capacity.

- *Optimize Problematic Metropolitan Airports.* The operations around busy metroplex areas would become much more rigid, structured, and efficient. This would likely involve the imposition of mandates for equipment in such places.

VIII. The Five Challenges of Transformation

How then to proceed? Significant investments in planning and development have already been made, both in the RTCA Task Force 5 report and FAA's own planning and development.

Yet issues remain, and questions abound. Five issues stand out: *Financing, Incentives, Innovating, Failure Modes, and Governance.*

1. Financing

The historic paradigm—and current practice—says that airlines pay for planes; government pays for infrastructure. Government has *always* underwritten air traffic control infrastructure—towers and runways, for example—as public benefits. The airlines have always equipped the planes.

"Clearly," one respondent observed, "government needs to pay for the FAA's infrastructure or the infrastructure that's necessary to deliver the service." This includes radars, transmitters, ground infrastructure, and controllers who operate the system.

The NextGen paradigm arguably shifts this equation: under NextGen, public benefit infrastructure relocates *from the ground to the cockpit.* With infrastructure moving to the cockpits, many believe that government should fund the capital improvements. After all, the very virtue of NextGen is that avionics in the aircraft are not just serving the airlines or the airplane operation anymore. They are serving the *system*—making it more capable and providing benefits across the board.

This then became a case of supporting an important public benefit infrastructure that has moved from the ground to the plane. If the airplane is to become a central cog in the air traffic control system, should government not subsidize the required technology on par with subsidies for ground-based air traffic control equipment?

In today's fiscal climate, those investments are dear, whether by government or industry. One airline executive asserted that equipping his fleet would cost $80 million to $100 million.

Who, then, should pay? And who will move first?

Yet the "who pays?" issue might be a red herring of sorts. Some argue the "real pocket" that will pay is the citizen, and that the decision is really how to apportion that cost: either on those who pay to fly (freight and passengers) or on taxpayers, even if they never leave the ground.

"In any event," one respondent stated, "either it has to happen by mandate, which would force the users to pay for it and then pass the cost along in ticket price, or by government financing. To me, there's not a big difference between the two."

"The rest of the argument," the participant suggested, "is really just about the most effective way to capture that revenue stream."

2. Incentivizing Investment

FAA's role is to "look for opportunities to allow aircraft to fly the profile/mission that they are equipped to fly," one participant asserted. Make this possible, he said, and "you'll get the pioneers leaning forward to equip."

Currently, there are obstacles in the path. Because the system currently works "below its common denominator," as one participant put it, "there's no operational advantage to actually equipping."

With respect to separation standards, for example, "the control function is exceedingly inefficient," the participant said. "We're currently legal to separate airplanes 3 miles within 40 miles of the airport, and 5 miles through the remainder of the whole US airspace. The typical control is about double those measures. A lot of it is just simply lack of any sort of incentive to do any better."

As a result, "It's hard for airlines to monetize operational benefit," a participant observed. "When you get on a plane the customer is not making a decision based on whether it has ADS-B or not."

Breaking the logjam is hard. The air transportation system is currently functioning at extremely high levels of safety, for example. In fact, there has been a "ratcheting up" of "target levels of safety" as subsystems have gone through cycles in which the many subsystem owners have added technical requirements, making the cumulative safety requirements for new systems "almost unattainable," one participant asserted.

"Nobody gets criticized for over-specifying the safety requirements for their subsystem," he said, "But it makes it extremely difficult to make the type of changes that will be necessary—precisely because we cannot actually get most of NextGen through the safety approvals process fast."

This construct translates to balking by airlines that are uncertain they will realize return on their investment—in time, or at all.

Making the argument to a Chief Financial Officer even on the basis of a 5-year return on investment (ROI) when his or her investment ROI timescale is between 18 and 24 months, for example, is "an impossible sell," one executive said. The deal is "dead on arrival" once coupled, further, with the lack of credibility of any benefit analysis. Many prior investments in technology have not yielded promised operational benefits.

"The urge to invest again is not overwhelming," one participant said. Government's past failure to make good on promises of collateral changes in policies and procedures rings loudly. "Risk needs to be apportioned differently this time around," he said.

If current market forces seem too weak to incent first movers on this round, how then to ensure change, when there is no rush to be first—and no downside to being last?

Mandates. From FAA's perspective, mandates are appropriate only when there is not—or never will be—sufficient incentive for operators to equip. However, mandates have the effect of reducing business uncertainty—which some operators might prefer, if intelligently applied and matched by government action. If, for example, FAA mandated the purchase of equipment of a certain level in order to operate in New York Class B airspace, this would be—according to one observer—"a no brainer. I can walk into my board meeting and get approval in 15 minutes."

Managing the Mixed Equipage Environment. Demonstrating capability to roll out and manage a mixed-equipage environment may well provide strong incentive, demonstrating the value of investing in best equipped, best served-enabling equipage. "Best-equipped, best served is a systematic reward for NextGen upgrades," a participant observed, a "pure competitive market system." FAA could then mandate the remainder much more easily—limiting it to those who do not voluntarily equip.

"But we need to prove our way into this," a government participant observed. "We've got to prove that we are going to burn less fuel, that we can space our planes closer together, that we can fly more efficiently, that we can fly more direct routes."

Industry takes a "show me" attitude. To be meaningful for business case purposes, especially, and attract investment, these results must be measurable. "The only way government can really prove out the true benefit is to get enough of the fleet equipped to actually try it," one industry participant said. "It cannot be done on paper and proved."

Even demonstrating mixed-equipage capability at the level of a proof may only go so far. The local political equation must also be solved sufficient to allow NextGen to grow the amount of traffic operations that can be achieved from the same footprint. Flight patterns, particularly in the northeastern corridor and New York, that produce new efficiencies also shift noise and raise political disputes.

"Will local populations let us move forward with that?" one participant asked. "If you can't do the redesign in the air space you can have all the technology in the world, you can solve all these other problems, but you're not going to have an efficient system."

3. Gaining Acceptance: The Challenge of "New-Product" Adoption

At its heart, NextGen is a major cross-boundary change initiative requiring deep consensus, broad alignment, and shared risk taking. Yet the classic "burning platform" that would mobilize support and action is absent—no 9/11, for example.

"We don't have a strong external driver on the capacity issue. When you have a slow degradation in performance of an infrastructure, it's the 'boiled frog' problem," one participant stated. "The urgency is not there to say that we have to solve this problem today."

"It's a very interesting marketing challenge because you're not selling NextGen as it's going to save lives—that bar is now set very high," another participant observed. "You're selling NextGen on the basis it's going to save dollars, and it's going to save time, and it's going to save the environment."

Absent a nationally felt crisis like 9/11, the move to NextGen is prone to being slowed or derailed by a diverse public on many issues. Moreover, the Session also learned of research that points to the inherent difficulty of new product adoption under the best of circumstances.

"Losses loom larger than gains," research shows—meaning that any new product must be more than simply a little bit better than the old to ensure adoption. It may need to be up to *10 times better* to be felt. Where old ways must give way to new ways, users' familiarity with the old, combined with the uncertainty of the new, means users are loath to part with the old (and well-known) only for some modest gains from the new (and unknown).

Clearly, "warts and all," operators in every domain of the national air transportation system have figured out how to make the "old" system "work." Introducing new equipment, new procedures, a new ethos—best equipped, best served, for example—runs the risk of rejection if the introducers cannot gain the support of those concerned. At the very least, this means being transparent, collaborative, and inclusive in planning any "new product" introduction.

This is especially so as some NextGen models suggest likely contraction of towers as the control infrastructure moves from the ground to the cockpit. In the interim, there is a significant challenge for controllers in handling the mixed equipage environments. And pilots, when asked, express reluctance to take up "air traffic control duties" in the cockpits.

"We don't talk enough about the workforce dimension to the problem," one respondent observed. "You can bring as many technologies to the table [as] you want but we still have pilots and controllers involved. They've got to see the value added that comes from these

changes and it has to be value added to them. They have to appreciate that, in order for them to buy into it—and it's not going to be successful without them."

4. Failure Modes: Averting "Predictable Surprises"

Participants came to understand the importance of considering "predictable surprises" as an approach to addressing likely modes of failure.[5] In NextGen, as with any complex cross-boundary initiative, there are potential risks and failure points. Areas of risk could be political, conceptual, labor, financial, technical, or organizational, for example.

What are these failure points in NextGen development? What barriers might prevent the community of interest from foreseeing them? What strategies would help mitigate these risks? There was considerable interest expressed at the Session in further investigating the "predictable surprises" of NextGen.

5. Governance

The issues of governance loom large for NextGen, in both expected and unexpected ways.

As with any government-involved initiative, questions arise for NextGen, including determining levels and concentrations of authority within FAA; achieving unambiguous lines of report and charters; and distributing or acquiring powers to bind, commit, and ultimately lead.

Ultimately, such gaps do slow decision making or make mandates fuzzy, frustrating government and industry executives alike. Remedies ultimately involve straightening lines of report, clarifying duties, empowering those tasked to do certain work to accomplish the mission, and performing other bureaucratic housekeeping. They often lead to calls for strong and decisive—even somewhat autocratic—leaders. The solutions proposed for NextGen are no exception.

What is characteristic of these moves is this: they are predicated on the belief that much that impedes NextGen from delivering needed *external* transformations can be addressed by remedying FAA's *internal* governance arrangements. It is true that NextGen might improve its overall performance by making its operations more efficient for necessary decision making, policy redesign, financing and acquisition, and other deliverables.

The roundtable, however, produced the notable discovery that the conundrum, challenges, and obstacles of the NextGen external environment will not likely be solved by fixing internal NextGen governance alone. Essential as the internal moves are for improved

performance, the meeting also found that solving all the external challenges—from financing and incentivizing, to proving and documenting, to rescripting procedures and flight paths, to gaining political support and new user buy-in—represented a set of capacities that few could easily envision any one group possessing or able to deliver alone.

Indeed, solving any *one* of these problems has proved difficult; solving them altogether and at once appears practically impossible—even with a strong hierarchy; charters and authorities; and clear, unambiguous internal governance.

IX. A Networked Governance Strategy for NextGen?

Might a new strategy of *networked governance* provide a workaround to these stubborn obstacles?

With this strategy, the role of FAA might be less to manufacture specific NextGen outcomes or results, and more to steward the formation of a network of networks that can ensure such results.

Many of NextGen's challenges at the national level seem monolithic, risky to embrace, and filled with uncertainty. By contrast, they present themselves at the local level in unique constellations and seem to offer many more levers for change locally.

By expanding the problem to the local level—and empowering local networks to solve them—the prospects for change seem *higher,* both by avoiding "predictable surprises" and by crafting locally relevant solutions.

The task of our current network of partisans, represented by those at the roundtable, might be to design its own network to support the controlled proliferation of a network of networks *each solving the NextGen challenge at the local level.* At the local level, networks would assure that the right parties come to the table, making it possible for the right incentives to align, the right economic drivers and investment cases to be made, and the right local interests to converge.

Airspace is of course a national asset, and some solutions will require response at the national scale, with top-down accountability. Design and planning for NextGen-wide enterprise architecture, development of certain policies and procedures, and funding and procurement, for example, all require a strong central role.

"We have to ask for top-down. That's the political mandate from the President or from the Administration," one participant said, and it is critical to the success of NextGen. "There

must be someone on the FAA side who has the accountability for everything that has to happen within that organization, be held accountable, and make the commitments."

But the great challenges of implementation might be best addressed by grassroots-level local networks if such networks were given a broad *bottom-up* charge consistent with a national strategy, resourced by FAA with some authority and support, and tasked to develop the local solution that works.

Under this model, the opportunity exists for FAA to use its powers and authorities not solely to directly manufacture NextGen products and services, but rather to steward the networks that will. The role of government might be to encourage, convene, and support the formation of such networks. The challenge of governance shifts from managing bureaucracies to governing networks.

This model becomes an opportunity for this group, the roundtable felt, to contribute as a network—perhaps, a *consortium*—that itself can design governance for the proliferation of local solutions, which together create national impact and outcomes.

The challenge to this group, then, would be to design *itself* as a group of enlightened industry and government executives who agree that the future of the country depends on its success in moving our aviation infrastructure forward.

The prospect of top-down effort where necessary, with rich bottom-up networks actively devising local solutions, and a mid-range consortium assuring vitality, consistency, and governance across the networks, seems potent.

What steps could such a consortium take to create a *network of networks* representing a vast new capability to address the challenge of NextGen design and implementation?

"We have a lot of work to do as a community sitting at this table," one participant offered, "even an incomplete community, to form this consortium—a coalition for NextGen. It makes it palpable," he said. "It creates the mandate for governance to change, to make it happen."

X. A Technical Research and Development Agenda

Opportunities exist for research and development. Participants suggested the following priorities for action:.

- **"Weatherproofing the nest."** Systems operate well in good weather; when the weather turns bad and capacity goes down, problems arise. Weatherproofing the nest means using available technologies *to operate as if the weather is good all the time.*

- **Networked governance of research and development (R&D).** How to best maintain a balance and informed dialogue between those charged with "looking over the horizon" and those involved in deployments and implementation? Neither can function successfully without the other. A networked R&D approach can solve problems from multiple perspectives simultaneously—whether from the perspective of passenger security or unmanned aerial vehicles (UAV) in the eventual system—balancing all interests in the model and the sky.

- **The role of automation versus humans; the role of air versus ground.** Many tradeoffs loom for which we lack clear answers—not theoretical answers but practical, tested, and proven solutions. Change must address this complex question, but we are not yet in command of this aspect of our future.

- **Policy on best equipped, best served doctrine.** There is anecdotal, operational evidence to inform policy, but a lack of scientific basis. "It's easy to agree that that should be our priority," said one observer. "We've got to have an infrastructure in place that allows us to get this right level of information."

- **The role of air versus ground.** What can we do in the air and how much can we do on the ground? What is the good balance of that? This still requires significant investigation.

- **Separation standards.** Consensus holds that planes can and must fly nearer to one another, but how close is close? Is 2,500 feet, as some suggest, feasible? Or perhaps even 2,000 feet? What is the most efficient and safest long-term standard, and how can we prove or test for that standard today?

- **"Laying concrete."** Assuming that the airspace problem has been solved and that runways can operate independently, can we "lay down concrete" in New York—and in new sites—opening up a range of options that do not exist today? The implications of this must be examined.

- **Unmanned aerial vehicles.** This is not a future question. UAVs are here, now, and are proliferating. US Customs and Border Protection, to name one client, operate UAVs constantly along the northern and southern US borders. UAVs will be controlled by software, either autonomously or from the ground. The automation and human changes in the role of controller will require complex software solutions. How will we develop and certify such capabilities for use in domestic airspace?

XI. Ten Elements of Strategy for NextGen Networked Governance

A go-forward strategy might involve fostering a network of networks based on a shared

sense of the urgency for action and a unitary vision (perhaps born of the RTCA Task Force 5 report recommendations) comprising top-down, bottom-up, and mid-level roles and supporting a preliminary technical R&D agenda.

What would be the requirements of such a strategy—the imperatives for the *network of networks* to take action? What could this network do—if, for example, formed by the group as a consortium—to create the networks that would produce the resources, governance, and throughput for NextGen?

1. **Clarify the Win.** "I go back to the question of how do we define success," one participant said. "With the people of this table, at what point will you say we've been successful—and that you will have delivered success to your constituency?" It is imperative to resolve the ambiguity of benefits, understand the overlapping vital interests, and align stakeholders on a set of objectives to attain within stated times.

   As one participant observed, "If you don't know what success looks like, then any road will do. It doesn't matter which road we take because we'll never know whether we are there or not."

2. **Evolve a New Form of Leadership.** With the win "clarified," the distributed leadership model of a network will have its objectives. How might this model work?

   Although networked governance is often seen forming around complex social problems, it is still evolving as a science and an art. Unlike traditional top-down forms of bureaucratic management, no one is "in charge" of a network, comprising as it does likeminded partisans from diverse institutions and organizations. How would the network of networks function? What would be its protocols, how would it operate, what would be the purposes of its nodes or elements? How would a network of networks establish collective accountability around end results?

3. **Map the Networks' Beneficiaries.** "The idea of a beneficiary," one participant stated, "is someone or group who will stand up and cheer once we have achieved our objectives. Who will be out there supporting us, whether it be in Congress or elsewhere? Who will commit to helping us get there?"

   The group, if re-formed as a consortium, could sponsor detailed mapping of beneficiaries at every relevant level of benefit.

   Some say there is already a "rock solid" clarity of benefits at the "macro" level regarding the overall environmental, safety, and capacity benefits to be realized through NextGen. Good metrics exist, for example, on "fuel burn," whether for Atlanta, Dallas, or elsewhere.

What may be missing is *who this benefits at the micro level*—who stands to gain from these benefits? The RTCA Task Force 5 report takes a first pass at describing some of these beneficiaries, but gaps remain.

The group-re-formed-as-a-consortium could, for example, specify a generic map of beneficiary networks so that local networks could map their own micro-level beneficiaries. Unlike a manufacturing map, a beneficiary map would show where jobs will be, where costs will be saved, how this effort might be made vivid, and what potential risks exist going forward. Local beneficiary maps could roll up to national maps—and permit marketing at the local and national levels.

4. **Raise the Key Strategic Issues.** Not all questions have answers today—but asking the right question is essential. This group might say, for example, "We don't know what the answer is, but we ask, 'Are we better to be part of the huge national infrastructure deficit?' The ports are billions of dollars behind, the roads are billions of dollars behind. Are we better to be part of that conversation, or separate?" There are many such important conversations—from who is at the table, to who leads the conversation, to how the conversation translates into a congressional mandate.

5. **Build New Metrics/Focus on Outcomes.** The networked governance model requires new kinds of success metrics. These metrics will span, capture, and measure performance across the boundaries of individual organizations. For example, beyond the success of laying new concrete, what are the expected benefits in those areas that have invested in more capacity, efficiency, and reliability for customers? They want *outcomes*.

"It isn't just developing or deploying infrastructure," said one participant. "It's not just the technology. It's all of the things you have to do to get to that actual improvement in the performance."

What does it take to realize these boundary-spanning outcomes? Those requirements will be the elements of *plans*.

6. **Develop the Plan, Gain the Commitments.** Even with a network, all parties who have a role delivering the elements of success, however they are defined, must *commit*. Those commitments, one participant said, "have to be tangible, they have to be on the table, and people need to sign up for them" whether from government or industry. Such commitment implies sufficiently strong leadership from FAA, in particular, to commit and bind that organization, as well as from operators and manufacturers.

7. **Reset/Realign the Economic Incentives.** These are difficult economic times. "It's very hard for me to figure out how you create political will for a large appropriation,"

one participant said, "or find anybody at the 'table' who will want to tax themselves dramatically to solve a problem where the benefits are highly diffused." Having mapped the beneficiaries and their micro cost/benefit perspective, might we *rearrange the incentives* to create the economic impetus for a solution—"as part of the process to convince folks that there needs to be change?" The prospect is intriguing.

8. **Pulse the Status.** Even with all these factors in place, and executed to plan, success requires constant "pulsing" of the implementation to assure benefits are being realized. The networked model could be designed for this purpose.

One participant recalled a past implementation. "As we rolled out and produced all those outputs," he said, "we overlooked the issue of integration as it relates to airspace procedures and a mixed equipage environment. We didn't see it as a *system*. So while we got consensus on a way forward, arguably we missed the mark from really producing something of great value for the system."

The network design, then, should provide for a capability to continuously pulse the implementation—to see if the benefits keep producing the results the original framers intended.

9. **Raise the Visibility/Market the Effort.** Some participants suggested re-forming the group as a broader consortium. That consortium would bring the activist partisans together, even in advance of knowing what constituted a win. The consortium would help to frame a series of wins that would be manageable and advance collaboration between government and industry around shared purposes. It could fill a white space, draw attention, make things "vivid," and energize local networks of partisans around clear benefits. It could, for example, capture the imaginations of local or state groups that are looking for economic development.

Ultimately, some suggested, "the government is going to have to start to build it, and they're going to have to be the push, whether it's incentivizing the industry to equip or mandating it." But that push may need to come from below: some doubt whether airlines, FAA, and allies have the support now to make much headway by top-down means alone.

10. **Rinse the Mystery Out of Accountability.** What will be expected of the airlines? FAA? Pilots? Air traffic controllers? Airports? Assigning accountability for representing these interests in the network may be essential. Even so, assuring transparency to the organizations themselves is crucial.

"If all of those boxes are secret," one participant observed, "and we don't know what we expect from the airlines or the FAA—who, specifically, in the organization is

responsible for action against the organization's commitments—we're going to be talking in circles for a long time."

Even now, with the RTCA Task Force 5 report, there is mystery, some say. "Do you go out everywhere in the system? Do you go out to certain locations?" one participant asked. "There's a whole level of detail which frankly hasn't been done. It's not clear who is the real decision maker from a system architecture standpoint saying, 'Yeah, we're going here, we're not going there,' making the hard calls."

XII. Options for Action: The Path Forward

What are the near-term options for action for the roundtable group? How might it translate these findings into practice? A number of continued investigations intrigued the group. Some of those are described as potential work streams:

Governance

1. **Provide an overarching governance model for the network represented at the table.** Investigate types of governance models that would work for a national network of networks. Explore alternatives and offer options for consideration and development. Encompass all the stakeholder groups, expanded to include those not yet present. Be the bow-breakers, the strategic investors for NextGen's networked governance.

2. **Define a series of overall goals and "win" for the network of networks.** Define the overall vision and metrics. Help networks follow a process by which they can define local metrics and assure metrics are well-specified and consistent with the overall objectives. Resolve ambiguities and clarify overall goals and objectives sufficient to articulate throughout the network and focus the efforts of all.

3. **Select five or six geographic areas where networks might be fostered and begin the work at hand.** Using the Task Force 5 recommendations, identify several geographic regions, including highly complex metroplex environments. Let the choice represent a cross-section of airspace complexity, converging runway complexity, and related factors.

4. **Assure overall integration of networks.** Enable the capacity to pulse the implementations for impact, stitch all constituencies together for the longer term vision, capture the success stories, and measure performance across the networks.

5. **Create a learning bank.** Every solution has to be local, but each has to make sense nationally and globally. Those discoveries need to stitch together in ways that link all stakeholders so they share the learning being obtained and pool their networked impacts and influence. The networked environment is a dynamic learning

environment. With constant capture and replay of lessons learned, no one will make the same mistake twice.

Incentives

1. **Map the networks' beneficiaries.** Support the convening of local networked groups in each location. Look at the complete stakeholder dynamic in terms of who benefits—and who loses, from jobs and improved efficiencies—from all the outcomes that are NextGen's promise.

2. **Help networks define their success criteria, and integrate to national priorities.** "Clarify the win" both as a network of networks, and for individual (local) networks, so that goals are clear. Decide on easily understood measurements.

3. **Charter the development of networks' plans to reflect national priorities and requirements, but also to capture the value proposition for local beneficiaries.** Help networks align their stakeholders on the overlapping vital interests they share and on a set of objectives to attain within stated times.

4. **Help evolve a new form of networked leadership.** Incent participation and commitment.

5. **Define network communication strategies.** Based on the individual sites, define a communication strategy focused on grassroots approaches. Look beyond just the obvious benefits of reduced emissions, reduced fuel consumption, or reduced taxi times. Look, rather, to the potential of the economic benefits in the *surrounding* communities and how champions in those communities could support the effort.

Financing

1. **Charter networks' efforts to design, develop, and support financing solutions.** Every network will have unique constellations of beneficiaries and finance requirements. By chartering the networks to devise the solutions, the best efforts of many can be mobilized.

2. **Identify the shared and unique financing requirements for networks' implementation of needed next steps.** Create best practices for the networks by showcasing their solutions and letting others use or improve them.

3. **Identify roles and capabilities of a national network to address further networks' financing requirements.** Some financing requirements may be best addressed by a larger network than smaller networks; identifying the financing role and prospects for the larger network versus the local networks will be important.

4. **Support efforts to champion NextGen as an issue for local community involvement and development.** Involve the community in a *change in the social contract.* With changes in procedures, reach out and invite the airport to help us understand how to better work for the community.

Predictable Surprises

1. **Understand and document the local risks.** Local risks include classic stumbling blocks, such as environmental issues of noise abatement and issues in airspace redesign, as well as what might be "predictable surprises" nationally or locally.

2. **Do it fast.** Form working teams. Develop a timetable to force the network to meet self-imposed mandates. Make sure, as Secretary Mineta reminded all over lunch, that as a nation in global competition, we get there the "firstest" with the "mostest."

XIII. Parting Words in Five Voices

All of us are stakeholders. Why don't we look back over notes and the discussions of the last day and a half and think of one piece that each of us would like to advance that comes out of these areas, that we need to address. It can be big or small, and I don't mean to suggest that as an individual, one of us is going to take it on and solve it. But where do you see your role in this? Imagine we're a part of a virtual group: where could you really make some constructive contribution?

NextGen is a magic mirror. We're all looking in that mirror and we're seeing what we want to see: that is an obstacle to our joint success. It's complicating our ability to get a ground swell of support because we communicate in different ways. It's complicating our ability to plan the details and truly implement because we are implementing different pieces that don't line up. So it's essential for us to roll up our sleeves and agree on what NextGen is. It's a content issue: What it is really? Does it include Tier 3 technologies? Does it not? At what stage? How does that work? But to some extent, it's a communication challenge.

We need to cut it out, guys. At some point in all of this "we can't define the problem, we have different visions, different views, et cetera, et cetera" there ought to be a way that we could agree. If we take the following steps or we do the

following things, then we're going to lock in on what it is essential, and how to do it. We do not know where R&D is going to take us. But we're spending too much time on all of us saying, "Well, I'm not sure I know." Well, if we don't know, believe me, we're not going to sell this to anybody.

We should stop worrying about something that we're all in so much alignment on. I don't hear any dissent. On the vision thing—if we all had to put it on a piece of paper and ask, "Can we talk clearly about NextGen?" I think we can do that. I absolutely do. And we need to go ahead and put something together. We say, "All right, here are the key points we're going to all start using and making, and let's use the same language." This isn't that hard.

If someone were to show up here at 4:00 today and say, "I have looked at five geographic regions. I have determined a potential governance structure and roles, responsibilities, authorities, and accountabilities. I have looked at how one might distribute the benefits and what that means in a quantitative sense. I have looked at how we can achieve a champion locally who, by the way, could reach upward into their congressional district then ultimately to the appropriators. I have looked at what that means in terms of equipage or incentives or operational incentives or financial incentives, and what would be required to do that?" I think we would all want to hear that.

AGENDA

"Assuring the Transition to the Next Generation Air Transportation System"

John F. Kennedy School of Government, Harvard University

November 3-4, 2009

November 3, 2009	Location: Harvard Faculty Club, 20 Quincy St., Cambridge
12:00 – 1:00 p.m.	**Lunch and Registration:** *Library, 2nd Floor*
1:00 – 1:15 p.m.	Welcome, Introductions, Plan of the Day and Goals
1:15 – 2:05 p.m.	The Blue Sky of NextGen: Images of the Future
2:05 – 2:55 p.m.	"They're Holding the Horses": The Challenge of Transformation
2:55 – 3:15 p.m.	Break
3:15 – 4:10 p.m.	The Next, Best NextGen Moves: "Going In" Perspectives
4:10 – 5:00 p.m.	Making the Right moves: Strategy in the Public Sector – and NextGen
5:00 – 6:15 p.m.	Optional Harvard Yard Tour/Shopping/Free Time
6:15 – 7:00 p.m.	**Reception:** *North Dining Room, 1st Floor*
7:00 – 9:00 p.m.	**Dinner:** *North Dining Room, 1st Floor*

November 4, 2009	Location: Harvard Faculty Club, 20 Quincy St., Cambridge
8:00 – 8:45 a.m.	**Continental Breakfast:** *Library, 2nd Floor*
8:50 – 9:00 a.m.	Recap and Plan of the Day
9:00 – 10:15 a.m.	Critical Issues, Difficult Conversations (1): Marketing and Communications
10:15 – 10:40 a.m.	Break
10:40 – 11:50 a.m.	Critical Issues, Difficult Conversations (2): Financing, Mandates and Incentives…Outsource vs. Insource, Buy vs. Build, Public vs. Private
11:50 – 12:00 p.m.	Recap
12:00 – 1:15 p.m.	Lunch
1:15 – 1:30 p.m.	Break
1:30 – 2:30 p.m.	Critical Issues, Difficult Conversations (3): Governance and Leadership
2:30 – 3:10 p.m.	The Next, Best NextGen Moves: "Going Out" Perspectives and The Counsel for Leaders
3:10 – 3:50 p.m.	R&D and the Role of the Group Going Forward
4:00 p.m.	Adjournment

Attendees of the Executive Session

Shown for informational purposes only. The views expressed here are the authors'.
No endorsement by any attendee of the Session is expressed or implied.

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End Notes

[1] At FAA's request, for example, the RTCA established a government-industry task force to achieve community-wide consensus on the recommended NextGen operational improvements, and priorities, between now and 2018. This *NextGen Mid-Term Implementation Task Force*, known as Task Force 5, has attracted active participation from over 300 aviation experts representing over 100 stakeholder groups. Its soon-to-be-published report will likely acknowledge that additional multi-stakeholder work is required to both develop a strategy for accelerating equipage and reach closure on the use of incentives.

[2] An updated FAA *NextGen Implementation Plan*, released in January 2009, for example, is helping the aviation community reach a common understanding of NextGen. Together with the recently updated *NAS Enterprise Architecture*, it provides an increasingly clearer depiction of deliverables and activities for the period 2012 to 2018.

[3] Cornerstone projects include Automatic Dependent Surveillance-Broadcast (ADS-B) and System Wide Information Management (SWIM). These technology initiatives will allow the transition from ground-based to satellite-based surveillance and navigation, and move from stove-piped and incompatible information systems to network-centric architecture. Both of these programs are progressing; for example, ADS-B essential services are already being deployed across the US and in the Gulf of Mexico.

[4] John T. Gourville, *Eager Sellers and Stony Buyers: Understanding the Psychology of New-Product Adoption.* Harvard Business Review. June 2006. Reprint R0606F.

[5] Max H. Bazerman and Michael D. Watkins. *Predictable Surprises*. Boston, MA: Harvard Business Press. 2008.

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