

H=C³ (The Three C's of Global Harmonization)

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Abstract

In order to ensure the proper *harmonization* of the Next Generation Air Transportation System (NextGen) with other systems and air traffic modernization efforts around the world, we must: *Collaborate* with our global peers and partners, pooling our intellectual talents to develop globally viable standards; *Cooperate* within and across the regions of the world to ensure synchronized investments and operational improvements; and *Coordinate* our efforts with any and all stakeholders to implement a truly global Air Traffic Management (ATM) system. The Federal Aviation Administration (FAA) Air Traffic Organization (ATO) International Office is working on the following five key activities to collaborate, cooperate, and coordinate with the global community to harmonize NextGen with other efforts being developed around the world. This paper will elaborate on each and provide insight into the *ATO International Strategy* document that captures the associated work.

(1) ATO International co-leads the Joint Planning and Development Office (JPDO) Global Harmonization Work Group (GHWG), a joint government-industry body responsible for outlining a plan for coordinating systems and procedures, and implementing global standards.

(2) The International Civil Aviation Organization (ICAO) develops standards and recommended practices (SARPs) and associated procedures for air navigation services (PANS) for global civil aviation. ATO International is coordinating and collaborating with other FAA offices, ICAO, and industry to identify, prioritize, and develop the SARPs, PANS, and related manuals and guidance materials needed for NextGen.

(3) Operationally-seamless regional boundaries require systems that can share data and support common (or at least compatible) procedures, which allow airspace users to realize the same level of service as they transition from one provider to

another. In support of this reality, ATO International plays a leadership role in various formal and informal planning groups in the Atlantic, Asia/Pacific, and Caribbean/South American regions.

(4) ATO International also leads and/or facilitates bilateral activities with key partners in Canada, Mexico, Japan, China, and Europe, the latter of which specifically includes the harmonization of NextGen with the Single European Sky ATM Research (SESAR) project. All these bilateral relationships are focused on the cooperative development of integrated roadmaps and/or work plans.

(5) In an effort to demonstrate, validate, and provide some benchmarks regarding what's possible with NextGen, ATO International is coordinating two projects with international partners. The Asia and South Pacific Initiative to Reduce Emissions (ASPIRE) partnership has already conducted three demonstration flights, all of which yielded significant reductions in fuel and emissions. The Atlantic Interoperability Initiative to Reduce Emissions (AIRE) is a partnership with the European Commission to hasten the development of environmental improvements for all phases of flight by collaborating on innovative solutions that leverage existing technology and/or procedures from either side of the Atlantic.

These five activities, along with other more tactical work, are captured in a new planning document called the *ATO International Strategy*. ATO International is responsible for the development and maintenance of this document, which organizes ATO support for all the aforementioned activities across four top level strategies: (1) Harmonize Global Air Traffic Management; (2) Harmonize Standards for CNS/ATM Technologies and Procedures; (3) Advocate ATO Technologies, Security and Safety Standards, and Business Practices through Targeted Outreach; and (4) Provide Technical and Operational Services and Support.

ATO International collaborates, cooperates, and coordinates across the ATO, with other FAA lines of business, with other United States government entities, and with international governments and service providers to ensure the harmonization of NextGen with the future global Air Traffic Management System.

Three Very Important C's

In order to ensure the proper harmonization of the Next Generation Air Transportation System (NextGen) with other systems and air traffic modernization efforts around the world, it's important to begin with a common understanding of the term. According to the American Heritage Dictionary¹, *harmonization* means "To bring into agreement; having appropriate elements combined to form a whole."

Looking further, the definition also uses terms like "pleasing" and "beauty" to describe things that are in harmony. On the surface, these are not terms that one generally associates with NextGen, until you think about something that Buckminster Fuller, the famous philosopher and inventor, said about the architecture design process: "When I am working on a problem, I never think about the beauty. I think only of how to solve the problem. But when I have finished, if the solution is not beautiful, I know it is wrong."² This concept of beauty is certainly a goal of NextGen.

Exploring a few other words commonly used in this arena, it's fairly straightforward to see how, when taken together, they provide both the foundation of harmonization and the means to achieve it. *Collaboration* involves the process of working together in a joint intellectual effort. *Cooperation* involves working together toward a common end or purpose. *Coordination* involves working together in a common action or effort. All three cite the need to work together; it is clear that NextGen requires that work to be toward a common end, executing common tasks, and leveraging common intellectual resources to the extent possible.

Hence, in order to ensure the proper *harmonization* of the NextGen with other systems and air traffic modernization efforts around the

world, we must: *Collaborate* with our global peers and partners, pooling our intellectual talents to develop globally viable standards; *Cooperate* within and across the regions of the world to ensure synchronized investments and operational improvements; and *Coordinate* our efforts with any and all stakeholders to implement a truly global Air Traffic Management (ATM) system. The Federal Aviation Administration (FAA) Air Traffic Organization (ATO) Strategy and Performance International Office (ATO International) is focusing on five separate, but integrated activities to collaborate, cooperate, and coordinate with the global community to harmonize NextGen with other efforts being developed around the world:

- Joint Planning and Development Office (JPDO) Global Harmonization Working Group (GHWG)
- International Civil Aviation Organization (ICAO) standards development
- ICAO Planning and Implementation Regional Groups (PIRGs)
- Bilateral and multilateral relationships
- NextGen demonstration partnerships

The working level activities associated with these five areas are kept in lock-step by the ATO International Office through the annual publication of the *ATO International Strategy*.

Five Integrated Approaches

The development of the tools and technologies required to move into the next generation of air transportation rests squarely on the shoulders of industry partners both in the US and abroad. Global harmonization in its most fundamental form is accomplished when these NextGen tools, technologies, and requisite procedures proliferate around the globe as a result of international commerce. ATO International co-leads the Joint Planning and Development Office (JPDO) Global Harmonization Work Group (GHWG). As is the case with all working groups operating within the JPDO, the GHWG is co-chaired by government and industry. Its mission includes the development of United States positions, collaboration with international partners on the development of joint positions, and the advocacy of the resulting

policies, standards, technologies, and/or procedures. The GHWG establishes mechanisms to support global sharing of NextGen industry products, and identifies areas where industry is best suited to take the lead in harmonization efforts. Much of this work is being captured in a document called the *NextGen International Strategy*, a plan for coordinating systems and procedures and implementing global standards. This document is currently being updated by the GHWG to broaden its scope to include perspectives from all JPDO member agencies, and to establish the foundational elements for a multi-faceted NextGen harmonization approach. From this strategy, JPDO partner organizations will establish harmonization work programs which may be tailored to fit the responsibilities of each member organization.

ICAO develops standards and recommended practices (SARPs) and associated procedures for air navigation services (PANS) for global civil aviation. ATO International is coordinating and collaborating with other FAA offices, ICAO, and industry to identify, prioritize, and develop the SARPs, PANS, and related manuals and guidance materials needed for NextGen to ensure their availability to support our acquisition and implementation timelines. It is important to note that these timelines involve rulemaking in some instances, making it imperative that proposed rules are based on stable standards (versus those in development or an otherwise state of flux). These documents are generally prepared by Panels or Study Groups under the ICAO Air Navigation Commission. The nomination of appropriate technical experts to ATO-related Panels and Study Groups is managed by ATO International, which is also responsible for ensuring that the work of individual members and their respective bodies is consistent with ATO positions, and that standards and procedures development work is well-coordinated with those organizations that must implement the resulting products.

The United States does not operate alone during this process. There is frequent engagement with peer Civil Aviation Authorities (CAAs) and ANSPs in Europe, Asia, and Latin America, both during development and when the standards are out for global comment and approval. ATO collaborates closely with industry groups like

RTCA and the Civil Air Navigation Services Organization (CANSO) to identify and resolve operational and technical issues, and expand their role in the development of the technical standards needed to build ICAO SARPs-compliant systems. It should be noted that much of the NextGen work with RTCA also involves EUROCAE through the execution of joint work plans, adding yet another avenue for harmonization. ATO International is also encouraging ICAO to provide guidance and expertise to its regional offices around the world, with a focus toward improved planning and commitment, and a more consistent implementation of the standards and procedures it develops.

Current activities include the identification and prioritization of the global standards, procedures, and guidance material needed to support NextGen. From the ATO perspective, it is very important for ICAO to remain focused on performance standards, and leave the development of corresponding technical specifications to the aviation industry to the extent possible. This would allow ICAO to focus its very limited resources more on implementation, and empower industry to take ownership in the specifications needed to design and build to them. It is clear that there are a number of institutional issues that need to be worked out, but historically speaking, such a paradigm would be a win-win for all involved.

Without diminishing the importance of the aforementioned performance standards, procedures, and guidance, if they are not (or cannot be) implemented consistently on a global scale, the work will have been for naught. Operationally-seamless regional boundaries require systems that can share data and support common (or at least compatible) procedures, which allow airspace users to realize the same level of service as they transition from one provider to another. Success here requires a common language based on ICAO global plans, common planning tools and roadmaps, and consistent and coordinated participation by our various task force, sub group, and management group members. In support of this reality, ATO International plays a significant leadership role in three ICAO Planning and Implementation Regional Groups (PIRGs), and uses these entities to cooperate and coordinate with adjacent States and providers. The North Atlantic Systems Planning

Group (NATSPG) is run out of the ICAO Regional Office in Paris; the Asia Pacific PIRG (APANPIRG) is run out of Bangkok; and the Caribbean and South American PIRG (GREPECAS), which also includes Mexico and Central America, is co-led by the ICAO offices in Mexico City and Lima, Peru. The operation of today's National Airspace System and tomorrow's NextGen borders on all three of these regions operationally, so it is imperative that we work with them to ensure a consistent and coordinated approach to the implementation of NextGen capabilities. In addition to the formal ICAO groups, there are also multiple informal bilateral and multilateral activities, which tend to serve as the breeding ground for cooperative new approaches to air traffic management in their respective regions. Not only do these groups provide excellent opportunities to collaborate, cooperate, and coordinate with governmental and service provider counterparts, they can also include a mix of airspace user representatives, industry trade groups, and system/equipment manufacturers, without whom, NextGen cannot be successful.

In addition to working with the aforementioned regional groups under the ICAO umbrella, ATO International establishes and oversees bilateral and multilateral relationships with key partners in Europe, Canada, Mexico, Japan, and China to harmonize their modernization plans with NextGen and ensure seamless operations for ATO customers. ATO International oversees a series of research and development action plans under the auspices of a formal Agreement between the United States and Europe, and is actively working to harmonize NextGen with the Single European Sky ATM Research (SESAR) project there. Under the umbrella of the North American Aviation Trilateral (NAAT), the United States, Canada, and Mexico comprise the NextGen Trilateral Strategy Group (NTSG). Japan and China also participate in NextGen Steering Groups established under formal bilateral Agreements with the ATO. In the case of China, a government/industry US/China Aviation Cooperation Program (ACP) has been established that provides an additional forum for a coordinated outreach on NextGen planning and implementation activities. All these bilateral relationships are focused on the cooperative development of integrated roadmaps and/or work plans.

In an effort to demonstrate, validate, and provide some benchmarks regarding what's possible with NextGen interoperability and environmental improvements, ATO International is participating in two international partnerships. The Asia and South Pacific Initiative to Reduce Emissions (ASPIRE) partnership involves multiple air navigation service providers and industry partners in that region, and has already conducted three demonstration flights, all of which yielded significant reductions in fuel and emissions. Each demonstration featured what could be termed a "perfect flight," providing unimpeded, user-preferred movement from gate-to-gate. The first east-bound flight over the Pacific Ocean, featuring Air New Zealand, saved over 3500 kilograms of fuel and emitted over 11,000 fewer kilograms of carbon into the atmosphere compared with a "regular" flight in today's system. A similar United Airlines flight demonstrated slightly greater savings. When the same operational efficiencies were applied to a west-bound Qantas Airbus A380 flight, the savings nearly doubled when compared to a flight that had not been optimized for fuel and emission savings³. In addition to the demonstration of these potential savings, ASPIRE was developed by its partners to be a holistic regional approach to environmental stewardship, emphasizing operational best practices, as well as the development of shared performance measurements and improved efficiencies using existing as well as new procedures and technologies. Expansion of ASPIRE is being planned to include additional partners and environmental service improvements for a broader area of the Pacific Rim.

The Atlantic Interoperability Initiative to Reduce Emissions (AIRE) is a partnership with the European Commission to expedite the development of environmental improvements for all phases of flight by collaborating on innovative solutions that leverage existing technology and/or procedures from either side of the Atlantic. Since its inception in 2007, AIRE has demonstrated tailored arrivals into Miami (savings of 590 to 1040 kilograms of fuel per flight) and Optimized Profile Descents into Atlanta and Miami (savings of 110-145 kilograms of fuel per flight)⁴. AIRE has also demonstrated a number of operational improvements in North Atlantic oceanic airspace, and is planning a gate-to-

gate demonstration from Europe to the United States.

One ATO International Strategy

These five activities, along with other more tactical work, are captured in a new planning document called the *ATO International Strategy*⁷. ATO International is responsible for the development and maintenance of this document, which organizes ATO support for all the aforementioned activities across four top level strategies: (1) Harmonize Global Air Traffic Management; (2) Harmonize Standards for Communication, Navigation, and Surveillance (CNS)/ATM Technologies and Procedures; (3) Advocate ATO Technologies, Security and Safety Standards, and Business Practices through Targeted Outreach; and (4) Provide Technical and Operational Services and Support.

Harmonize Global ATM

The ATO provides air navigation services to approximately 77 million square kilometers of domestic and international airspace delegated to the United States by ICAO. In support of this vast area, the ATO operates an ATM system that is by far the most complex and, with over 46 million aircraft handled each year, the most heavily used in the world. An integral part of the ATO's responsibility as the United States' ANSP is the direct daily interaction on a range of ATM issues with the 18 foreign ANSPs that control the 29 adjacent Flight Information Region (FIRs) that abut the United States National Airspace System (NAS). Harmonization is essential on issues ranging from air traffic flow management, safety, environmental, and security linkages such as voice and data, to coordinating future air traffic management architectures and supporting technologies and procedures. The ultimate goal is seamless operations across as many boundaries as possible. This is accomplished through bilateral and multilateral Agreements, local Letters of Agreement (LOAs), participation in formal ICAO PIRGs, and participation in informal coordination groups.

Harmonize CNS/ATM Standards

ATO customers' safety and efficiency interests extend beyond the borders of our airspace system. Operational efficiencies gained in United States airspace should be continuous to the extent possible, as aircraft traverse the region as a whole. Additionally, as system users invest in aircraft technology, they expect it to be compatible with systems and procedures used by other ANSPs. Ideally, they would prefer to use the technology around the world to achieve the same safety and efficiency gains made here in the United States Standardization of CNS/ATM technologies and procedures is critical to cross-border, regional, and multi-regional interoperability. This, in turn, drives regional and global harmonization of systems. Such technical and operational alignment can take many forms, depending on the target technology or procedure. CNS/ATM standardization is accomplished through ATO participation in ICAO Technical Panels and Study Groups where standards and recommended practices and associated procedures for air navigation services are developed and through leadership, and participation in regional seminars on new and evolving capabilities such as Performance Based Navigation (PBN), Air Traffic Flow Management (ATFM), and automation interfaces.

Targeted Outreach

In order to advocate ATO technologies, standards, and business practices, the ATO works extensively with organizations such as CANSO, ICAO, and through other regional entities and partnerships. This outreach is targeted toward encouraging the adoption of ICAO standards and FAA/ATO procedures, technologies, and architectures to advance civil aviation around the world and to better align the future global air transportation with NextGen. More specifically, outreach efforts allow the ATO to resolve technology differences that inhibit or limit harmonization, address legislative mandates regarding user equipage, influence infrastructure development, pursue intergovernmental collaboration on NextGen development, and promote ATM safety, security and environment initiatives. Sometimes, these efforts involve

partnering with United States industry and other government agencies. The ATO also coordinates its research internationally, not only on the development of NextGen capabilities and their associated operational components, but also on test methods and procedures, analytical tools and models, technical data and criteria, and human factors.

Technical and Operational Support

The ATO frequently receives requests on for technical support related to air navigation services and facilities. In many cases, such support differs from other types of international work in that it can be related to the operation of the NAS if it involves the infrastructure of a neighboring or downstream FIR. This makes the support rendered more tactical than strategic in focus. However, the ATO still has a significant interest in many of these requests even if a nearby State's problem does not affect the daily operation of our system, for the issues may affect our customers' operations. In some cases, such technical support is desired by ATO or elsewhere in the United States Government to promote or ensure harmonization with ATO capabilities, particularly when it involves the stabilization or modernization of infrastructure of strategic allies or adjacent States whose airspace is under some level of ATO control, as delegated by ICAO.

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In summary, The ATO Strategy and Performance International Office collaborates, cooperates, and coordinates across the ATO, with other FAA lines of business, with other United States government entities, and with international governments and service providers to ensure the harmonization of NextGen with the future global ATM System. Co-leading the JPDO GHWG ensures a common understanding of which issues need which "C" applied, and when. Collaborating with other States, ANSPs, and the aviation industry ensures the necessary global standards are in place when they're needed. Coordinating NextGen planning within and across the regions of the world ensures investments are synchronized and technologies are integrated. Cooperating with key

strategic partners on everything from planning to implementation ensures operational and technical integration, especially at the international boundaries of the National Airspace System. Collaborating with governmental and industry partners allows the leveraging of each other's technologies, mitigating risk and laying the groundwork for what's possible. Finally, capturing all the ways the ATO collaborates, coordinates, and cooperates internationally in one annually-updated document ensures the ATO is working in lock-step as it plans and implements its very critical pieces of NextGen.

This looks like a daunting task from here, but perhaps the 16th President of the United States, Abraham Lincoln, provided some guidance when he said, "Give me six hours to chop down a tree and I will spend the first four sharpening the axe."⁶ In this case, the tree is a global air transportation system that can meet the needs of the 21st century, and our axe is NextGen. We sharpen the axe by collaborating, cooperating, and coordinating with anyone else who's got an axe to ensure we're all swinging in a harmonized fashion to not only drop the tree, but to ensure that it's the right tree, it falls in the right direction, and nobody gets hurt.

References

¹ The American Heritage Dictionary, Second College Edition, 1982, Boston, MA, Houghton Mifflin Company.

² http://www.quotationspage.com/quotes/R._Buckminster_Fuller/

³ ASPIRE fuel and emissions data provided by Air New Zealand, Qantas, and United Airlines.

⁴ AIRE fuel and emissions data for Tailored Arrivals provided by Boeing (based on performance averages from San Francisco trials). Fuel and emissions data for OPDs provided by the Georgia Institute of Technology.

⁵ Federal Aviation Administration, Air Traffic Organization, 2008, International Strategy – Fiscal Year 2009.

⁶ <http://www.quotationreference.com/quotefinder.php>