Operational Incentives

(Version 1.0)

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Addendum to the Operational Incentives Report

The Federal Aviation Administration (FAA) prepared the Operational Incentives report in response to Section 222 *Operational Incentives* of the *FAA Modernization and Reform Act of 2012*. The report identifies five incentive options to encourage the equipage of aircraft with Next Generation Air Transportation System (NextGen) technologies, provides the costs and benefits of each option and lists industry stakeholders from the Best Equipped Best Served (BEBS) Public Meeting[1] held by the FAA March 2012.

While the report was being generated and coordinated, the fiscal environment evolved. Therefore, this addendum to the report, dated September 2013, addresses the impacts of sequestration and budget constraints on the operational incentives work.

Operational Incentives A: Performance Based Navigation (PBN) Procedures to De-Conflict Airport Operations at John F Kennedy International Airport (JFK) and Chicago Midway International Airport (MDW)

Current Status:

- In progress; targeted for implementation in 2016-2018

Near Term Activities:

- Performed the initial Human-in-the-Loop (HITL) testing in April 2013 and plan for the second round of HITLs scheduled for September 2013
- Finalize the Concept of Operations and develop Operational Requirements in 2013

Operational Incentives B: PBN Simultaneous Offset Instrument Approach (SOIA) Procedures at San Francisco International Airport (SFO)

Current Status:

- Closed
- Safety case not pursued due to SFOs challenging geography combined with the marginal benefit this incentive would have produced since the FAA already implemented Precision Runway Monitor (PRM) Area Navigation (RNAV) Global Positioning System (GPS) SOIA for Runways 28L/R arrivals at SFO to provide dual RNAV/PRM simultaneous continuous arrival capability using existing infrastructure

Operational Incentive C: ADS-B East Coast Offshore Routes

Current Status:

- In progress
- Until En Route Automation Modernization (ERAM) is operational at New York Center (ZNY), the use of Automatic Dependent Surveillance-Broadcast (ADS-B) Out on the east-coast offshore routes will not be achievable

Near Term Activities:

- Budget permitting, projecting to resume operational runs at ZNY in 2014

[1] http://www.faa.gov/about/office_org/headquarters_offices/apl/environ_policy_guidance/2012meeting/

Operational Incentive D: Automatic Dependent Surveillance Broadcast (ADS-B) In Trail Procedures (ITP)

Current Status:

- In progress
- The FAA investment decision in May 2012 enhances capabilities in oceanic airspace leveraging ADS-B in conjunction with ground automation changes
- All United Airlines 747 pilots have been trained and the FAA has seen an increased number of ITP requests in the Oakland Oceanic Flight Information Region (averaging about 15 requests per month)
- Operational flight evaluation of ADS-B ITP currently in progress with United Airlines on routes between the US west coast and Australia/Asia

Near Term Activities:

- ITP Advanced Technologies & Oceanic Procedures (ATOP) modification requirements developed and planning for implementation in 2015

Executive Summary

This report responds to the FAA Modernization and Reform Act of 2012 Section 222. It describes the FAA's progress toward developing operational incentives and addresses the following provisions required by the Act:

1. Identify incentive options to encourage the equipage of aircraft with NextGen technologies, including a policy that gives priority to aircraft equipped with Automatic Dependent Surveillance-Broadcast (ADS–B) technology;
2. Identify the costs and benefits of each option; and
3. Include input from industry stakeholders, including passenger and cargo air carriers, aerospace manufacturers, and general aviation aircraft operators.

The Next Generation Air Transportation System (NextGen) is a comprehensive overhaul of the United States (U.S.) National Airspace System (NAS) to make air travel more convenient and dependable, save fuel and reduce noise and emissions. To realize these benefits, FAA systems, airspace and procedures need to be transformed in conjunction with complementary operator investments in systems (airborne and ground based), training, and processes. As noted by the aviation industry in the Radio Technical Commission for Aeronautics (RTCA) NextGen Mid-Term Implementation Task Force Report, more than equipage is necessary for implementation and benefit accrual. NextGen economic value depends on the rate advanced capabilities, both government and industry, are deployed across the NAS; more rapid capability penetration produces a higher net present value.

The FAA seeks to provide opportunities for NextGen-capable aircraft to receive better services and derive benefits directly from operations that use these capabilities, and this report provides examples of ongoing efforts to deliver these benefits today. However, in a variety of operational environments a "critical mass" capability level is needed before benefits materialize. As a result, below this level there is less enthusiasm from operators to make the necessary investments without a reasonable expectation of benefits. For this reason operational scenarios are under consideration to produce early benefits, thus incentivizing more rapid equipage, training, and crew certification to achieve higher capability levels. Under these scenarios, aircraft with higher capabilities derive benefits from the concept that NextGen-capable aircraft are eligible for improved service, such as priority handling, relative to the non-capable aircraft. This report introduces a new term, Aircraft Priority Access Selection Sequence (AirPASS), for referring to the service concept of offering priority for aircraft operations with higher NextGen capabilities.

The goals of operational incentives are to increase the NextGen capability of as many aircraft in the National Airspace as possible and to increase benefits captured by aligning appropriately capable aircraft, air traffic, and airport environments. Therefore, in order to achieve a critical mass of NextGen capability operating within a particular airport or airspace, or in order to achieve those near-term benefits from initial infrastructure deployment, the FAA is considering offering a broad range of complementary financial and operational incentives.

The FAA is taking an incremental approach in deploying and validating the concept of operational incentives to increase NextGen capability. Based on FAA analyses of a variety of factors, including operational viability, specific technology (ADS-B, Performance Based Navigation (PBN), Data

Communications, etc.) and deployment maturity, 10 operational candidate scenarios were identified for implementation within two years. These scenarios were publicly presented at an FAA-sponsored Industry Day in March 2012. Stakeholders from industry, including aircraft operators, aircraft manufacturers, and avionics manufacturers, were provided descriptions of the scenarios and offered feedback both at the meeting and during a comment period following the session.

Input from Industry Day as well as ongoing stakeholder engagement through such forums as the NextGen Advisory Committee (NAC) were considered in the selection of five of the scenarios for operational use to inform policy development, identify and mitigate operational risks ahead of broader operational use, and provide operational benefits through improvement in NAS performance.

The operational incentive scenarios focus on PBN and ADS technologies, which are at a relatively higher maturity level. They include near-term deployment of PBN approaches to alleviate airspace flow conflicts that are often caused by marginal weather conditions in busy New York and Chicago airports, as well as the supporting ground-based automation necessary to manage the complexities of mixed-capability environments. (It is expected that for the foreseeable future the U.S. aircraft fleet will be comprised of a broad spectrum of differing NextGen capabilities.) Additional scenarios focus on ADS-equipped aircraft.

This report covers operational incentive scenarios that could be implemented in the near term; there is a broader set of options that remain under consideration for future deployment of operational incentives. In addition to working with stakeholders on near term implementation of operational incentives, the FAA will also continue to engage with stakeholders in exploring future incentive implementation options.

1 Introduction

1.1 Background

As technologies such as PBN, ADS-B, and Data Communications (datalink) develop and mature, more aircraft have, or will have, these technologies. The aviation community, including industry, airports, and government, has wrestled with how to make most use of this advanced equipage while still servicing airframes (and operators) with “legacy” equipage.

In the January 2009 NextGen Implementation Plan, the FAA first proposed the Best Equipped, Best Served concept. The proposal described the provision of "best equipped, best served" priority to operators with higher performing technologies and offering incentives to encourage early adopters of NextGen avionics. Since the concept’s introduction, ongoing stakeholder dialog and analyses have been undertaken to realize the benefits envisioned for NextGen.

The FAA Modernization and Reform Act of 2012 specifies under Section 222 that the Administrator of the Federal Aviation Administration shall issue a report that—

1. Identifies incentive options to encourage the equipage of aircraft with NextGen technologies, including a policy that gives priority to aircraft equipped with ADS–B technology;
2. Identifies the costs and benefits of each option; and
3. Includes input from industry stakeholders, including passenger and cargo air carriers, aerospace manufacturers, and general aviation aircraft operators

It is the objective of this report to meet the legislated requirement.

2 Operational Incentives – An Historical Overview

2.1 Initial Best Equipped, Best Served (BEBS) Perspective

As noted in the NextGen Implementation Plan (NGIP - 2009), "NextGen will be implemented airport by airport, region by region, aircraft by aircraft, over a period of years. The FAA proposes moving from the concept of 'first-come, first-served' to 'best-equipped, best-served’. While early adopters will reap the greatest benefits, lesser equipped aircraft must still be accommodated. The FAA must work with the aviation community on an operational transition plan that adequately accommodates all types of operators with varying levels of equipage, while maximizing overall system performance and enhancing safety." Even at this early stage it was recognized that accommodating a U.S. operational fleet comprised of mixed equipage would present significant challenges. In supporting operational environments, operators investing in higher levels of equipage would desire systems and procedures that maximized the benefits of their investments. However, avoiding adverse impacts to other operators or overall NAS throughput would be difficult in specific operational environments.

Stakeholders also recognized the complexities and potential impacts created by prioritizing "best equipped" aircraft ahead of others. As noted by the RTCA NextGen Mid-Term Implementation Task Force in their final report: "The Task Force believes that the challenge of delivering benefits in a mixed equipage environment needs to be explored in the context of each specific operational capability and location." In response to the consensus view that the subject warranted analysis and consideration in light of the breadth and variability of U.S. operations, the FAA chartered a cross-Agency working group to address the subject, including:

- Define an overall framework and cases for policy intervention
- Survey and analyze existing BEBS scenarios
- Facilitate decision making

2.2 Initial Analysis and Considerations

2.2.1 Operational Incentives Policy Case Descriptions

Major outputs from the cross-Agency workgroup described above included the identification of a potential framework to describe operational incentives policy cases and an initial, unconstrained inventory of "best equipped, best served" scenarios, concepts and ideas.

From the analysis and discussions an initial framework to describe, at a high level, the differing preferences and impacts was developed. In summary, the cases were expressed as:

- Non-Interfering Service Improvement -- Benefits accrue to equipped aircraft, however there is no disadvantage to non-equipped operations.
- Operational-Positive Preference -- Non-equipped aircraft are disadvantaged by giving preference to equipped aircraft only when there will be net system benefits operationally to NAS users (either through capacity enhancement, or through benefits to equipped outweighing dis-benefits to non-equipped, or both). In other words, the operational changes themselves are net-beneficial as they are implemented.
- Societal-Positive Preference -- Non-equipped aircraft are disadvantaged to obtain a societal benefit (such as reduced emissions) or "tip the scale", even though there is a stand-alone, net operational dis-benefit to NAS users.
- Transitional Preference -- Preference is given without regard to the operational and societal dis-benefits to motivate higher equipage leading to longer-term benefit.

2.2.2 Scenarios & Concepts

In conjunction with the high-level framework describing potential policy cases, a body of work was created by the cross-Agency workgroup describing operational scenarios and opportunities to be considered as providing incentives for operators to equip. The scenarios spanned both near-term technologies such as PBN as well as those in the planning stages at the time, such as Data Communications.

The body of work represented by the inventory of scenarios, ideas, and different concepts served as input to the follow-on activity whose focus was to identify an operationally viable, near-term (approximately 2 years) set of scenarios to pilot through implementation.

This report focuses on five operational incentive candidate scenarios that the FAA has been studying for implementation by 2014, and provides a qualitative discussion of the estimated costs and rough order of magnitude (ROM) benefits of implementing the selected operational incentives. The report also discusses the significant issues and concerns from industry stakeholders on the candidate operational scenarios and planned next steps. Future implementation of operational incentive scenarios will require additional analysis and continued collaboration with the aviation community.

3 Today's Operating Environment and Considerations

Since the first discussions and concepts regarding "best equipped, best served" were proposed three years ago, the operating environment has continued to evolve. From the introduction of more aircraft with higher equipage levels and through the creation of updated procedures, supported by the necessary safety criteria, the NAS has grown in both capability and complexity. Additionally, the analyses and collaboration across the aviation community have supported a better understanding of the implications and considerations ahead of operational implementations.

3.1 Today's Operating Environment - Overview

Today, there is an insufficient concentration of aircraft with the capability for Required Navigation Performance (RNP) 0.3 with Radius-to-Fix legs (RF) to enable full utilization of the capability; therefore operational incentives are being considered to reach critical mass and thereby deliver the systemic NAS-wide benefits of using RNP in the approach phase. In the case of ADS-B Out, the FAA has mandated equipage by 2020, however, the rate of ADS-B Out equipage today remains low, so incentives are proposed to encourage operators to begin to equip sooner.

Table 1 below provides some estimates of the existing state of advanced navigation equipage. Operational approval to make use of this equipage would be required to begin realizing benefits in a particular airspace. While advanced navigation capability would not have to be achieved by all operators in order to make RNP approaches the standard procedure at a given airport, a large percentage of aircraft arriving at a given airport would need a full capability to normalize RNP procedures. Incentives under consideration are designed to increase the number of capable aircraft past this critical mass of equipage, at which point incentives are no longer necessary, and the expected full complement of benefits to operators and the air traffic management (ATM) system are realized.

Table 1 Equipage statistics: Aircraft with RNP 0.3 with RF Leg [2]

Location	**Aircraft with RNP 0.3 Approach with RF Leg outside the Final Approach Fix (FAF), (Aircraft w/ OPSPECS Approvals)**
NAS Wide	43 % (26%)
New York Metroplex	43%
LaGuardia Airport (LGA)	34%
John F Kennedy International Airport (JFK)	43%
Newark Liberty International Airport (EWR)	53%
Chicago Metroplex	30%
O'Hare International Airport (ORD)	23%
Midway International Airport (MDW)	56%

3.2 Equipage vs. Capabilities

From early discussions regarding the evolution of the NAS a predominant focus has been on aircraft equipage. This focus continues to be reflected in the term "best equipped, best served". However, capability of an aircraft is not based solely on NextGen equipage; it also entails the aircraft and aircrew having the appropriate training, equipment certifications, and operational policies in place to perform NextGen operations. Making use of NextGen capability also requires the FAA to have the appropriate procedures, air traffic controller training, and ground systems in place to support the operation of the aircraft. While the purchase and installation of equipage represents the most significant cost factor for airlines, NextGen equipage alone will not result in a change in operations.

For example, as noted in Table 1, aircraft equipage rates for the fleet operating at a location may be near or over 50 percent. However, the percentage of flights operating at that location with crews possessing the necessary authorities, certifications, training, and currency to execute the NextGen procedures may be half that number. Operational incentives will therefore target specific NextGen capabilities rather than just equipage in aircraft.

The dependence on more than equipage to achieve the envisioned NextGen operational benefits was also recognized by industry stakeholders in RTCA's *NextGen Mid-Term Implementation Task Force Report.*

[2] MITRE/CAASD equipage statistic re: RNP 0.3 with RF Legs Equipped vs. Capable of US Domestic Part 121, 191 carriers.

3.3 Communicating the Service Concept

It has been noted that the term "best equipped, best served" has introduced a level of confusion. Because it does not reflect significant elements recognized across the aviation community as necessary for successful operational implementations, use or incentives, consideration is being given to a new term of reference to describe the service concept of providing priority for aircraft operations with higher (NextGen) capabilities.

The term is AirPASS. It stands for Aircraft Priority Access Selection Sequence and conveys the general meaning of prioritized service and is similar to terms used for other modes of transportation (highway in particular). Additionally, it advances the service concept that if you have the proper equipment, training, certifications, and procedures (both in the air and on the ground) an aircraft is eligible for priority handling relative to flights without these capabilities (non-AirPASS capable).

4 Operational Incentives – Current Initiative

4.1 BEBS Workgroup

Building on the earlier workgroup and products, the FAA's NextGen Management Board, in December 2011, tasked a workgroup to identify a selection of operational candidates/scenarios that would:

- provide specific input to the development of an operational incentives policy;
- identify and mitigate operational issues that may result from widespread adoption of a new service prioritization founded on a flight's capabilities;
- deliver operational benefits; and
- could be piloted in the near-term (approximately 24 months).

Workgroup participation came from across the Agency's Lines of Business. The potential pool was reduced to the "Top 10" candidates through assessment of implementation timescale, operational viability, risk, etc. They are organized into 5 technological/use areas:

- De-Conflict Airport Operations/Lower Weather Minimums
- SOIA (Paired SOIA Paired Aircraft Approaches):
- ADS-B East Coast offshore routes
- ADS-B In Trail Procedures (ITP) / South Pacific and Beyond
- NextGen Minimum Capability Priority

4.2 Challenges

The FAA is taking an incremental approach in deploying and validating the concept of operational incentives to increase NextGen capability. Several types of risks associated with the development of operational incentives make this incremental approach advisable. Among the risks FAA has taken into consideration include:

Operational Approach

While the types of procedures and air traffic management initiatives advanced in the operational incentive options are well understood and consistent with certified operations today, the management of operators by capability is a relatively new approach. In considering the options and their probable effects, the FAA must continue to ensure that incentives selected for deployment will be safe and meet operator needs for increased efficiency and capacity of the NAS. The analysis of operational incentives also includes the effect of the incentive on the FAA workforce and the process through which new approaches to air traffic management would be carried out.

Lack of Stakeholder Consensus

The FAA continues to receive valuable feedback on the best way to provide benefits to operators. However, there remains varying opinions across the stakeholder community on the most effective elements of an operational incentive program. Internationally, the FAA has not found cases where policies on operational incentives have been defined and adopted.

Execution Timeline

Based on the recommendations from the aviation community, the FAA has determined that it is in the best public interest to deliver benefits from NextGen as soon as possible. In choosing to propose solutions for operational incentives that could reasonably be deployed within 2 years, the FAA has committed to an aggressive schedule that limited operational incentive options featured in this initial deployment.

Technical Gaps

Deploying an operational incentive requires that the FAA be able to determine the capability of an aircraft (e.g., whether it is equipped and trained to use an RNP route). An automated means of determining a specific aircraft's NextGen capability has not been developed at this time; developing the needed automation will expand opportunities for pursuing other operational incentive options in the future.

4.3 Types of Incentives

As the analyses and stakeholder discussions have resulted in greater insight into the impacts and considerations surrounding operational incentives, the same is true of the framework that can be used to communicate the incentive options at a high level. The framework described in this section is being reviewed relative to the earlier framework described in Section 2.2.1.

As much as possible, the FAA seeks to provide opportunities for NextGen-capable aircraft to receive better services and derive benefits directly from operations that use these capabilities without changes to current policy. This approach works for operations that can deliver benefits to each capable aircraft, independent of the capabilities of surrounding aircraft or whether a critical mass of NextGen capability has been reached within the airspace or at a specific airport.

At this stage of NextGen implementation, some operators have delayed their decision to invest in NextGen enabling technologies, so the number of NextGen capable aircraft remains relatively low. The percentage of equipped operators is below the critical mass required to render the capability usable without having an adverse impact to other operations. Therefore, FAA has been considering a broader

set of operational incentives that would give priority services to NextGen-equipped and capable aircraft while encouraging the unequipped to invest in NextGen capabilities.

The goal for operational incentives is to increase the NextGen capability of as many aircraft in the national airspace as possible. Another goal for operational incentives is to increase benefits captured by aligning appropriately capable aircraft, air traffic, and airport environments. As mentioned in section 3.2, capability of an aircraft is not limited to NextGen equipage. Operational incentives will therefore target specific NextGen capabilities rather than just equipage in aircraft.

To provide a framework for discussing and assessing operational incentives, this section of the report classifies operational incentives in two dimensions. One dimension is based upon the effect on operators and the ATM system, and the other is based according to the mechanism used to deliver the incentive. In the first dimension, incentives are differentiated according to benefits, for example, how the incentive affects service to aircraft with and without the targeted capability, and the aggregate effect of the incentive on performance of the ATM system, mainly in terms of capacity and efficiency.[3]

By definition, all operational incentives considered would provide better services to benefit aircraft capable of the targeted NextGen capabilities. However, the effects of an operational incentive on aircraft without the targeted capabilities or the ATM system may be positive, neutral, or negative. Operational incentives that have negative effects to unequipped aircraft remain viable options for ultimately achieving the policy goal of accelerating the delivery of benefits from ATM system improvements. The degree to which an incentive results in overall system improvements to capacity, efficiency, predictability, and flexibility depends on the number of aircraft operations within the targeted airspace or airport. As more aircraft become capable, individual aircraft efficiency and overall airspace capacity and operational efficiency is expected to improve.

Table 2 Incentive Impacts

Type	ATM System Benefit	Capable Aircraft Benefit	Non-Capable Aircraft Benefit
1	Positive	Positive	Positive or Neutral
2	Positive or Neutral	Positive	Negative
3	Negative	Positive	Negative

The first incentive, Type 1, is what the FAA provides today when aircraft are able to use their advanced capability independent of surrounding aircraft's capabilities or when a critical mass of a capability has been reached within an airspace or airport. Benefits accrue to the capable aircraft, without negatively impacting those that are non-capable. In addition, less capable aircraft may also benefit if the new routes or approaches for the capable aircraft result in relieving congestion for their planned route of flight.

[3] These incentives would also result in costs and benefits beyond those internalized by operators and in addition to airspace capacity and efficiency, but are not used as discriminators among the types of incentives.

The NAS benefits from the aggregate effects on both the capable and non-capable aircraft without negative impacts on the service to non-capable aircraft. This incentive type is the most straightforward to implement. However, at the present stage of NextGen implementation, with the small number of aircraft capable of advanced operations, it may be desirable to consider creating a greater incentive for operators to equip and train by giving priority services to capable aircraft.

Under Type 2 and Type 3 incentives, capable aircraft benefit from priority service, while aircraft without the targeted capability receive a reduced level of service. The difference between the two lies in the net effect of the incentive on airspace system capacity and/or efficiency. Under the Type 3 incentive, the net effect of the incentive on airspace system capacity or efficiency is negative, because the critical mass of capable aircraft has not been reached or the number of aircraft with the targeted capability is too small to make optimal use of the airspace.

Under a Type 2 incentive, there are enough aircraft with the targeted capability to result in neutral to positive effects on system capacity and/or efficiency. As more aircraft become capable, aggregate benefits to the operators and system increase, naturally progressing from Type 2, and eventually to Type 1 benefits.

It is also useful to classify operational incentives according to the mechanism for delivering them. Operational incentives can be delivered by natural or artificial mechanisms, or a blend of both. A natural incentive offers a benefit solely from the use of the targeted capability. An artificial incentive offers a benefit from an operation that does not require the targeted capability. Natural and artificial incentive mechanisms may also be blended in a way that requires use of the capability, but the use of the capability is enabled by an artificial environment, such as by segregating operations. Type 2 and Type 3 operational incentives can be delivered in all three ways, but Type 1 incentives can only be delivered through a natural mechanism.

Hypothetical examples of each type of mechanism are listed below.

Table 3 Incentive Mechanisms

Mechanism	**Hypothetical Examples**
Natural	Preference given to DataComm-Tower Data Link Service (TDLS) capable aircraft by first providing digital pre-departure clearances before voice clearances when releasing aircraft from a Ground Delay program.
Artificial	Preference given to ADS-B Out-capable aircraft when releasing aircraft from a Ground Delay program.
Blended	Dedicating times when an airport runway is available on a priority basis for Required Navigational Performance (RNP) 0.3 with RF Legs capable aircraft, and arriving aircraft would use an advanced RNP approach into that runway.

By making use of natural incentives, the FAA is ensuring that benefits are provided to capable aircraft and increasing the utility of NextGen operations for those operators. However, the level of benefit the FAA can provide from natural incentives may be constrained when the critical mass of aircraft capability needed to constantly use a NextGen technology has not been reached.

To overcome this challenge, the FAA could temporarily resort to an artificial incentive, by providing operational preference to aircraft with targeted NextGen capabilities, such as the hypothetical example above, until the critical mass of capabilities was reached and therefore, usable. Alternatively, the FAA could create an environment that segregates operations of capable aircraft from non-capable aircraft, thereby providing an environment to encourage equipage for NextGen operations that require a critical mass of capability to achieve systemic benefits. The operational impact to the system, as well as individual aircraft, can be very sensitive to the levels of equipage.

In summary, the types and mechanisms described conceptually in this section can be combined to describe a broad range of operational incentives the FAA could employ to increase the overall numbers of capable aircraft in the NAS. Many of the incentive scenarios described in the following section for this near term effort are highly extensible to other locations and hence lay the foundation for the further evolution of NextGen. The following sections will also show that the incentives being studied for near-term implementation are structured to either have minimal or no impact on aircraft that are not currently NextGen capable.

4.4 Operational Scenario Descriptions

This section of the report describes the ten operational incentive scenarios presented at a public meeting held by the FAA on March 13, 2012, as candidates for implementation by 2014.[4]

In identifying candidate operational incentives for near-term 2012-2014 implementation, the FAA also considered their associated costs and benefits. Costs and benefits to the operators, the traveling public, the airspace system, the FAA, and the environment are among those to be considered before deciding to implement a particular operational incentive. All of the candidate incentives for near-term implementation were deemed to provide benefits to NextGen-capable aircraft and/or the NAS.

The FAA has identified ROM costs and benefits of these incentive options. As the FAA proceeds with more in-depth analysis of the operational incentive candidates, collaboration with stakeholders is needed to better quantify the costs and benefits – especially for the operators. Benefits are expected to increase substantially once a critical threshold of a capability in a given area has been reached. While the benefits from a specific operational incentive by itself may not close an operator's business case for acquiring an advanced capability, combining several operational incentives with financial incentives is expected to more likely succeed in accelerating NextGen equipage and capabilities.

The two initial NextGen capabilities targeted by these operational incentive candidate scenarios are (1) Area Navigation enabled by the global positioning system (RNAV/(GPS)) or Required Navigation Performance RNAV(RNP) with Radius-to-Fix legs (RNP 0.3 w/ RF legs), and (2) ADS-B Out.

RTCA has provided recommendations to advance both these technologies. RNP 0.3 with RF Legs allows repeatable curved approaches on a shorter path than traditional arrival and approach procedures

[4] This report does not address legal issues or legal policy concerns associated with the implementation of the described scenarios.

using ground-based navigation aids. All RNAV (GPS) approaches include RNP-0.3 minima (LNAV) and can have RF Legs added in the future, where needed.

Potential benefits to equipped users include but are not limited to:

- Improved flight efficiency via shorter arrival paths
- Improved de-confliction of traffic arriving and departing from adjacent airports
- Improved hazard avoidance
- Increased numbers of arrival and departure paths for airports

With ADS-B Out, controllers and their decision support tools can use aircraft surveillance based on GPS position information transmitted by the aircraft itself. ADS-B Out is considered an improvement over radar because the surveillance data is updated more frequently and includes intent information in close-to-real time. The positional accuracy does not degrade with distance or terrain, and it can be used to provide surveillance in certain non-radar airspace. Potential benefits to equipped users include but are not limited to:

- Improved spacing and routing in non-radar airspace (for example, the Gulf of Mexico)
- Increased capacity due to improvements in air traffic control (ATC) merging and spacing
- Increased surface traffic efficiency for airport operations [5]

In the case of RNP 0.3 with RF legs, although there is an increasing number of equipped aircraft in the U.S. Domestic Air Carrier fleet (approximately 43 percent are equipped), only approximately 26 percent are capable (aircraft with operator- specific approvals or OPSPECS) (see Table 1 above). Today, there is an insufficient concentration of aircraft with the capability for RNP 0.3 with RF Legs to enable full utilization of the capability; therefore operational incentives are being considered to reach critical mass and thereby deliver the systemic NAS-wide benefits of using RNP in the approach phase. In the case of ADS-B Out, the FAA has mandated equipage by 2020, however, the rate of ADS-B Out equipage today remains low, so incentives are proposed to encourage operators to begin to equip.

Table 1 provides some estimates of the existing state of advanced navigation equipage. Operational approval to make use of this equipage would be required to begin realizing benefits in a particular airspace. While advanced navigation capability would not have to be achieved by all operators in order to make RNP approaches the standard procedure at a given airport, a large percentage of aircraft arriving at a given airport would need a full capability to normalize RNP procedures. Incentives under consideration are designed to increase the number of capable aircraft past this critical mass of equipage, at which point Type 2 or Type 3 incentives are no longer necessary, and the expected full complement of benefits to operators and the ATM system are realized.

Most of the scenarios use a “natural” or “blended” mechanism for delivering the operational incentive, that is, requiring the targeted capability to receive a benefit or priority NextGen services. One scenario

[5] Descriptions are per the RTCA NextGen Advisory Committee Report “NextGen Equipage: User Business Case Gaps”, September 2011

proposes an "artificial" mechanism whereby operators with the targeted capability receive a benefit without actually using the capability.

4.4.1 Operational Incentives A: PBN Procedures to De-conflict Airport Operations:

The following four candidate operational incentive scenarios propose RNP procedures for equipped aircraft with RNP 0.3 with RF legs capability*.

***Equipped Aircraft with RNP 0.3 with RF legs: The flight management system (FMC/ FMS) must be capable of maintaining lateral navigational positional accurately within 3 tenths of a nautical mile during the approach phase of flight, per Advisory Circular-90-101.*[6]

These were developed to de-conflict airport configuration conflicts that presently occur and result in excessive delays in the NY and Chicago Metro areas. For example, if all aircraft arriving into JFK had capability for RNP0.3 with RF legs, there would be no conflict with LGA, and operational delays in the NY Metro area would be reduced dramatically. However, since only a portion of JFK arrivals are capable aircraft, a mechanism is required to segregate the flows and avoid the conflicts. One way of achieving this would be to limit operations into JFK for a designated time period to allow only capable aircraft access to the airport; for example, for periods between 30 minutes and 1 hour during specific weather and/or wind conditions, non-capable aircraft without the targeted published RNP capability could not operate into JFK on the designated RNP approach runways).

During these weather conditions, the RNP instrument approach would be the primary instrument approach to the runway, providing NextGen capable operators with an operational advantage during these time periods. The non-capable aircraft would operate under the same procedures as today, but they would not receive priority service as capable aircraft during these times. Because this incentive prioritizes capable aircraft requesting an approach into the airport during certain conditions, it creates a small operational disadvantage for aircraft that are not currently NextGen capable during those times. While the proposed procedures make use of RNP 0.3 equipage, the FAA is also altering the management of air traffic during given conditions to favor capable aircraft. This type of scenario uses a "blended" mechanism for delivering the incentive, such as an equipage-based ground stop, that limits access to that airport or runway to capable aircraft (only), while providing an operational benefit of improving the overall efficiency of the airport operations.[7]

PBN approaches to John F. Kennedy International Airport (JFK) Runway 13L

***Technical Description*:** This candidate incentive incorporates RNP procedures for capable aircraft and flight crews, i.e., RNAV/RNP 0.3 with RF legs that closely tracks the existing *"Parkway or Canarsie"* Chartered Visual Flight Procedure (CFVP) for JFK Runway 13L. This operational scenario would keep JFK in an optimal configuration; while improving capacity at adjacent NY Metro airports during marginal Visual Meteorological Conditions (VMC) weather and/or strong SE wind conditions. During these

[6] FAA Advisory Circular (AC) 90-101- FAA Guidance on RNAV/RNP 0.3 with RF legs, Available @ www.faa.gov: http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC%2090-101A.pdf

[7] The estimated capacity increases and benefits for Operational Incentives A scenarios were developed in consultation with the local Air Traffic Facility Staff Personnel at the New York TRACON (N90), Chicago TRACON (C90) by the NextGen Air-Ground Team, CSSI Inc.

weather and wind conditions, arrivals normally would use the Instrument Landing System (ILS) to Runway 13L, which is preferred at JFK. This configuration results in significant delays and impacts capacity at all of the NY Metro airports.

Impact:

1. The weather conditions for this scenario exist for approximately 5 percent to 10 percent of 365 operational days or up to 18-36 days per year.
2. There are 43 percent, or approximately 292, equipped aircraft per day that would benefit from RNP approaches.
3. During periods of RNP approaches, the NY Metro airports operational efficiency and capacity is expected to improve by maintaining throughput and reducing delays for approximately 50 aircraft operations per hour.

PBN Approaches to LaGuardia Airport (LGA) Runway 31 and Runway 13

Technical Description: This candidate incentive incorporates RNP procedures for capable aircraft and flight crews, i.e. RNAV/RNP 0.3 with RF legs that closely tracks the *"Expressway Visual"* to Runway 31 and *"River Visual"* to Runway 13 CVFP's for LGA. This scenario provides RNP instrument approaches during weather conditions that are less than visual approach vectoring minimums (for example, 3000 ft. x 5 miles for Runway 31, and 3200 ft. x 5 miles for Runway 13). This scenario keeps LGA in an optimal configuration with near visual approach throughput rates during marginal VMC weather and/or during specific strong NW or SE wind conditions, while maintaining independent airport operations at the adjacent NY Metro airports.

Impact:

1. The weather conditions for this incentive candidate exist for approximately 10 percent of 365 operational days or up to 36 days per year.
2. There are 34 percent, or approximately 165, equipped aircraft per day that will benefit from RNP approaches.
3. During periods of RNP approaches, the NY Metro airports operational efficiency and capacity is expected to improve by maintaining throughput and reducing delays for approximately 42 aircraft operations per hour.

PBN Approaches to Teterboro Airport (TEB) Runway 6 and Runway 1

Technical Description: This candidate incentive incorporates RNP procedures (for example, RNAV/ RNP 0.3 with RF legs for TEB Runway 6 and Runway 1) for capable aircraft and flight crews, and involves tracking the *"Passaic River"* and *"Cedar Grove*" CVFP's to Runway(s) 6/1. The RNP approach is expected to increase capacity during marginal VMC weather and lower ceiling by reducing the need for the ILS Runway 6 into TEB. This instrument approach conflicts with EWR Runways 4/22 operations and results in significant delays and restrictions into EWR.

Impact:

1. The weather conditions for this incentive candidate exist for approximately 20 percent of 365 operational days or up to 73 days per year.
2. There are 43 percent, or approximately 172, equipped aircraft per day that operate into TEB who may benefit from RNP approaches.
3. During periods of RNP approaches, operational efficiency and capacity is expected to improve at TEB and EWR by maintaining throughput and reducing delays for approximately 32 aircraft operations per hour.

PBN Approaches to Chicago Midway International Airport (MDW) Runway 13C

Technical Description: This candidate incentive incorporates RNP procedures (for example, RNAV/RNP 0.3 with RF legs for MDW Runway 13C) for capable aircraft and flight crews, and involves tracking the *"I- 55"* CVFP to RWY 13C. The RNP Runway 13C instrument approach procedure is currently published and is in use for MDW by capable aircraft and trained crews.[8]

The RNP approach to Runway 13C de-conflicts the arrival flows for MDW from conflicting departures from Chicago O'Hare International Airport (ORD) Runway 22L and Runway14R. This procedure uses custom RNAV Standard Terminal Arrival Routes (STARS) and a transition to a RNP approach into MDW runway 13C. The ILS Runway 13C configuration results in significant delays on both arrivals and departures at both MDW and ORD. This RNP procedure enables both airports to operate independently, resulting in increased capacity and through-put rates at both MDW and ORD during marginal Visual Meteorological Conditions.

Impact:

1. The weather conditions for this incentive candidate exist approximately 10 percent of 365 operational days or 36 days per year.
2. There are 56 percent, or approximately 114, equipped aircraft per day that may benefit from RNP approaches.
3. During periods of RNP approaches, throughput rates and capacity at both ORD and MDW are maintained and delays are reduced for approximately 50 aircraft per hour vs. conflicted rates using the ILS to MDW Runway 13C.

Cost and Benefits Summary

Costs to FAA: Approximately $1-2 million each

The costs associated with these procedures are expected to be somewhat less than a new procedure because the proposed procedure largely overlays or tracks existing CFVPs and visual approach flight

[8] The MDW Runway 13C RNP IAP is published as a "public use" procedure, only trained crews and capable aircraft may use this procedure. Additional RNP procedures are being developed for other configurations at MDW to de-conflict operations from ORD.

paths. Regardless of this advantage, procedure development costs will still make up a majority of the costs incurred by the FAA.

Research and analysis, including the development of operational specification and modelling, will still be necessary to design and certify the most efficient route feasible. Environmental procedural design reviews and air traffic controller training also represent sources of cost necessary to fully implement this procedure. Enhancements are needed to incorporate the equipage state information into the Traffic Flow Management System (TFMS) to provide situational awareness and to modify the TFMS Ground Delay Program/Ground Stop algorithms to segregate the demand.

Quantitative benefits for this procedure, or for any of the other incentive options presented, will require the input of industry to be fully reflective of the potential of the capability.

Qualitative Benefits to Users and the National Airspace System:

- Leverages existing RNP 0.3 with RF Leg equipage to achieve lower approach minimums with more efficient approach profiles
- RNP procedures allow the candidate airports (JFK, LGA, TEB, and MDW) to remain in a more efficient configurations by de-conflicting the adjacent airport traffic flows
- RNP procedures reduce delays and increases overall capacity and throughput at the NY Metro Airports and Chicago Metro Airports
- Reduces inter-facility coordination and traffic management restrictions

4.4.2 Operational Incentives B: PBN Simultaneous Offset Instrument Approach (SOIA) Procedures:

The following three operational incentive candidate scenarios incorporate simultaneous offset instrument approach (SOIA) PBN procedures for arrivals to select airports with closely spaced parallel runway operations (CSPO). These scenarios leverage the experience of the San Francisco International Airport (SFO) Runway 28L and Runway 28R Localizer/ Directional Air (LDA/DME) SOIA approach with precision runway monitoring (PRM) instrument approach procedures by incorporating a phased implementation of PBN procedures.

This operational procedure is anticipated to increase arrival capacity at airports with closely spaced parallel runways during periods of marginal VMC weather conditions and/or less than visual approach vectoring minimums. All PBN Paired Approach options make use of the capabilities of NextGen navigation equipment to allow for more efficient approaches into runways and allow those approaches to occur in more challenging visual conditions. The use of this capability does not present a disadvantage to unequipped operators and may marginally decrease congestion for them as NextGen capable aircraft will be able to access a different runway. As this incentive provides benefits without negatively impacting non-capable aircraft or the NAS, this is a Type 1 benefit. This incentive also provides benefit through the direct use of advanced navigation technology, rather than requiring a special environment to enact it, and is therefore a “natural” incentive.

The use of PBN procedures is expected to reduce dual ILS dependent and staggered operations at these airports to realize additional arrival capacity. SOIA procedures can produce up to approximately 50 percent more arrival capacity than existing single stream operations during instrument flight rules (IFR) and marginal VMC weather conditions. In this class of scenario there are no negative impacts, the NAS gains substantial capacity and both capable and non-capable users realize reductions in delays.

A PBN version of SOIA is not expected to require the expensive ground infrastructure (for example, PRM) or staffing needs in the current versions of SOIA such as at SFO. RNAV, GPS, or RNAV/RNP 0.3 with RF leg instrument approach procedures to lower minimums are not currently authorized for SOIA CSPO operations.

A phased implementation of RNAV/GPS, then RNP 0.3 with RF leg instrument approach procedures would support achieving lower approach minimums by capable aircraft and flight crews using the PBN approach procedures, while non-equipped operators would still be sequenced to the paired ILS runway. There are 12 major airports with dual arrival runway configurations where these procedures may be applicable (and is hence extensible) and perhaps some with triple runways, such as ATL. Today, RNAV/ GPS and RNP 0.3 are not published or authorized for SOIA CSPO operations.

PBN Paired SOIA at Philadelphia International Airport (PHL) Runway 9L/R and Runway 27L/R

Technical Description: This operational incentive scenario provides procedures for PBN SOIA instrument approach procedures to PHL Runway 9L/R and Runway 27L/R with 1,400 feet between runway centerlines. This scenario would initially develop RNAV or GPS instrument approach procedures to an offset runway, with or without a Final Monitor Aid (FMA) or Precision Runway Monitor (PRM) system. The use of FMA or PRM will support radar monitoring to achieve lower approach minimums. The PBN procedure also reduces the existing approach minimums for runways 9L/R and 27L/R and increases airport arrival capacity during periods of marginal VMC conditions.

Impact:

1. The weather conditions for this candidate incentive scenario exist for approximately 15 percent to 20 percent of 365 operational days or up to 54-73 days per year.
2. Leverages existing equipage by providing more options for PBN-based instrument approaches, while non-equipped operators would still be sequenced to the paired ILS runway.
3. There are 91 percent, or approximately 470, RNAV-equipped aircraft and 42 percent, or approximately 216, RNP 0.3 with RF leg equipped aircraft per day that would benefit from PBN approach operations.

PBN Paired SOIA Approaches at San Francisco (SFO) Runway 28R/L

Technical Description: This operational candidate incentive provides PBN SOIA procedures at SFO Runway 28R, with 750 feet between runway centerlines. This procedure enables RNAV/GPS or RNP 0.3 operations to fly an offset approach to Runway 28R, during lower weather minimums and may be used

either with or without a Precision Runway Monitoring (PRM) system to achieve lower instrument approach minimums. Additional benefits may be achieved using either RNAV or RNAV/GPS w/ RNP 0.3 capability to obtain lower minimums than exist today. Currently, SFO Runway 28R offers an offset instrument approach LDA/DME approach with PRM to monitor separation. The SOIA procedure utilizes an ILS/PRM approach to one runway and an offset Localizer-Type Directional Air (LDA)/PRM approach to the paired runway. This approach may be flown down to a ceiling of 1,600 ft. with 4 miles of reported visibility.

Impact:

1. The weather for this scenario exists approximately 15-20 percent of 365 operating days or up to 54-73 days per year.
2. Leverages existing equipage by providing more options for PBN-based instrument approaches, while non-equipped operators would still be sequenced to the paired ILS runway.
3. There are 95 percent, or approximately 492, RNAV equipped aircraft and 58 percent, or approximately 304. RNP 0.3 with RF leg equipped aircraft per day that would benefit from PBN approaches.

PBN Paired SOIA Approaches at Newark (EWR) Runway 4L/R

Technical Description: This operational incentive candidate scenario provides PBN SOIA procedures to EWR Runway 4L, with 950 feet between runway centerlines. This operational capability would permit PBN (i.e., RNAV/GPS or RNP 0.3 with RF leg) capable aircraft to fly an offset approach to a CSPO runway and may be used either with or without an FMA.

Impact:

1. The weather for this operational incentive candidate exists for approximately 15-20 percent of operating 365 days or 54-73 days per year.
2. RNP procedures reduce the existing approach minimums for runways 4L/R and increase airport capacity during periods of marginal VMC conditions.
3. Leverages existing equipage by providing more options for PBN-based instrument approaches, while non-equipped operators would still be sequenced to the paired ILS runway.
4. There are 89 percent, or approximately 408, RNAV-equipped aircraft and 54 percent, or approximately 250, RNP 0.3 with RF Leg equipped aircraft that would benefit from PBN approaches.

Costs and Benefits Summary

Costs to FAA*:* Approximately $3-5 million

The costs of developing a SOIA would be fairly significant in terms of procedure development and certification, since RNAV/ RNP approaches have not been certified for SOIA operations. Unlike those options presented for RNP approaches, a SOIA approach does not have comparable existing procedures to work from and costs are anticipated to be higher. Significant testing and modelling, including a flyability study, will be necessary. Environmental review, flight crew and air traffic controller training represent other sources of cost in implementing this procedure. Enhancements are needed to

incorporate the equipage state information into TFMS to provide situational awareness and to modify the TFMS GDP/GS algorithms to segregate the demand.

Benefits to Users and the National Airspace System:

- The NAS capacity and efficiency is improved with both capable and non-capable experiencing reductions in delays.
- Capable aircraft would use PBN-based instrument approaches, while non-capable operators would still be sequenced to the ILS runway with improved efficiency in the arrival sequence.
- Increased arrival capacity is achieved by reducing dependent ILS and staggered approaches.
- Non-capable aircraft would be limited to using the ILS approaches but should not experience any degradation in service and may benefit in terms of increased access to the airport provided by equipped users making use of other runways.
- SOIA approaches results in an estimated increase in approximately 6-8 arrivals per hour on the PBN runway, depending on the departure demands and weather at the airport.

4.4.3 Operational Incentive C: ADS-B East Coast Offshore Routes

Technical Description: This operational procedure relieves congestion during severe weather or high volume conditions by enabling ADS-B equipped flights to make use of routes between the NY Metro airports and other northeastern US airports and select Florida and Caribbean destinations when those routes would otherwise be out of service. Route M201 is the only off shore radar route from the north-eastern airports to Florida and Caribbean. This incentive makes use of the range of ADS-B surveillance to provide coverage along M201 and increase the capacity of the NAS when there is a radar outage. While the procedures for the request or use of the route have not changed, operators will be able to make use of NextGen capability to improve the flexibility for their route of flight during periods of congestion. Aircraft that are not NextGen capable will not be affected compared to today's operations, and may experience a marginal increase in system capacity due to capable aircraft making use of routes that would otherwise be unavailable.

M201 is used primarily as relief from Traffic Flow Management (TFM) initiatives and delay constrained routes along the eastern seaboard between the north-eastern United States and southern Florida. It is also used extensively as a weather offload route during Severe Weather Avoidance Plan (SWAP) operations. Use of M201 can mitigate high departure delays but the route is normally closed to air traffic when Oceana (QVR) and/or Fort Fisher (QGV) Long Range Radars (LRR) are not in service. ADS-B ground station range exceeds that of LRR, and the use of this technology/equipage would provide surveillance redundancy and continuity of operations along these routes for ADS-B aircraft in the event of loss of radar.

This incentive provides benefits for capable operators and provides an opportunity for benefit for non-capable operators; it makes use of ADS-B technology without requiring new environments or procedures and is therefore a Type 1, natural incentive.

Costs and Benefits Summary

***Costs to FAA**:* Already included in ADS-B program baseline ($4.2 Million)
Some initial costs of developing and using these routes have already been accounted for and funded through the FAA's signed memorandum of agreement with JetBlue Airways. These costs are included in the approved baseline of the ADS-B program, and include air traffic controller training; an environmental review is not expected as actions above 10,000 feet have little to no potential to affect the environment. Initial costs of the program also included ADS-B avionics installation and certification costs for a limited set of aircraft. In attempting to expand this program through operational incentives, the FAA will not continue to pay for costs related to the avionics.

Benefits to users and the National Airspace System:

- This operational incentive offers users the ability to use routes that would otherwise be unavailable but are often requested as alternatives to typically congested routes north and south along the United States east coast.
- Other aircraft will also experience a benefit because in requesting east coast routes, NextGen capable aircraft will reduce overall congestion.
- The major benefit of this scenario is a demonstrated reduction in ground delays out of the key departure airports both in the Northeast (Boston, JFK, La Guardia, Newark, and Dulles) and in Florida/Caribbean (Ft. Lauderdale, Jacksonville, Orlando, West Palm Beach, Caribbean-BOS, and select Caribbean-to-JFK city-pairs).

4.4.4 Operational Incentive D: Automatic Dependent Surveillance Broadcast (ADS-B) In Trail Procedures (ITP)

Technical Description: This incentive makes use of ADS-B surveillance to allow for transition to optimal altitudes in non-radar airspace. Operators will be able to make use of NextGen capability to improve the flexibility for their route of flight when flying over the ocean outside radar coverage. Aircraft that are not NextGen capable will not be affected compared to today's operations, and may experience a marginal increase in system capacity due to capable aircraft self-maneuvering into the most efficient configuration.

This operational procedure offers reduced separation standards for climbing or descending in oceanic airspace where no primary radar exists. This capability takes advantage of ADS-B "In" to display airborne traffic on an aircraft's Electronic Flight Bag (EFB). Aircraft can request ITP procedures based on their ability to identify other ADS-B equipped aircraft around them. ITP allows ATC to authorize the flight crew of capable aircraft to climb or descend through altitudes. The situational awareness provided by ADS-B would allow the requesting aircraft to make this climb or descent when other standard separations do not allow for climb or descent through the altitude of blocking aircraft. ADS-B/ITP will allow aircraft operators to obtain optimum enroute altitudes more often, which will reduce fuel burn and carbon emissions and allow for more cargo capacity.

Operational trials are currently on going in the Oakland Flight Information Region (FIR). The FAA is currently in discussions with the air navigation service providers (ANSPs) for New Zealand and Fiji about expanding the ITP operational evaluation into the Nadi FIR and the Auckland Oceanic FIR. The FAA has also held discussions with the Japan Civil Aviation Bureau about the potential for offering ITP in the Fukuoka FIR at some point in the future. The FAA has worked with the International Civil Aviation Organization (ICAO) to develop a new oceanic separation standard that allows aircraft to climb or descend through the altitude of blocking traffic.
This incentive provides benefits for capable operators and provides an opportunity for benefit for non-capable operators; it makes use of ADS-B technology without requiring new environments or procedures and it therefore a Type 1, natural incentive.

Costs and Benefits Summary

Costs to FAA: Already included in ADS-B program baseline ($11.6 Million)

Some initial costs of developing and using these routes have already been accounted for and funded through the FAA's signed memorandum of agreement with United Air Lines. These costs are included in the approved baseline of the ADS-B program and include air traffic controller training, procedural development, and obtaining operational approval for the operation. The program has secured funding in Fiscal Year 2014 that would cover any changes that may be necessary to the Advanced Technologies and Oceanic Procedures (ATOP) automation system and international coordination of the concept with partner nations (initially Australia). Costs also included avionics, development, installation, and supplemental type certifications for an initial fleet of partner aircraft.

Benefits to Users and the National Airspace System:

- Aircraft capable of requesting and performing an In-Trail Procedure will have improved access to optimal altitudes during oceanic travel, improving their flexibility of flight.
- The use of flight level change procedures to achieve optimal altitudes, enabled by ITP, can supplement oceanic standards creating greater operational efficiency, increased fuel savings, and reduced CO_2 emissions.
- Aircraft capable of requesting and performing an In-Trail Procedure will be capable of carrying more cargo and less fuel.

4.4.5 Operational Incentives E: NextGen Minimum Capable Priority (NMCP)

Technical Description: NMCP represents a policy choice to provide priority treatment to aircraft with advanced NextGen equipage and capability. NMCP can be applied to virtually any strategic Traffic Management Initiatives (TMI): re-routes, Miles In-Trail Restrictions, Ground Delay Programs (GDP), Airspace Flow Programs (AFP), etc. Advanced NextGen equipped and capable aircraft would receive benefits in the form of delay reduction from priority service. These benefits could be applied to almost any form of NextGen equipage. NMCP does not require the actual use of NextGen capability and is therefore entirely artificial in its means of delivering benefit to the operator. For example, flights equipped with RNP 0.3 with RF leg capabilities may receive priority service into JFK during a Ground Delay Program (GDP), although the RNP capability is not necessary for the execution of that GDP.

NMCP will often operate in concert with other incentives and as such can serve as a mechanism for organizing or concentrating traffic to enable use of equipped aircraft (for example, equipage-based ground stop implemented to support JFK/LGA de-confliction).

In order to achieve the necessary level of capability, it may be necessary to consider incentives that result in less than optimal efficiency in the NAS for a short time if the end result is a significant gain in the NextGen capability. This incentive also allows for the effect on the NAS to be minimal or non-existent, but unequipped operators would still experience some delay compared to the NextGen capable aircraft that have been given operational preference. It is worth noting that the effect to overall NAS efficiency could also be positive, due to the increased speed with which NextGen capable aircraft can be managed. This type of incentive is presented as part of a full set of options. There are clearly complex [operational, policy and legal] issues that would need to be addressed and resolved if this option is to be pursued further.

Costs and Benefits Summary

Costs to FAA*:* Specific costs are dependent upon the targeted TMI to which the incentive would apply. Incorporation of NMCP into GDPs is estimated at $2 million. It is anticipated that costs will be somewhat higher for more tactical TMIs. Exact costs for this incentive proposal cannot be applied until the incentive is attached to a specific traffic management initiative. In general, sources of costs would accrue from necessary changes to the TFMS. Training may be necessary for Traffic Managers and the Traffic Management personnel, but because directions would be coming from the TFMS in the same manner as today to air traffic controllers; no broader training is likely to be necessary.

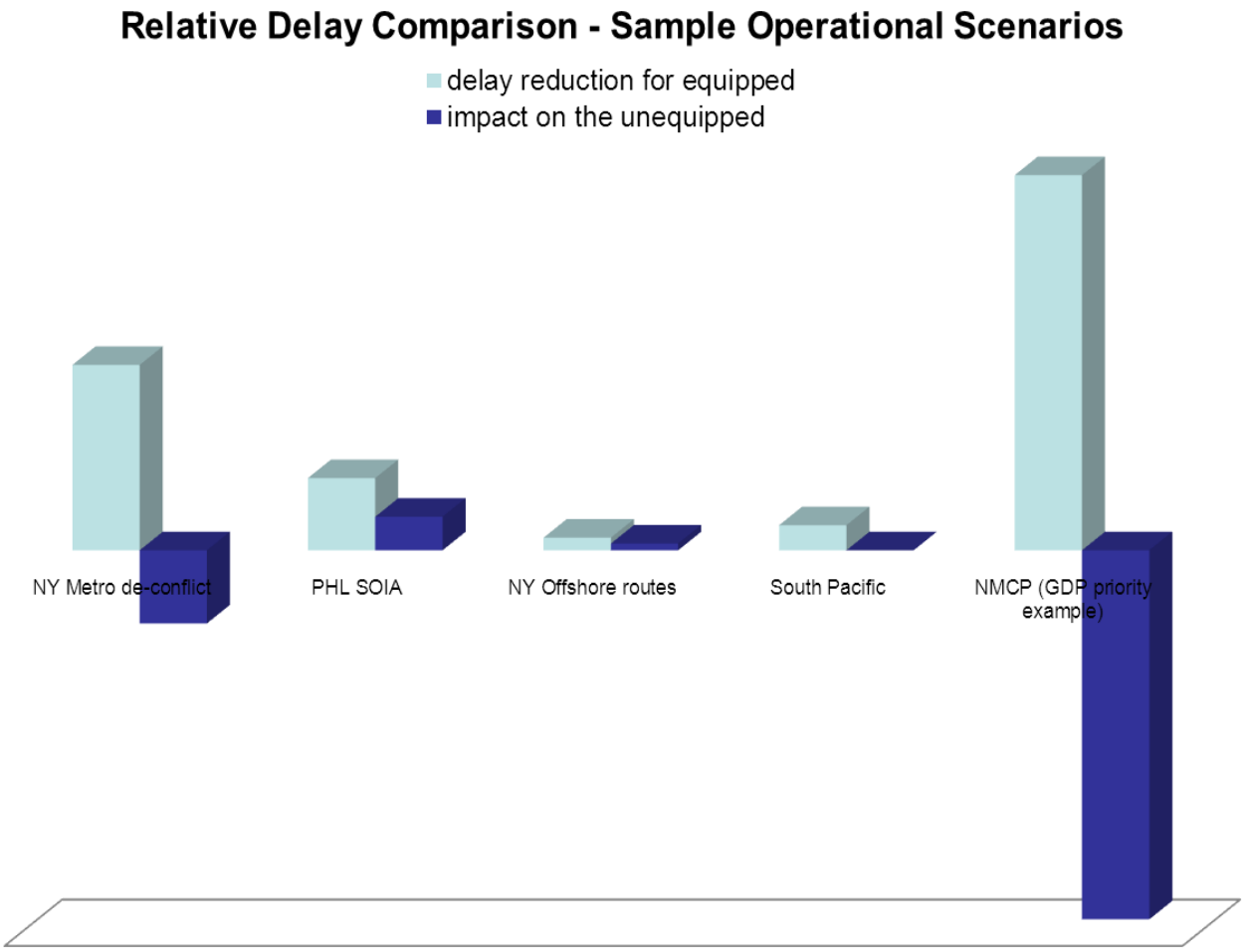
Depending on the specific TMI in question, procedural changes may apply (for example, for issuing departure clearances during a GDP). There will also be costs associated with developing a mechanism for determining the capability of aircraft. This solution might be developed using existing means of communicating with airlines (for example, collaborative decision making); costs would be significantly higher if new automation was necessary to resolve this challenge.

Benefits to Users and the National Airspace System:

- As with costs, the specific benefits accrued by users through this incentive would be dependent on the TMI selected. If the TMI was nationwide or local, time constrained or run all the time, run in poor weather or regardless of conditions, all these characteristics would have a definitive effect on benefits. However, the total benefit to capable users would be roughly equivalent to the operational disadvantage accrued by non-NextGen capable aircraft. (See Figure 1 below).
- Benefits would not be based on direct use of the selected NextGen technology, but accrued in reduced delay (from early release of GDPs) and potentially reduced fuel burn.
- Benefits to capable aircraft (and disadvantage to incapable aircraft) could be capped through algorithms in automation, and would therefore be flexible to be set and adjusted as necessary.
- Disadvantage to the unequipped would increase sharply as equipage approached the threshold needed to make full use of the technology. Benefit for the equipped would correspondingly decrease as more aircraft were able to take advantage of the incentive. It would be possible for

the FAA to limit the disadvantage to the unequipped to any threshold through the use of the automated tools used to control TMIs.

Figure 1: Annualized Delay Impact from Operational Incentives (ROM)[9]



4.5 Current Implementations Providing Operational Benefits

This section of the report provides information on FAA's efforts currently underway to deliver benefits to those aircraft that already have NextGen capabilities, distinct from those operational incentives described in the previous section. As much as possible, the FAA seeks to provide opportunities for NextGen-capable aircraft to receive better services and derive benefits directly from operations that use these capabilities without changes to current policy. This approach works for operations that can deliver benefits to each capable aircraft, independent of the capabilities of surrounding aircraft or whether a critical mass of NextGen capability has been reached within the airspace or at a specific airport. Examples of ongoing efforts to deliver benefits to those aircraft that already have some NextGen capabilities are provided below.

[9] The operational impacts i.e, delay reduction of each operational candidate scenario was evaluated to assess ROM benefits. TFM System Wide assumes 20 percent equipage. Calculations by Metron Aviation and Crown Consulting.

4.5.1 Greener Skies over Seattle

The Greener Skies over Seattle initiative is a collaborative project among the FAA, airlines, the Port of Seattle, and the Boeing Company intended to improve the efficiency of routes and approaches around Seattle. The FAA will add 27 new procedures, expanding the use of Optimized Profile Descents (where the airplane essentially glides in idle to the runway threshold), RNAV arrivals (which are GPS-guided arrivals) and RNP approaches (which take RNAV to an additional level of precision). These procedures will be available to any aircraft equipped and capable of performing the operations this spring.

A goal of Greener Skies is to prove that satellite-based navigation approaches can be flown using the same separation standards as procedures using ground-based instrument landing systems have today. The trials sought to demonstrate that a curved RNP approach to one runway is so precise and predictable, that when it is flown next to another aircraft that is approaching a parallel runway it merits the same separation standard as two straight-in parallel approaches.

The Greener Skies flight trials verified air traffic control processes, procedures and traffic flow management. The environmental analysis has been completed and we are now in the process of updating air traffic controller and aircraft operator rule books (for example, Advisory Circulars, Federal Aviation Regulations) with the modified separation standards for use by all qualified operators and in all weather conditions. The reduction of separation standards will increase the capacity of Seattle-Tacoma International Airport (SEA). The use of the more efficient navigational procedures will mean that capable aircraft burn less fuel, take less time to make their approach and reduce the number of people exposed to noise than standard approaches into SEA.

4.5.2 Optimized Approach Procedures in the Metroplex

The FAA continues to develop new procedures every year that help operators take advantage of advanced navigation equipment. Improved navigation approaches allow capable operators to more smoothly fly into an airport, reducing fuel burn and saving time compared to standard approaches. In order to allow aircraft to make use of RNAV and RNP equipment, a cross-organizational team has been tasked to prioritize and efficiently develop performance–based navigation (PBN) procedures in and around major cities. The Optimization of Airspace and Procedures in the Metroplex (OAPM) effort is an ongoing project that delivers an expedited process to enable predictable and repeatable flight paths into airports using NextGen capability.

OAPM responds to industry recommendations in improving the use of airspace in major metroplexes and developing procedures to increase system capacity and efficiency. In 2012, the team developed new procedures in the following metroplex areas:

- Florida
- Northern California
- Atlanta
- Charlotte
- Houston
- North Texas
- Washington D.C.

- Southern California
- Phoenix

While the procedure development projects are expected to be complete by summer of 2013, implementation may not commence until later. Procedure development will be an ongoing and iterative effort. OAPM will develop standard approach routes that make use of RNAV and RNP, increase the use of optimized profile descents -that will save time, fuel, emissions, and often reduce noise-, and employ private sector third parties to maximize the number of new procedures developed each year.

4.5.3 ADS-B in the Gulf

The ADS-B system is enabling air traffic surveillance in the Gulf of Mexico. Aircraft equipped with ADS-B -primarily helicopters- are able to operate in oceanic airspace as they do over land. This new surveillance capability means that aircraft can operate more safely and significantly improves the capacity of the airspace. Because ADS-B units are much smaller and more easily deployed than traditional radars, the FAA was able to enter into agreements with oil platform owners to install ADS-B on their facilities and improve air traffic management services.

Until 2009, controllers working the large amounts of helicopter traffic near the Gulf of Mexico needed to space the aircraft far apart, relying on verbal communication and large separation between the flights to ensure safe movement since radar coverage did not extend into the Gulf. Without that coverage, air traffic controllers had to use non-radar separation standards.

When using ADS-B, aircraft position data are relayed from the aircraft to ground receivers and then to the Houston Center. There, it is combined with radar data, and controllers are able to monitor helicopter positions and provide safer and more efficient services over the Gulf of Mexico airspace.

Before ADS-B, IFR departures from Gulf Coast heliports often experienced long delays due to the large separation requirements of non-radar airspace. Using ADS-B's reduced separation standards, controllers can integrate the same flights into traffic flows much faster than they could in the past, reducing departure delays significantly. In addition, helicopter operators can manage their trajectories more efficiently, which translates into fuel savings, lower fuel requirements and increased payloads (including personnel and equipment). The improvements create opportunities for more multi-leg trips to reach multiple oil platforms before returning to shore. Such trips are also enabled by improved weather information disseminated by stations deployed on oil rigs, another feature of the ADS-B deployment.

Providing for more efficient ATM, the enhanced capabilities in the Gulf region have also provided for improved Search and Rescue operations.

ADSB provides significant improvement in surveillance information. The capability provides position reports at least twice a minute, and therefore far exceeds the update rate enabled by conventional procedures. Search and Rescue procedures are initiated after two consecutive position reports are missed. Current response time for emergency situations has decreased from more than 90 minutes to just a few minutes.

4.5.4 ADS-B and WAM

ADS-B is one set of tools being used to provide surveillance in areas difficult for radar. For mountainous terrain in particular, NextGen technologies are being deployed to improve service and safety in areas where deploying traditional means of surveillance would be expensive and challenging.

Multilateration is a surveillance technology that works by employing multiple small remote sensors throughout an area to compensate for terrain obstructions. The data from multilateration sensors is fused to determine aircraft position and identification. This data is then transmitted to air traffic control for use in providing surveillance separation services. Wide Area Multilateration (WAM) is now allowing air traffic controllers to track aircraft along difficult approaches in Alaska and Colorado.

Increases in air traffic have resulted in growing delays and inability to provide certain service at the Colorado mountain airports, especially during bad weather. Instrument meteorological conditions can reduce aircraft acceptance rates for these airports from 12 to 17 flights per hour, to only four per hour. In 2005, the FAA, at the request of the State of Colorado Department of Transportation's Division of Aeronautics, conducted an analysis of these delays and cancellations. The FAA study determined that the lack of surveillance contributed to reduced capacity during instrument meteorological conditions, and identified multilateration as the preferred solution for providing surveillance to the Colorado mountain airports. This system has already been deployed at several regional airports and more systems are scheduled to be installed.

This new surveillance capability means that air traffic controllers no longer have to employ large margins for aircraft separation in inclement weather. For aircraft capable of ADS-B operations, this means that they have improved access to mountain airports. Typically, inclement weather around Colorado mountain airports means the air traffic controllers have to employ a "one-in, one-out" rule in allowing aircraft into the airspace. By using ADS-B, controllers can now maintain arrival rates similar to a good weather day.

4.5.5 DataComm

Data Communications (DataComm) is a key element of the transition from the current analog voice-only air-to-ground communications system to a system in which digital communications becomes an alternate and eventually predominant mode of communication. In order to satisfy this concept in an affordable and operationally effective way, aircraft with existing digital communication technology will be provided with service for early implementation of DataComm capabilities.

In the current voice based communication system, revised clearances cannot be delivered via a Pre-Departure Clearance. This leads to voice frequency congestion at clearance delivery positions and can lead to significant delays during weather events. With DataComm, reroutes will be delivered as soon as they are available allowing users to optimize and negotiate their routes. Reducing delays helps maintain on-time performance and schedule integrity.

Future capabilities of DataComm will improve on-time performance and schedule integrity, reduce delays during weather and congestion situations (on the ground and the air), improve efficiency (through tailored optimized descents), and save fuel and money. All data communications equipped aircraft would be able to derive benefits from advanced capabilities not possible using the current

voice system such as automated frequency changes and more direct route clearances resulting in reduced flight times.

In 2013, the FAA will begin DataComm trials to test the departure clearances for aircraft in text form, and the goal will be to verify and validate air and ground concepts of operations, requirements, training, and human factors. Deployment of pre-departure clearances will occur at three test sites to include Memphis, with FedEx being the lead airline; Newark, where the FAA will coordinate with United Airlines; and Atlanta, where the FAA will coordinate with Delta.

5 Stakeholder Feedback

The success of NextGen depends on the collaboration and synchronization of plans and activities between the FAA and the operators. Stakeholder input is essential to developing operational incentives. The FAA has formally requested and received input regarding operational incentives from the RTCA's Task Force 5 and NextGen Advisory Committee (NAC), and a public meeting.

In 2009, the RTCA's Task Force included a specific overarching recommendation that the FAA establish, "a National Airspace System (NAS) where system users who have aircraft with higher aircraft performance/capability levels get higher levels of service." This recommendation, coupled with other recommendations to develop and expand NextGen capabilities, led to several FAA commitments in January of 2010. The FAA agreed to a continued involvement with the user community to define "best-equipped, best served" and analyses to determine the risks and opportunities of mixed equipage environment. The FAA noted in its response several Task Force conclusions that were important to establishing an operational incentive strategy. Among these conclusions were that; the approach for incentivizing equipage would not necessarily be the same for every operational capability, and that during specific times some airspace would require NextGen capabilities to achieve greater system benefits within that environment.

5.1 NAC Feedback & Agency Response

The NextGen Advisory Committee was established in the summer of 2010 (see Appendix D for FAA tasking to the NAC) at the request of the FAA to develop a common understanding of NextGen priorities. The committee built on the work of previous RTCA committees (such as Task Force 5) and provides a venue to solicit recommendations on near and mid-term efforts. NAC members are senior executives representing operators, manufacturers, air traffic management, aviation safety, airports and environmental entities from civil and military sectors (see Appendix C for NAC membership).

The FAA requested that the NAC address operational incentives as follows:

- For each relevant equipage type and/or user group, as appropriate, identify the incentive(s) most likely to close the business case gap. Also, identify which delivery mechanisms would be most effective for the recommended incentives(s).

- Define a realistic timetable for recommended financial and/or operational incentives to drive investment decisions and transition, along with any related considerations.
- In terms of an incentives program, identify the assurances that could be provided to early adopters of NextGen technology.

On September 29, 2011, the NAC approved the recommendations developed by its workgroups and submitted them to the FAA. The NAC recommended a focus on accelerating NextGen capabilities in the region bounded by the Washington DC Metroplex, the New York and Boston Metroplexes, and the Chicago Metroplex. However, given that the mobility of user aircraft made it difficult to apply the business case to a subset of aircraft, the NAC has instead evaluated business case gaps considering the entire US fleet.

The FAA has since responded, and committed to actions that take into account funding allocations, schedule constraints, investment decisions, and other critical work that will be required by the FAA and industry. Some excerpts from the recommendations received from the NAC, and the FAA response are below:

NAC Recommendation:
The FAA should collaborate with the aviation community to develop capabilities (including needed policies, procedures, and complementary automation) to enable the large percentage of currently equipped users to perform RNP 0.3 with RF leg procedures routinely, to realize near-term benefits in a mixed-equipage environment and to stimulate forward-fit and retrofit decisions.

FAA Response[10]:
The FAA will continue to identify locations where RNP-equipped aircraft can achieve benefits, and we will continue to work with industry on RNP procedures. We will identify issues that constrain the use of PBN procedures, including operator readiness and willingness, and together with operators develop a mitigation strategy to establish PBN procedures as the primary operation unless conditions dictate otherwise.

NAC Recommendation:
The FAA and the aviation industry should validate and agree on which specific capabilities warrant equipage incentives.
FAA Response:
The FAA will provide feedback on our priorities for incentivizing operator equipage for PBN, ADS-B, and Data Comm. We will work with the NAC to identify specific NextGen capabilities for which we can provide operational incentives and evaluate the business-case implications for equipped users.

NAC Recommendation:
The FAA should work with the NAC to identify candidate NextGen capabilities for operational incentives and evaluate the business case for equipped users. The FAA should make incentives available for aircraft that are first to be equipped but cannot reap benefits

[10] From the FAA's NextGen Implementation Plan, March 2012

FAA Response:
The FAA supports operational incentives and will give them priority. We are working on several near-term proposals for operational incentives. When these proposals are mature, we will work with the operators on validation and possible implementation. The long-term FAA Reauthorization Act, signed into law in February 2012, contains a provision that authorizes us to establish a financial incentives program. The FAA is studying this new authority.

5.2 BEBS Public Consultation Feedback

Since these recommendations were received the FAA has continued its collaboration with the user community. A public meeting was held on March 13, 2012, that allowed the aviation community an opportunity to comment on the proposed incentives. The purpose of the meeting was to describe the candidate scenarios in detail and solicit stakeholder feedback. The top ten candidate operational incentive scenarios were discussed. Stakeholders who participated in the discussion included air carriers, general aviation operators, airframe and avionics manufacturers, and aviation associations (see Appendix B). The questions and feedback received at this meeting, and the associated written comments, were instrumental in analyzing the list of candidates. It is not likely that all of the incentives listed will be implemented in the near term; future implementation will depend on continued iteration with the user community.

Of the issues received by the FAA (both in writing and at the initial public meeting) major themes of the comments included:

- Alternate proposals that make use of more prevalent avionics (e.g., the use of RNAV rather than RNP)
- Concerns about the fleets' ability to equip with the proposed technologies, in the proposed timeline
- Concerns about the inability of business, military, regional, and general aviation fleets to participate in the proposed incentives
- Opposition (or requests for more information) to proposals that would not make use of the equipment

These comments were used as a basis to narrow down the most desirable candidates for near-term implementation of operational incentives. The FAA will continue to work with operators in the process of developing the operational incentives for implementation.

6 Next Steps

Of the 10 scenarios discussed in this report, based in part on the input provided by stakeholders, the FAA has begun implementation planning and execution studies for the following scenarios:

- De-Conflict Airport Operations/Lower Weather Minimums: JFK/LGA and MDW/ORD
- SOIA (RNP Paired SOIA Paired Aircraft Approaches) – pending safety analysis
- ADS-B East Coast offshore routes
- ADS-B In Trail Procedures (ITP) / South Pacific and Beyond

These incentives represent only a small part of the provision of NextGen benefit to operators; increasing NextGen capability will require a broad scope of efforts that work in concert. The implementation of the scenarios selected will increase operator and stakeholder confidence by rewarding those who have proactively invested in NextGen capabilities. They will affirm the accrual of specific operational impacts, which is essential to motivating users to support and invest in not only the equipage but also the training and certifications recognized by stakeholders as necessary to achieve the NextGen capabilities.

Operational incentive options initially considered (but not currently being implemented) have not been ruled out for possible future implementation. The FAA will require continued input from stakeholders in order to both analyze future incentive implementation options and effectively implement operational incentives. Some of the candidate options were deemed to require rulemaking, the development of new automation systems to identify specific equipage or capability on an aircraft, or on-the-ground capabilities scheduled for deployment beyond 2014 and did not meet the objective of near-term 2 year implementation; therefore these options were not considered for this initial effort. Several of these candidates are described briefly in Appendix A.

In addition to work on operational incentives, the Administration and industry have also been working to develop financial incentives.[11] Stakeholder input suggests that the use of both financial and operational incentives could encourage a faster rate of equipage. Therefore, the FAA intends for these efforts to be complementary. The Agency is actively seeking input from stakeholders about design and implementation of an equipage incentive program; the goal is to look carefully at how to move forward in a consistent and simultaneous way to incorporate financial and operational incentives.

[11] Section 221 of the FAA Modernization and Reform Act of 2012 allows for the establishment of an avionics equipage incentive program. The Act requires the FAA to leverage and maximize the use of private sector capital, and so the FAA is actively taking steps towards possible implementation of a loan guarantee program. However, consistent with the Federal Credit Reform Act, the agency would need language in an appropriations act before it could begin issuing loan guarantees. Also the FAA is still evaluating whether such a program would make an appreciable difference towards the goal of accelerating the number of NextGen-capable aircraft operating in the NAS.

Appendix A – Examples of Initial Operational Incentive Options

The following examples of operational incentive options represent themes from the large list of initially considered scenarios. These options do not represent discrete examples of incentives the FAA evaluated. While, operationally, these examples might seem similar to some of the options presented in the body of the paper, there were often differences between initially considered options and those advanced for public review. For instance, while several of the proposed incentives are performance based navigation procedures, initially suggested ideas may have proposed different implementation locations, slight differences in the operational approach, differences in required equipment, or a number of other factors. This summary list is intended to provide context across the types of incentives reviewed, without going into the specific implementation details provided for the options presented in the main body of the paper.

Traffic Flow Management (TFM) Delay Redistribution:

Of the initial scenarios considered for implementation as incentives, several involved cases where the impacts of Traffic Management Initiatives (TMIs) are lessened for equipped aircraft. These aircraft, through various possible means, receive higher priority in the TMI; delay is consequently more severe for unequipped aircraft. Total system delay generally remains unchanged. However, there appear to be opportunities to improve NAS system performance with greater numbers of equipped aircraft and the prospect of realizing such gains in the near term appear quite strong. Scenarios in this group can be applied to any NextGen equipage or combination of equipage, and can also be applied to equipment other than avionics equipage, such as more noise or emissions friendly aircraft.

Operationally, TMIs would not change for air traffic controllers; direction for aircraft to depart at a given rate would remain unchanged. The degree to which capable aircraft would benefit or unequipped aircraft be penalized, can be capped or adjusted depending on the algorithms input into the TFM automation system. While typically, disadvantage to unequipped aircraft would increase as more aircraft equipped and became eligible for preference, careful design of this incentive could constrain that delay to a specific number of minutes. TMIs that give preference to the equipped could be carried out through ground delay programs (local or national), re-route advisories, and other types of ground stops, even planned segregation of airspace. While there are various options for implementation and targeted equipage, TFM delay distribution cannot be more fully evaluated without selecting a specific means to provide incentive, targeted at a specific technology.

ADS-B Out

Several scenarios suggested locations where aircraft equipped with ADS-B Out receive improved service when transiting non-radar airspace. That improved service can take the form of better, improved capacity, more efficient route assignments and altitudes, and relief from pre-departure delays resulting from En Route spacing programs. With low levels of equipage the effects on the unequipped are negligible, but these effects become increasingly negative as equipage rates increase. For example, in the Gulf of Mexico preferred routes and altitudes can be allocated to ADS-B Out equipped aircraft first. At some point in the equipage curve, those preferred routes or altitudes may not be available to the unequipped. Provision of surveillance services in otherwise non-radar airspace

could be employed in several locations, other than east coast routes implementation was suggested in the ski country of Colorado, Jackson Hole Wyoming, the Gulf of Mexico, and other oceanic airspace. ADS-B Out could also be employed with safety mechanisms, such as an enhanced search and rescue function as the primary benefit.

DataComm Departure Clearances and Reroutes

Typically, following a weather related TMI many aircraft waiting to depart must first be given departure clearances revisions. Those that are equipped for ATC DataComm could receive revised departure clearances immediately via an automation generated "DCL" message, while non-equipped aircraft would be given revised clearances by voice with read-back – usually requiring several minutes each. Where airport surface layout and procedures allow, departure traffic can be re-ordered so that those aircraft already cleared move ahead in the departure queue and their take-off is not delayed behind aircraft not yet cleared.

Reroutes

DataComm can also provide an incentive by allowing more agile re-routing around weather or congestion. In preparation for weather or En Route sector congestion, the TFM system could re-route or delay non-DataComm aircraft away from flow constrained areas/times as needed, leaving a higher percentage of data communication equipped aircraft for which sector capacities are higher. This initiative would improve overall system performance as well as reduce the impact of the traffic initiative on DataComm flights. Non-DataComm aircraft can be delayed or rerouted *prior to departure* according to existing TFM collaborative procedures.

For DataComm aircraft, the potential for reroute is identified prior to departure and allowed for in fuel reserves, but the route assigned may remain unchanged. If route changes prove necessary, they are developed by the TFM system and provided electronically to a sector controller upstream (or downstream) of congestion. Because this controller does not have to develop and compose the clearance message, workload for delivering the DataComm reroute is small. Because it is developed strategically by the TFM system, delivery of the DataComm re-routes can usually be avoided in sectors experiencing congestion.

Performance Based Navigation Procedures

Several scenarios initially considered proposed the implementation of RNP based routes in a variety of congested airports and airspaces. In a general best equipped, best served concept, metroplex airspace is changed to use curved RNP procedures that de-conflict arrival and departure flows during high traffic periods. The change requires that all aircraft on these de-conflicted routes be equipped with RNP .3 and RF capability. Several of the proposed scenarios suggested segregating airspace so that unequipped aircraft are forced to arrive and depart at low traffic times, or else use other arrivals and departures.

While benefits of RNP and Curve Path are well understood for weather/terrain access and for efficiency (which has led to substantial air-carrier equipage), ascertaining the capacity benefits achievable from de-confliction requires case-specific designs and evaluations on an airport-by-airport

and metroplex-by-metroplex basis. Each must reflect the specific operations needs and constraints of the location – including environmental, geometry, weather patterns, airport configurations, and fleet mix considerations.

The FAA's initiative for Metroplex Optimization of Airspace and Procedures (OAPM is undertaking both strategic and specific evaluations of potential metroplex solutions. A major focus is on solutions that can be put in place within 2 or 3 years based on existing facilities and automation, existing procedure criteria, current fleet mix and equipage levels in local aircraft operations with categorical exclusions or environmental assessments under the National Environmental Policy Act. Operational incentives enabling arrival/departure de-confliction were considered and in some cases may be evaluated as one of the potential longer-term solutions available to each existing FAA metroplex study teams.

ADS-B IN Applications

Some proposals advocated use of ADS-B to enable advanced navigation procedures. In transition airspace, aircraft equipped with ADS-B IN avionics for Flight-deck Interval Management are able to acquire and maintain spacing behind an aircraft in front of them, thereby improving the accuracy of inter-arrival timing, and maximizing runway throughput while maintaining flight efficiency. Societal benefits, system benefits, and benefits to equipped aircraft operators may be able to be increased if this higher throughput is allocated preferentially to equipped aircraft, or if the societal benefits of decreased emissions justify preferential service levels for those equipped. The TFM system is a likely mechanism for adjudicating service differentials.

The work of the ADS-B IN rulemaking committee is already addressing some potential applications for this technology. Other options were not considered with a great deal of scrutiny, because avionics are not yet available and certified for many ADS-B In applications. The timeframe for making optimal use of ADS-B In applications exceeded the 2-year timeframe set as the goal for the incentive activity.

Appendix B – Attendance of Public Meeting on Operational Incentives

Name	Organization
Faulk, Scott	DOT
Williams, Heidi	AOPA
Spence, Craig	AOPA
Rudinger, Melissa	AOPA
Howerton, Lorraine	AOPA
Bowman, Jim	FedEx Express
Yerger, Mark	FedEx Express
Nadarski, Nick	GAO
Young, Ray	Saab Sensis Corporation
Peel, Robert	European Regions Airline Association
Cebula, Andy	RTCA
Lamond, Bob	NBAA
Klasinski, Ken	Enterprise Information Services, Inc.
Rinehart, David	Saab Sensis Corporation
Newton, David	Southwest Airlines
McGraw, Paul	A4A
Railsback, Paul	A4A
Fearnsides, Jack	MJF Strategies, LLC
Atkeisson, Randal	Cessna Aircraft Company
Thomas, Ron	US Airways
Morse, Glenn	United Airlines
Cochrane, Jeff	NAV Canada
Morin, Joel	IATA
Levy, Benjamin	Saab Sensis Corporation
Shearer, Geoffrey	Boeing Company
Cheng, Annie	LeighFisher
Bergener, John	SFO Airport Bureau of Planning
Deere, David	WestJet Airlines
Stevens, Edward	Raytheon
Bertapelle, Joseph	JetBlue
Harkness, Brian	Air Canada

Allen, William	JetBlue
Rein-Watson, Karl	Boeing Company
Mumford, Michael	United Airlines
Dyment, Michael	NEXA Capital
Cherney, Rich	NextGen Fund
Brockman, Carter	NEXA Capital
Oswald, Christopher	Airports Council International
Shapero, Ken	GE Aviation
Denmark, Ray	OIG
Treakle, Coletta	OIG
Leading, Kimberly	OIG
Basso, Phil	DOD NextGen Office
Stewart, Chuck	United Airlines
Jacklin, Steven	NASA
Benich, Chris	Honeywell
Heinrich, Richard	Rockwell Collins
Traynham, David	Boeing Company
McCardle, Matt	Boeing Company
McGaughy, Ellen	Rockwell Collins
Cato, Mark	ALPA
Kirkman, Deborah	MITRE
Chew, Russell	NextGen Fund
Tedford, Ann	FAA
Miller, Malia	GE Aviation
Oberhardt, Marilyn	SeaTec
Speir, Ken	Delta
AhmadBeygi, Shervin	Metron
Klopfenstein, Mark	Metron
Brennan, Michael	Metron
Parson, Les	United Airlines
Allen, Dan	FedEx Express
Beard, Robert	ATM Center for Excellence
Manville, David	US Army

Spence, Mark	Hawaiian Airlines
Davis, Jim	N/A
Rao, Naveen	JonesDay
Young, James	Rockwell Collins
Mutuel, Laurence	Thales
Waddell, Brad	Air Canada
Sammartino, Michael	Metron
Alcabin, Monica	Boeing Company
Paone, Thomas	Smithsonian Institution
Wood, Kevin	SeaTec
Bushman, Frank	DCS Corporation
Reyes, Alexandra	CQ Transcriptions
Myers, Jim	Jazz Aviation
Hudgens, Carol	Harris
Haraldsdottir, Aslaug	Boeing Company
Archer, Tom	Bell helicopter

Appendix C – NAC Membership

NextGen Advisory Committee Membership

5/25/11

Domain		Memb
Designated Federal Official	1	Michael Huerta, Deputy Administrator, FAA
Chair		Dave Barger, President and Chief Executive Officer, JetBlue Airways
Federal Aviation Administration	5	Vicki Cox, NextGen Christa Fornarotto, Associate Administrator for Airports Peggy Gilligan, Associate Administrator for Aviation Safety David Grizzle, Chief Operating Officer Air Traffic Organization Julie Oettinger, Assistant Administrator of Aviation Policy, Planning and Environment
Department of Homeland Security	1	TBD
Operators	5	Ed Bolen, President & CEO, National Business Aviation Association Craig Fuller, President & CEO, Aircraft Owners & Pilots Association Dave Barger, President and Chief Executive Officer, JetBlue Airways Jim Rankin, President & CEO, Air Wisconsin (Regional Airline Association – Chairman) Bob Gray, Vice President of Flight Operations, ABX Air, (Cargo Airline Association – Chairman)
International	2	Patrick Ky, Executive Director, SESAR Joint Undertaking David McMillan, Director General, Eurocontrol
Airports	2	Sue Baer, Director of Aviation Department, Port Authority NY&NJ Kim Day, Manager of Aviation, Denver International Airport

Department of Defense	1	Brett Williams, Major General, United States Air Force
FFRDC	1	Agam Sinha, Sr. Vice President & General Manager, The MITRE Corporation
RTCA	1	Margaret Jenny, President, RTCA

Domain		Member
Labor	3	Lee Moak, President, Air Line Pilots Association Paul Rinaldi, President, National Air Traffic Controllers Association Tom Brantley, President, Professional Aviation Safety Specialists
Aircraft Manufacturer	3	Sherry Carbary, Vice President of Flight Services, Boeing Commercial Airplanes, The Boeing Company Eric Stefanello, Sr. Vice President of Air Traffic Management , Airbus GA Aircraft Manufacturer rep – TBD
Air Traffic Control Automation Provider	2	John Mengucci, President, Lockheed Martin IS&GS John Harris, President, Raytheon Technical Services Company
Avionics	1	Carl Esposito, Vice President, Honeywell Aerospace
Environment	1	Arlene Mulder, Mayor, Village of Arlington Heights
Finance	1	TBD
Total	**30**	(3 unfilled positions)

Appendix D: FAA Tasking to NAC

Jan 28, 2011
Ms. Margaret Jenny
President, RTCA, Inc.
1828 L Street NW,
Washington, DC 20036

Dear Ms. Jenny:

RTCA has served the aviation community well for roughly seven decades be developing consensus based recommendation dealing with policy and implementation issues as well as operational performance standards. Its focus on achieving operational benefits through implementation in the current environment has been invaluable. As the Federal Aviation Administration's Federal Advisory Committee, are depending on the RTCA's NextGen Advisory Committee (NAC) to serve as a primary means for obtaining aviation community views regarding FAA's NextGen demonstration and implementation planning.

Recently the Administration proposed an infrastructure package that would include funding possibilities for NextGen. Aviation equipage presently under consideration is largely oriented to ADS-B In and Out, Data Communications, RNP with radius-to-fix turns, and WAAS LPV. As you may also recall, Secretary LaHood tasked the Future of Aviation Advisory Committee to examine ways of ensuring the competitiveness of the U.S. aviation industry and its capability to address the evolving transportation needs, challenges, and opportunities of the global economy. The committee's recommendations regarding NextGen equipage also provide important information on this subject. Finally, FAA has been exploring different types of operational incentives that could be used to increase equipage rates.

We would like to continue to explore the equipage question and ask that you take on the challenge of providing industry input to the following general questions and request that the recommendations are provided in two phases:

Phase 1 (Delivery in May 2011)

1. Prioritize the NextGen mid-term operations that are dependent on equipage; and
2. Recommend the aircraft types or user groups that should be considered for incentives. Groups to consider are: national and international air carriers, regional air carriers, charter operators, business aviation, personal use/general aviation, recreational use aviation, military air transport, military tactical aircraft, helicopters, and utility operators.

Phase II (Delivery in September 2011)

1. For each relevant user group, identify the gaps in the business case (i.e. the delta between cost and assessed benefit) for NextGen-required equipage that operational or financial incentives could be used to close;

2. For each relevant equipage type and/or user group, as appropriate; identify the incentive(s) most likely to *close* the business case gap. Also, identify which delivery mechanisms would be most effective for the recommended incentive(s). Most helpful would be scenarios of various financial options, i.e., loans, grants, other avenues, that are in accord with current political and fiscal climates;

3. Identify reasonable conditions that would justify investment of taxpayer funds on incentives;

4. Define a realistic timetable for recommended financial and/or operational incentives to drive investment decisions and transition, along with any related considerations;

5. In terms of an incentives program, identify the assurances that could be provided to early adopters of NextGen technology; and

6. Recommend criteria for evaluating the success of incentives.

Please note that while the timeframes noted above are ideal, FAA may need RTCA to accelerate its recommendations. Industry feedback related to equipage incentives and NextGen funding may be even more valuable in recognition of this year's congressional calendar, Federal budget activities, and potential opportunities to expedite NextGen.

We appreciate RTCA's many past contributions and looks forward to a continued long and productive relationship that serves the best interests of the public.

Sincerely,

Michael P. Huerta
Deputy Administrator

Appendix E: Addendum to the Operational Incentives Report

The Federal Aviation Administration (FAA) prepared the above report in response to Section 222 *Operational Incentives* of the *FAA Modernization and Reform Act of 2012*. The report identifies five incentive options to encourage the equipage of aircraft with NextGen technologies, provides the costs and benefits of each option and lists industry stakeholders from the Best Equipped Best Served (BEBS) Public Meeting[12] held by the FAA last March 2012.

While the report was being generated and coordinated, the fiscal environment evolved. Therefore, this addendum to the report, dated August 15, 2013, addresses the impacts of sequestration and budget constraints on the operational incentives work.

BEBS 1a & 1d: De-Conflict Airport Operations/Lower Weather Minimums with RNP0.3 w/ RF legs @ JFK and MDW (Status: In work; delayed due to Traffic Flow Management System (TFMS) related sequestration impacts)

Near Term Activities:

- Performed the initial Human-in-the-Loop (HITL) testing in April 2013 and plan for the second HITL scheduled for August 2013
- Finalize the BEBS Concept of Operations and develop Operational Requirements in 2013

BEBS 2: SOIA (Paired SOIA Paired Aircraft Approaches) with RNP 0.3 w/ RF legs – safety case @ San Francisco (SFO) (Status: Closed; not pursued. Currently evaluating other alternative airports that would be a candidate for SOIA)

Near Term Activities:

- Due to San Francisco runways being located in close proximity, determined it is not possible to leverage Seattle's safety case; therefore, RNP0.3 w/ RF legs are not operationally viable at SFO
- RNAV (GPS) approaches published June 27, 2013 permiting SOIA operations to be conducted to both runways
- RNP Standard Instrument Departures are being developed (proof of concept) and maybe proposed as an alternative (In progress at Atlanta)

BEBS 3: ADS-B East Coast offshore routes (Status: In work; En Route Automation System (ERAM) delays are sequestration related. Until ERAM is operational, the use of ADS-B Out on the East-Coast offshore routes will not be achievable)

Near Term Activities:

- Dependent on ERAM operational status at New York Center (ZNY) to realize the benefits of accessing the Off Shore Routes which is unknown at this time

BEBS 4: ADS-B In Trail Procedures (ITP) / South Pacific and Beyond (Status: In work; and on schedule. The FAA investment decision in May 2012 produces greater benefits than were originally considered in BEBS 4)

Near Term Activities:

- All United Airlines 747 pilots have been trained. The FAA has seen an increased number of ITP requests in the Oakland Oceanic Flight Information Region (FIR) (averaging about 15 requests per month)

[12] http://www.faa.gov/about/office_org/headquarters_offices/apl/environ_policy_guidance/2012meeting/

- Operational flight evaluation of ADS-B ITP currently in progress with United Airlines on routes between the United States west coast and Australia / Asia.
- ITP Advanced Technologies & Oceanic Procedures (ATOP) modification requirements developed and planning for implementation in 2015

If there are any questions regarding the information herein, please contact Richard Jehlen, Director Operational Concepts and Requirements, at 202-493-8286.