NextGen ATM Concept of Operations: ASAS-Reliant

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Concept of Operations Purpose

Describe and communicate JPDO view of how next-generation system is envisioned to operate in 2025

- Focus on significant changes from key user perspectives
- Drive research and implementation activities and non-material changes needed to achieve vision
- Represent and relate to Enterprise Architecture as a key transformation management mechanism

In many cases, this document presents “aggressive” concepts that have not been validated, but are envisioned to maximize benefits and flexibility for NextGen users. Many potential futures are possible, and much will depend on the insights gained by the evolution of the ConOps.

--Preface, NextGen ConOps v2.0, 13-Jun-07

Key Themes: User Focus

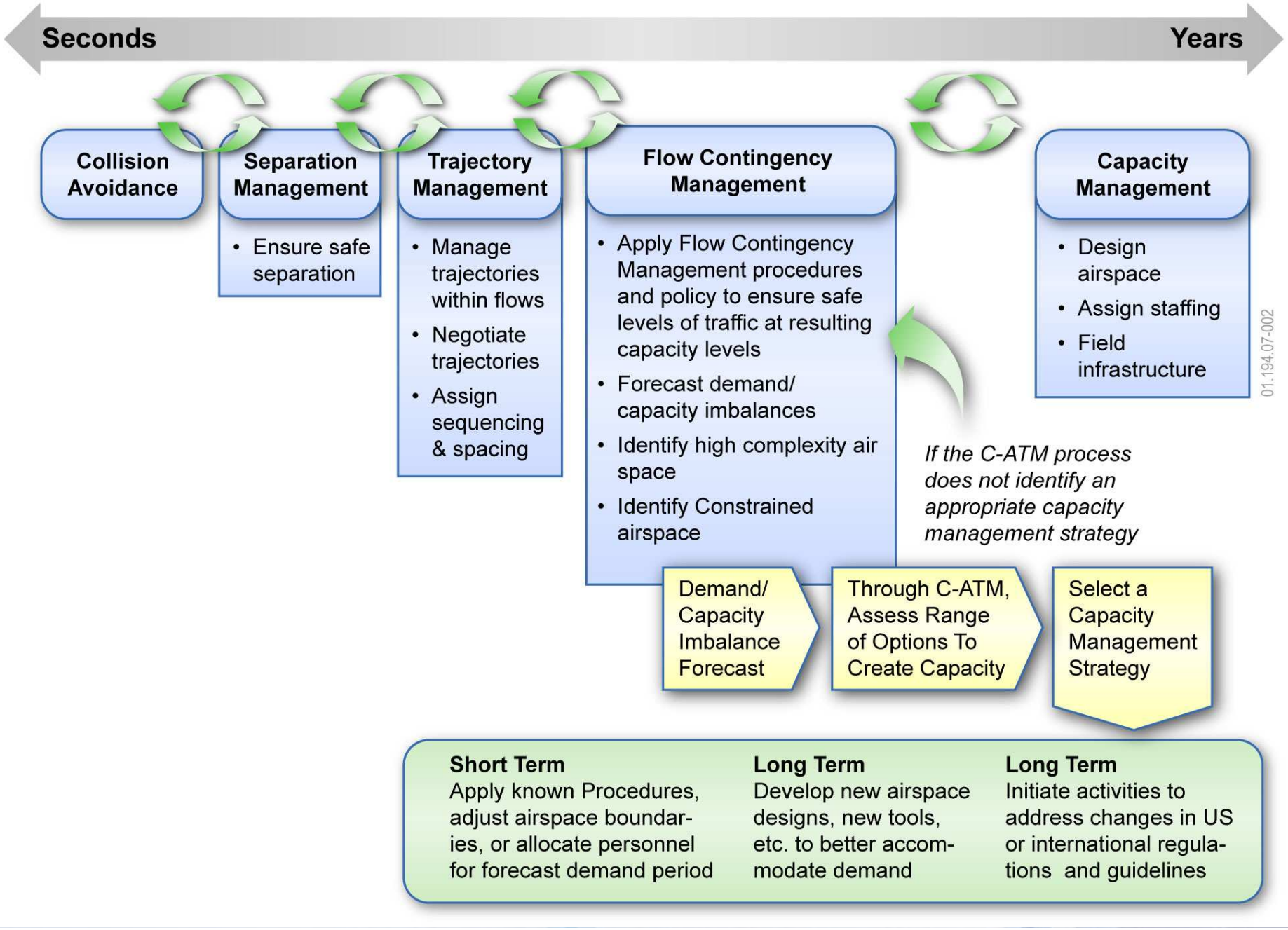
NextGen provides more flexibility and information to users while reducing the need for government intervention. NextGen enables operational freedom through greater situational awareness, and it aligns government structures and processes with user needs.

- Provision of multiple service levels permits a wider range of tailored services to better meet individual user needs and investment choices
- Capacity expands to meet demand by investing in new infrastructure, shifting NextGen resources to meet demand, implementing more efficient procedures, and minimizing the effects of constraints, such as weather, on overall system capacity
- Restrictions on access to NextGen resources are limited in both extent and time duration to those required to address a safety or security need

Key Themes: Scalability

NextGen adapts to meet changes in traffic load and demand that occur every day. Its capabilities provide an overall system design that can handle a wide range of operations and modes of operation.

- Increased use of automation, reduced separation standards, super-density operations, and additional runways allow busy airports to move a large number of aircraft through the terminal airspace during peak traffic periods
- New capabilities, such as virtual towers, enable the cost-effective expansion of services to a significantly larger number of airports than is possible with traditional methods of service delivery
- As a result of its scalability, NextGen is able to adapt both up and down with changes in demand, even when the changes in demand are not predicted well in advance


Seconds
Years
Collision Avoidance
Separation Management
• Ensure safe separation
Trajectory Management
• Manage trajectories within flows
• Negotiate trajectories
• Assign sequencing & spacing
Flow Contingency Management
• Apply Flow Contingency Management procedures and policy to ensure safe levels of traffic at resulting capacity levels
• Forecast demand/ capacity imbalances
• Identify high complexity air space
• Identify Constrained airspace
Capacity Management
• Design airspace
• Assign staffing
• Field infrastructure
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If the C-ATM process does not identify an appropriate capacity management strategy
Demand/ Capacity Imbalance Forecast
Through C-ATM, Assess Range of Options To Create Capacity
Select a Capacity Management Strategy
Short Term
Apply known Procedures, adjust airspace boundaries, or allocate personnel for forecast demand period
Long Term
Develop new airspace designs, new tools, etc. to better accommodate demand
Long Term
Initiate activities to address changes in US or international regulations and guidelines

Airspace Hierarchy

Managed Airspace

- ANSP provides ATM services; separation delegated as appropriate to equipped aircraft

Trajectory-Based Airspace

- Services/Operations based on precise trajectory execution

Self-Separation Operations

Flow Corridor

Superdensity Arrival/Departure Operations

Classic Airspace

- Services based on clearances
- Includes Classic VFR & IFR Operations

Non-Managed Airspace

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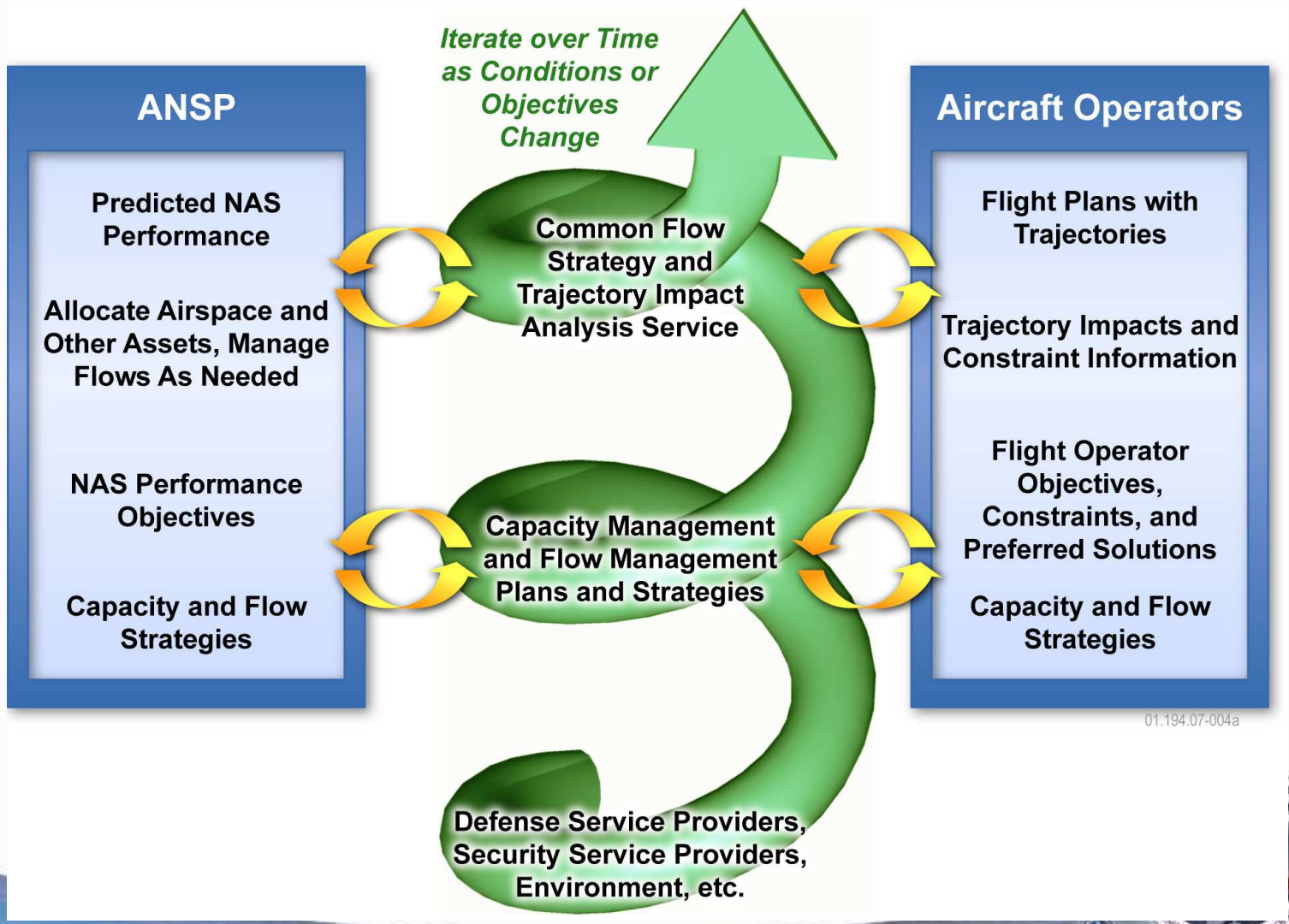
Collaboration Among ANSP & Operators



NextGen ATM Characteristics

- Trajectories are “coin of the realm” and provide basis for integrating decisions across time horizons (capacity -> flow -> separation)
- Robust data communication supersedes voice communications as primary means of communications (voice remains for appropriate use)
- Information sharing improves predictability and reduces uncertainty versus today’s system
  - Common weather information is ubiquitous and timely
- Managing remaining uncertainty is critical to maintaining high performance operations (as important as precision/accuracy)
- ATM System users become “equal partners” with ANSP in operational decision-making (except for “hammer clause”)
- ATM System relies on automation (both ANSP- and aircraft-hosted) for high-performance operations
- ATM System exploits aircraft capabilities (including separation assistance systems) to maximize airspace/airport throughput

NextGen Separation Management

- To safely achieve NextGen traffic density, the process of conflict detection will be automated
  - This is true whether the algorithms are on the ground or on the aircraft
  - Human controllers providing separation “manually” limits ability to achieve NextGen traffic levels
- Reduced and/or variable separation standards postulated by NextGen imply automation-generated resolution maneuvers
  - Pilot-in-command has ultimate responsibility for safety of aircraft, so reviews and approves maneuvers
- Appropriate level of automation in Separation Management is major research question
- Must provide capability for appropriate human intervention to ensure safety

Relating PO-ASAS & NextGen Terminology

PO-ASAS	NextGen ConOps
• Airborne Traffic Situational Awareness	• ***Term not used***, but ATSAW may be evolutionary path, e.g. for successive visual approaches (VSA) and oceanic In-Trail Procedure (ITP). ATSAW will be important for surface safety
• Airborne Spacing	• Merging and Spacing
• Airborne Separation	• Delegated Separation; term is broader than "Airborne Separation" and may include some procedures that involve several aircraft responsible for separation from each other
• Airborne Self-Separation	• Self-Separation; refers to operations in which aircraft self-separate in segregated airspace without any ANSP separation or trajectory management services *[Note contradictory statement on p 2-21, plus ongoing JPDO discussion]*

Major NextGen ASAS Drivers

- Achieving sufficient airport throughput to accommodate 2-3 times today's traffic with minimum environmental effects will require delegated separation procedures
  - Parallel and converging runway operations
  - Such operations will enable new runways built closer to existing runways than is possible today
- In non-radar airspace on long routes, improved climbing/passing maneuvers and reduced separation standards, enabled by spacing/delegated-separation/self-separation procedures will provide sufficient user benefits to motivate adoption
- Surface operations at NextGen traffic levels will require on-aircraft traffic situational awareness to improve surface safety, and delegated separation for safe, efficient operations in low visibility conditions

NextGen Merging and Spacing

- Some Anticipated Uses:
  - En-route for joining and maintaining appropriate spacing/timing for in-trail aircraft
  - Establishing and synchronizing arrival flows in upper arrival/departure airspace
  - Precision spacing/timing of aircraft on final approach for maximum runway throughput
- Merging and Spacing, which is currently in flight trials, could provide both an evolutionary path and a NextGen state
- Merging and Spacing expected to be a confidence-building "transition state" leading to delegated separation for maximum benefits in some operations
  - Improved ANSP productivity
  - Reduced separation and hence increased throughput

NextGen Delegated Separation

- Broad category of operations referring to any separation tasks delegated by the ANSP to suitably equipped aircraft in Trajectory-Based Airspace
- Includes approach procedures such as Closely-Spaced Parallel Approaches (CSPA)
- Includes “Flow Corridors”, high-throughput operations achieved with same-direction, near-parallel trajectories in en-route airspace
- Expect that delegated separation will be operating norm for managed airspace, but ANSP retains authority over when, where and to whom separation procedures are delegated
- Some delegated separation procedures, such as CSPA, rely on non-conflicting trajectories (“routes”) as primary component of separation management
- Delegated separation should provide benefits for “mixed equipage”

NextGen Self-Separation

- As defined in the ConOps, could be called “Aircraft-Based Separation Management”
- Major benefits are
  - ANSP “saves” resources by not providing Separation Management or Trajectory Management services for such operations
  - Users obtain routings as close to their preference as possible
- Expect earliest implementation of self-separation to be in oceanic and remote airspace, possibly with separation standards between current procedural standards and current radar-based standards
  - may provide evolutionary path to operations within delegated separation airspace, including “mixed” operations

NextGen ASAS Safety

- Expect Performance-Based Operations and Trajectory-Based Operations capabilities to be enablers for ASAS, as well as ground-based separation
  - Reduced separation standards will rely on improved ability to predict and communicate trajectories
  - Alerting for non-conformance so such aircraft can exit airspace for which it is no longer meeting performance requirements
- Delegated separation and self-separation will require definitive proof of safety, including hardware, software and human interaction in both nominal and off-nominal situations
  - Initial research results are encouraging, but
  - Major changes in operations and “culture” are a “grand challenge”
- Ensuring ASAS safety should be major international collaborative effort
  - Systems and procedures must be internationally interoperable

Approach for implementing ASAS

(illustrative example only)

- Phase A – Situation Awareness Tool
  - Tool that advises pilot of available altitudes for altitude changes
  - Advisory information only (low certification requirements)
- Phase B –ADS-B In-Trail Procedures
  - Altitude changes allowed based on cockpit derived data
  - No delegation of separation authority
- Phase C – Enhanced ADS-B In-Trail Procedures
  - Limited delegation of separation authority to cockpit during a maneuver
  - Onboard system monitoring of separation during maneuver
- Phase D – Airborne separation corridor
  - Aircraft allowed to self-separate in designated corridor
  - All aircraft properly equipped (conflict detection & resolution)

Increased Delegation of Separation to the Aircraft

Questions?

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