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INTERNATIONAL CIVIL AVIATION ORGANIZATION

A UN SPECIALIZED AGENCY

Development of ADS-B Regulations

Federal Aviation Administration

Presented to: NAM/CAR/SAM Workshop on the Development of the regulation for the implementation of ADS-B

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Agenda

- ADS-B Regulations as part of a CNS Strategy
- Stakeholder Engagement (before, during and after regulatory process)
- Performance-based Regulations
- Options for implementing Regulations
- Future-proofing Regulations

- Case Study: US ADS-B Program

ADS-B Regulations as part of CNS Strategy

- Surveillance Strategy for an airspace region should include consideration of ADS-B (along with cooperative surveillance radar and MLAT)
- Surveillance Strategy must be part of an overall CNS Strategy for an airspace region
  - C = Communications; N = Navigation
  - CNS capability determines possible Air Traffic Services
- Consider current/future traffic demand, current/planned ATC automation systems, available & future resources, and operating domains (Oceanic, En Route, Terminal, Surface)

Who are they?

Initiating Stakeholders

- ANSP (Air Traffic Control service provider), including controller workforce
- Civil Aviation Authority (regulator)
- Other Government authorities

Responding Stakeholders

- Aircraft owners/operators
- Industry; manufacturers of
  - ATM systems or related components
  - Aircraft or Aircraft components
- Airport owner/operators (if not included above)
- Interested Public
- Adjacent ICAO States

What do they want to know?

- What changes are you proposing?
- How much would it cost?
- How long would it take?
- What are the benefits?
- What are the risks?

- What does this mean to me?
  (to the specific Stakeholder asking…)

When to engage them?

- Always; it is a continuous process
- As early as your regulatory processes allow
- During your regulatory process, as permitted
- After your regulatory process is “completed” to ensure appropriate implementation

Where/How to engage?

- First and foremost, as your regulatory processes allow
- Use existing stakeholder platforms if you have them
- If needed, create mechanisms and platforms to engage stakeholders

Why?

- Ensures that all affected stakeholders are given a “say”
- Stakeholders can help you identify and address potential issues throughout the process and prior to public comment
- Constructive stakeholder engagement can turn potential adversaries into advocates

Performance-based ADS-B Regulations

- Must show that ADS-B is ‘as good’ as any radar already in use
- For “radar airspace” see RTCA DO-318 / EUROCAE ED-161 (ADS-B-RAD)
- For “non-radar airspace” see RTCA DO-303 / EUROCAE ED-126 (ADS-B NRA)
- Use whichever of the above documents best matches your airspace environment
- There must be a defined approach on how ADS-B will be integrated into any ATC system(s), including associated controller displays
- *An ICAO Manual for performance-based surveillance is planned for publication in 2025, but no need to wait for it*

Consider intended ATC operations

- 5-nm separation
- 3-nm separation
- Other separation minima
- Is there any intent to use ADS-B In applications?

Options for implementing Regulations

- Determining scope and timing of regulation
  - All affected airspace at once, or in phases?
  - Different compliance dates for “forward-fit” (new aircraft) and “retrofit” (adding the equipment to existing aircraft?
  - How long after regulation is published should the compliance date be?
    - Factors can include how many aircraft are already equipped, how many need to equip, capacity of repair shops to perform needed upgrades, aircraft heavy maintenance cycles for fleet operators, etc.
- Should the regulation exempt “State aircraft” or provide a different timeline for such aircraft?
- Does the regulation address UAS operations?
  See ICAO State letter SP 44/2-19/77

“Future proofing” Regulations

- Try to construct a regulation that will not need continuous amendments
  - If multiple ADS-B versions are acceptable, refer to the earliest version and utilize “or later” to address additional versions
  - Where possible, use minimal language to convey requirement(s)
- Any regulation will need to be amended later as conditions change or as new considerations emerge

Case Study: US ADS-B Program
Stakeholder engagement

- Why an airspace mandate?
  - ADS-B to become preferred source of cooperative surveillance (FAA strategic decision)
  - ADS-B Out equipage needed to enable
    - New ATC applications
    - New ADS-B-In applications
    - Removal of some legacy cooperative surveillance systems
- Is it worth doing (do benefits outweigh cost)?
  - Total cost/benefit perspective – "total" is the sum of government & private sector costs / benefits
  - Focus of most interactions with stakeholders
    - How to increase total benefits – while ensuring each stakeholder could see benefits for themselves
    - How to lower total costs – while considering each stakeholder's costs
    - Each stakeholder wanted to see positive cost/benefit for themselves

Case Study: US ADS-B Program
Stakeholder engagement

- Which airspace? *(see future slides)*
  - Generally aligned with transponder regulation (14 CFR 91.215)
  - Exception: New Class E airspace from US shoreline to 12nm offshore in Gulf of Mexico from 3,000-10,000 feet MSL
- How are benefits/costs allocated across user groups?
  - Most benefits to GA community were classified as “safety”
  - Most benefits to air carrier community were classified as “efficiency”
  - UAT was allowed as ADS-B “link” for aircraft operating below FL180
    - Early cost analysis showed UAT ADS-B systems would be substantially cheaper than 1090ES ADS-B systems (approximately one-tenth)
    - Additionally, FIS-B was only possible on UAT
    - Early indications from avionics manufacturers suggested that only UAT transmitting systems would be capable of receiving UAT

    (see next slide for how this turned out)

Case Study: US ADS-B Program
Stakeholder engagement

FAA Lesson

- Having two ADS-B “links” (1090ES and UAT) required FAA to provide ADS-Rebroadcast (ADS-R) services, adding significant complexity
- Market reality as of 2020:
  - Cost of a UAT system, depending on the system, can cost anywhere from comparable to about one-half (½) of a 1090ES system
  - Dual-link ADS-B receiving systems are available from almost all avionics manufacturers
- ***FAA recommends using only 1090ES for aircraft surveillance***

Case Study: US ADS-B Program
Stakeholder engagement

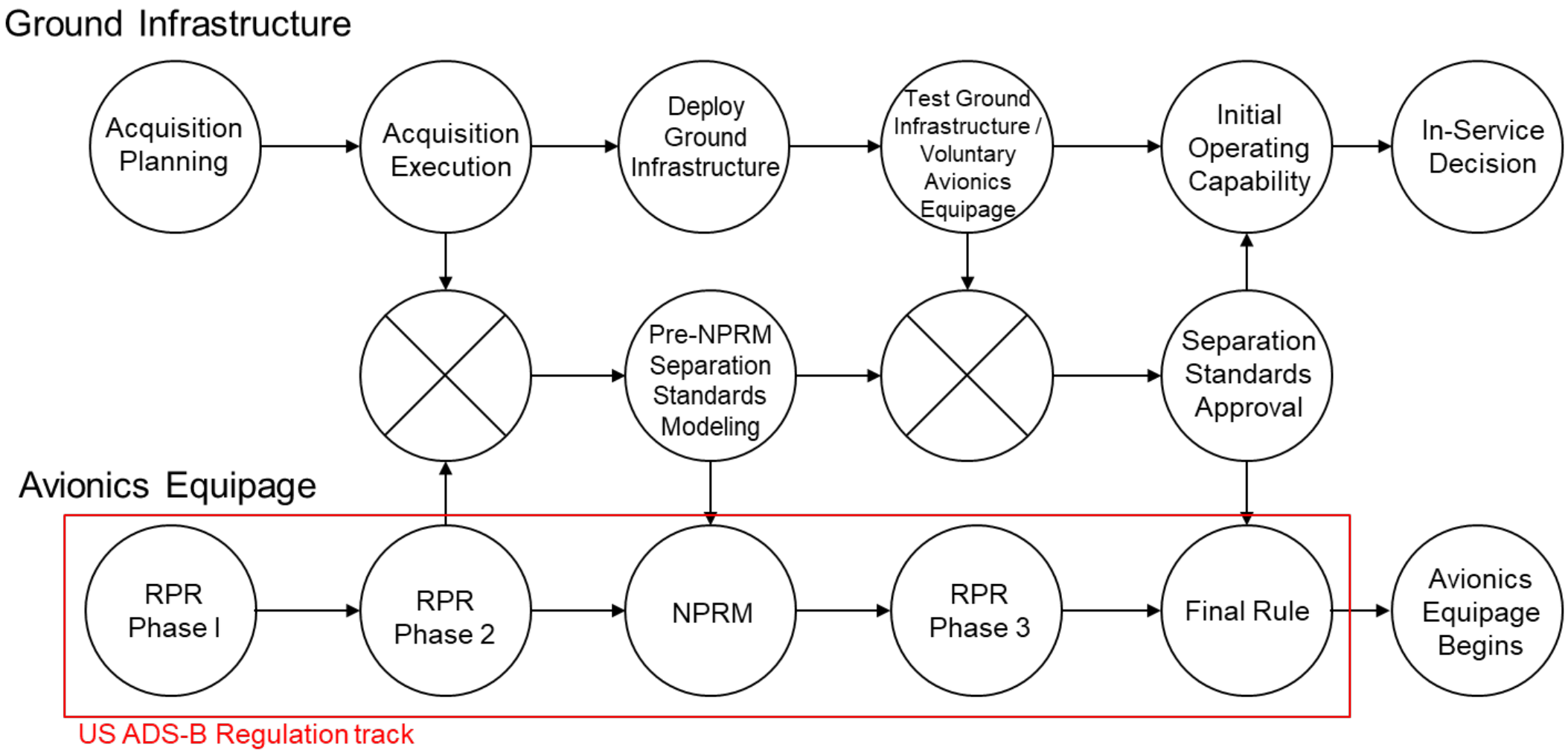
Federal Aviation Administration

RTCA Air Traffic Management Advisory Committee (ATMAC)

- ADS-B Work Group to advise FAA during “design” of FAA’s implementation program, including the ADS-B regulation
- Included many associations representing aircraft operators, such as AOPA, A4A/IATA, NBAA, GAMA, etc
- FAA first floated the need for an ADS-B regulation (mandate) in this forum, and received feedback on “conditions” under which this could be acceptable
- After discussions over about 6-9 months, resulted in a “Dual Track” strategy (shown on next slide)

“Dual Track” Strategy (circa 2006)

Federal Aviation Administration



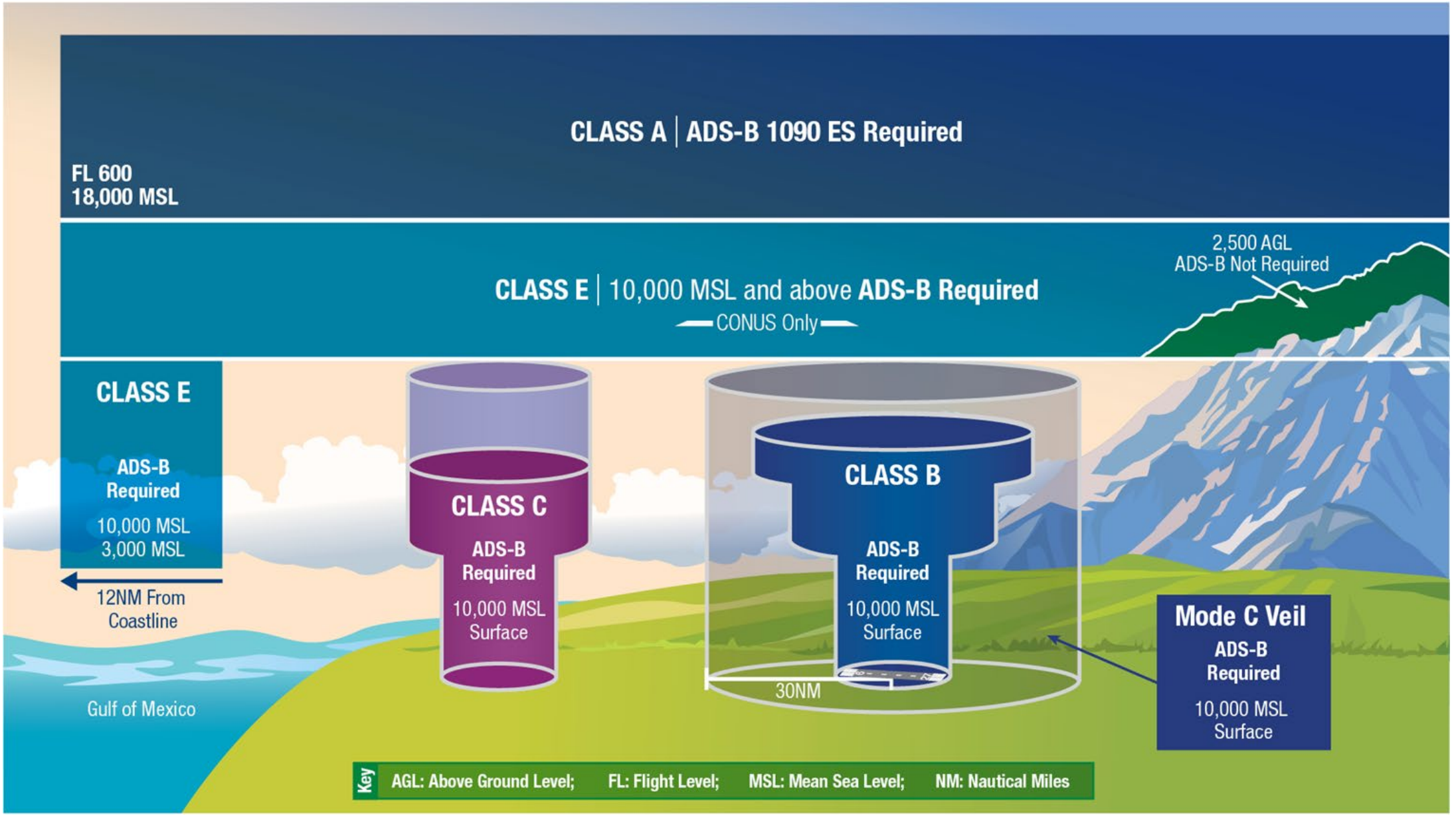
RPR = Rulemaking Project Record; **NPRM** = Notice of Proposed Rulemaking; **ISD** = In-Service Decision

Case Study: US ADS-B Program
Stakeholder engagement

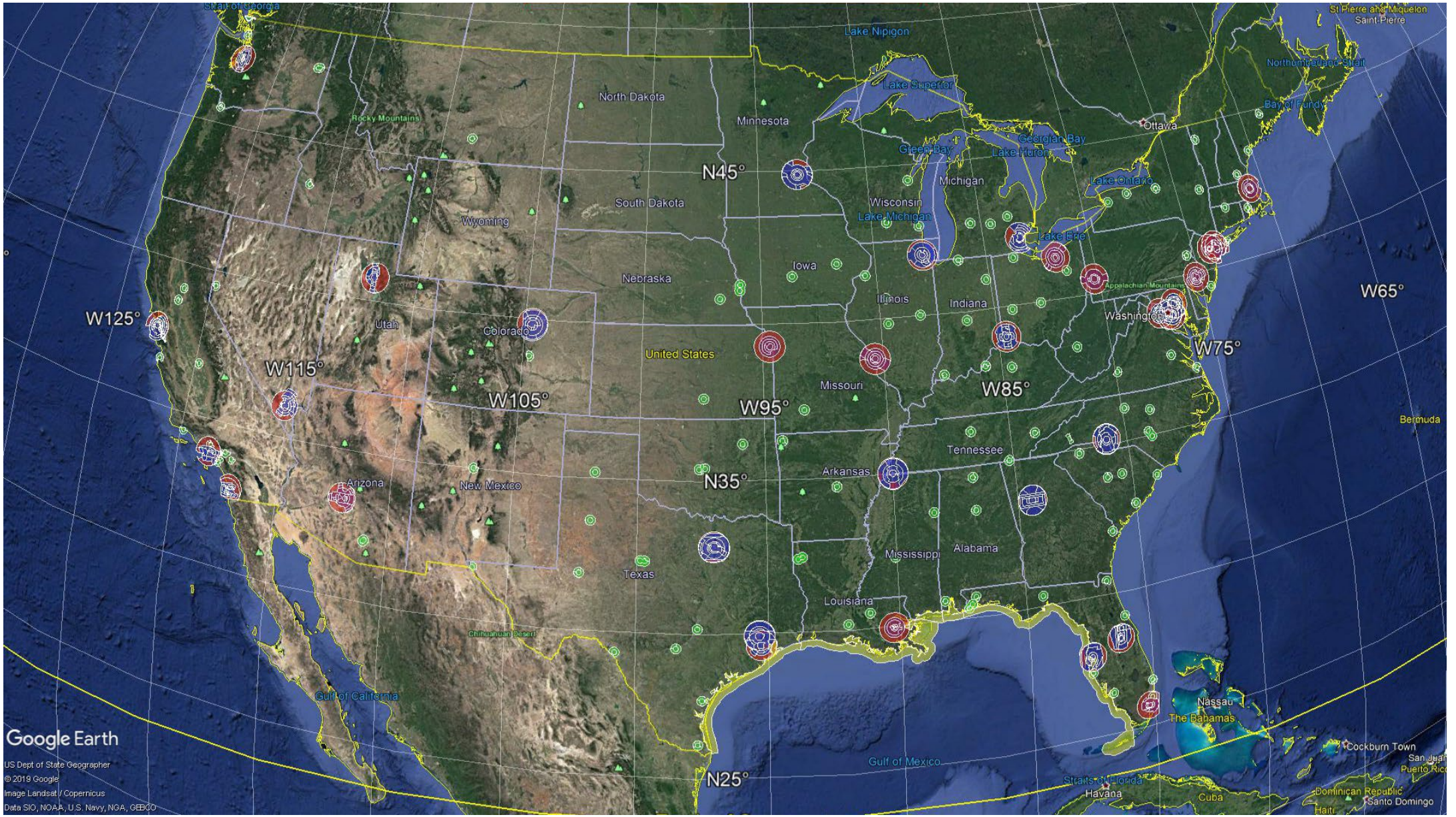
Federal Aviation Administration

- NPRM (prior slide) kicked off the formal US “rulemaking” process
- FAA used Aviation Rulemaking Committee (ARC) to advise on dispositioning comments received in response to NPRM
  - Recommendations on FAA Notice of Proposed Rulemaking No. 7–15, ADS–B Out Performance Requirements to Support ATC Service https://www.faa.gov/sites/faa.gov/files/air_traffic/technology/adsb/quicklinks/arcReport2008.pdf
- Resulted in FAA revisions to the final regulation

US ADS-B Required Airspace



US ADS-B Out Airspace Below 10,000’



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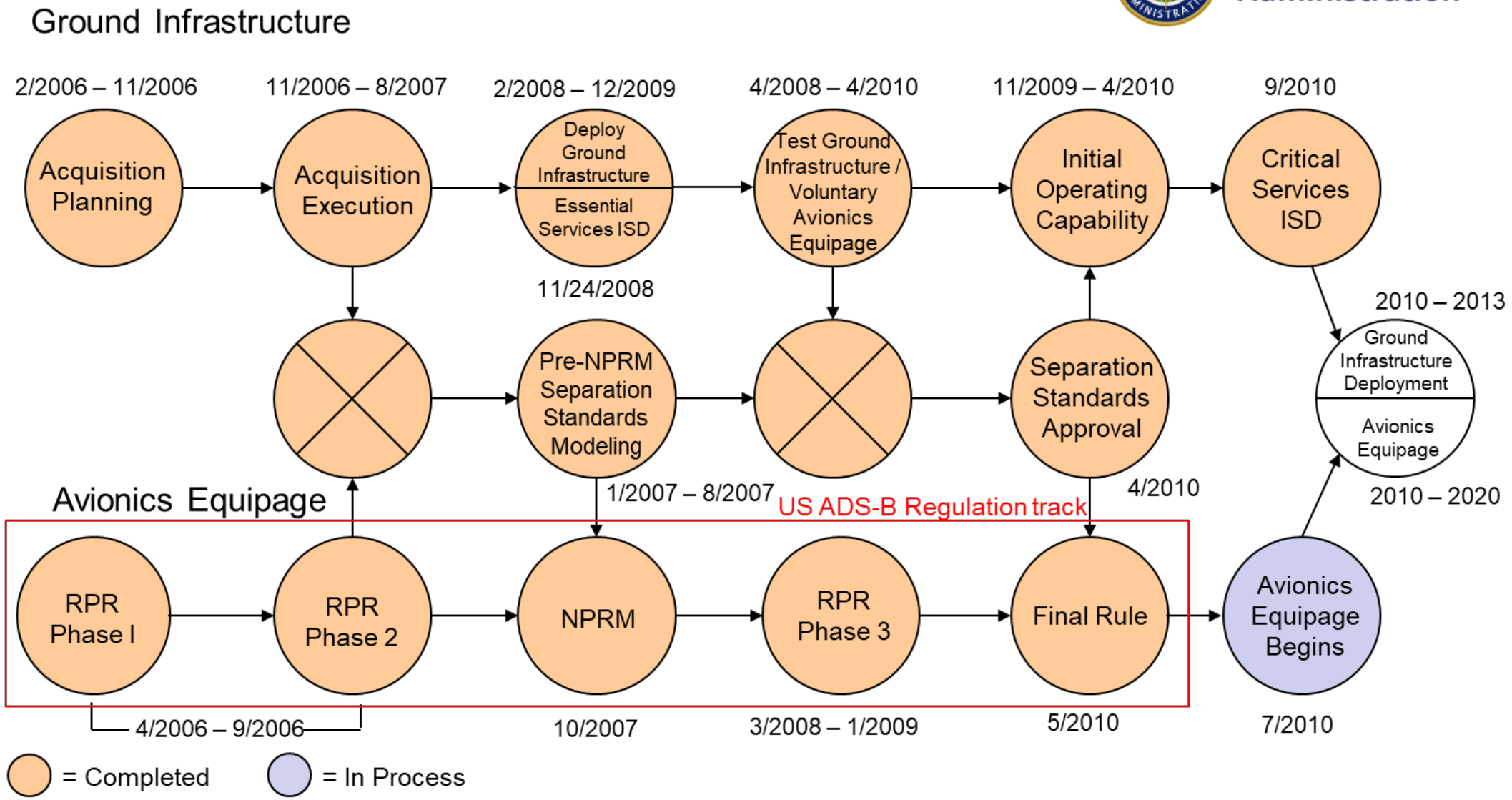
“Dual Track” Strategy (Sept 2010)

Federal Aviation Administration



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Case Study: US ADS-B Program
Stakeholder engagement

Joint Industry ADS-B Working Group [2011-2014]

- Industry-led forum for engaging with FAA ADS-B Program during implementation, after final publication of airspace mandate
- Discussion topics included implementation of ADS-B Out (both from an ATC perspective and an avionics perspective) and development of ADS-B-In applications
- Inspired FAA projects to incentivize early ADS-B equipage, to exercise FAA certification processes (ADS-B Out and In) and operational approval processes (certain ADS-B-In applications)

Performance-based ADS-B Regulations

- To determine the ADS-B performance requirements for the US ADS-B regulation, FAA performed the work shown in slides 17 and 21 as:
  - Pre-NPRM Separation Standards Modeling
  - Separation Standards Approval
- Work was performed in parallel with FAA/Eurocontrol development of RTCA DO-318 / EUROCAE ED-161 (ADS-B-RAD)
- Resulted in performance requirements which are part of the US ADS-B regulation (14 CFR 91.227)
- FAA intended for ADS-B to support all “radar separation” standards then in use by FAA, plus additional separation standards in the future
- Requirements: NIC ≥ 7, NAC_p ≥ 8, NAC_v ≥ 1, SIL ≥ 3, SDA ≥ 2
  - Aviation SBAS and SA-Aware GPS receivers routinely meet these requirements with >99.9% availability in the US

Options for implementing Regulations

Federal Aviation Administration

- FAA's regulation was published in May 2010 with a Jan 2020 compliance date
  - Both airlines and GA wanted to ensure that the FAA ADS-B ground system was deployed and operational before they committed to equipping
  - Airlines stated that they needed 5-6 years to equip (though they did it in less time)
  - Compliance date was established assuming that FAA ADS-B ground system would be fully deployed by the end of 2013, allowing 6 years after that for aircraft operators to equip
  - FAA worked with GA stakeholders to develop an ADS-B Out equipage rebate program for single-engine piston-powered aircraft – from 2016 to 2018, FAA spent $10M to incentivize ADS-B Out equipage of 20,000 aircraft
  - **FAA Lesson**: GA community can take the longest to equip, due to individual aircraft operators making independent decisions about when to visit a repair shop for equipage installation (shop capacity and equipment certification for specific aircraft can limit the equipage rate)

Options for implementing Regulations

- FAA's regulation was all affected airspace at once
  - If FAA hadn't sponsored some avionics development activities, the community might not have achieved the compliance date
  - US would have benefited from an earlier "forward-fit" (new aircraft) compliance date, as it would have encouraged all avionics companies to create products more quickly, allowing more time for retrofit activity
  - **FAA Lesson**: consider earlier compliance date for new aircraft versus current aircraft

Options for implementing Regulations

FAA Lesson:

- Original US ADS-B regulation did not allow for certain operations of State aircraft to be performed without ADS-B; regulation was amended in 2019 to allow “national defense, homeland security, intelligence or law enforcement” operations to operate without ADS-B active when “transmitting would compromise the operations security of the mission or pose a safety risk…”

FAA Lesson:

- Original US ADS-B regulation did not explicitly address RPAS operations; the US ADS-B regulation was amended in 2021 (https://www.faa.gov/sites/faa.gov/files/2021-08/RemoteID_Final_Rule.pdf) to prohibit unmanned aircraft operations with ADS-B Out equipment “unless the operation is conducted under a flight plan and the person operating that unmanned aircraft maintains two-way communication with ATC; or the use of ADS–B Out is otherwise authorized by the Administrator.”

“Future proofing” Regulations

FAA Lesson:

- FAA specified the required use of ADS-B v2 (DO-260B/ED-102A) and “incorporated by reference” the MOPS for 1090ES and UAT
- FAA must amend our regulation whenever ADS-B avionics standards change (example: ADS-B v3)

Thank You!

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