

Next Generation Air Transportation System (NextGen) Surveillance Sector

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Federal Aviation
Administration



Surveillance?

- **Determining the location of something.**
- **In our case, for the use of ATC Staff, We want to see Aircraft and Vehicles**
 - Aircraft that want to get a service and those that do not (Military, hostile, Smugglers, Criminals)
 - We “See them” on screens
 - Glass tubes, flat panels, (plasma, liquid crystal,LCD)
 - These Screens are connected to AUTOMATION



Automation

- **Generally, we combine Surveillance data with Flight plan data for use by the Controller.**
 - Classical Radar consists of , Primary and Secondary
 - Secondary has many “Flavors”
 - Beacon A/C, Mode S, PRM (E-scan)
 - New surveillance methods include ADS-A/B/C
 - A is addressable
 - B is Broadcast
 - C is contract
- **ATC Domains**
 - Ocean, Enroute, Terminal, Surface



Automation and Displays

- **Throughout the world, there has been Enroute, Terminal, and Oceanic Airspace. Automation was designed to accommodate the specific Domain of the Controller**
 - These domains were loosely based on what the radars could see.
 - Oceanic was almost entirely Procedural (no radar)
 - Enroute was out to two hundred miles and high altitude
 - Terminal was out to sixty miles and below 18K feet
 - Surface began to emerge as its own domain but historically was located under Terminal
 - Traffic Flow Management



Surveillance Roadmap Assumptions

- Migration to Automatic Dependent Surveillance - Broadcast (ADS-B) as primary means of surveillance
 - Airspace rule to be in effect and backup to be in place by 2020 (compliance date)
 - Existing surveillance infrastructure will remain in place until then
- ADS-B Backup Strategy:
 - Approved at February 2007 ADS-B Joint Resource Council (JRC)
 - Mitigate loss of on-board GPS
 - Reduced secondary surveillance network (after 2020)
 - Retain all en route beacons (~150 monopulse systems with selective interrogation)
 - Retain limited set of terminal beacons at OEP/High Density Terminals
 - Terminal primary radars are retained
 - Used as safety (ATC) backup
 - Need for additional systems dependent on emerging weather surveillance requirements; roadmap assumes all terminal primary radars required



Surveillance Roadmap Assumptions (continued)

- ADS-B Backup Strategy (continued):
 - ASR-11 program may be extended to replace a limited number of ASR-8/ATCBI systems
 - Primary and Secondary Radars will be retained at selected locations past 2020, additional tech refresh/SLEP work will be required
 - Surface primary radars no longer required after ADS-B rule compliance date
 - Requires mandated equipage of all surface vehicles
 - Surface surveillance to be supported by ADS-B
 - Multilateration will be retained as a backup to ADS-B at all ASDE airports
 - Multilateration (PRM-A) will replace E-Scan PRM system at existing locations; other candidate sites will be evaluated for deployment of PRM-A depending on business case
 - En Route primary radars are under single agency/multi-user (e-Gov concept)
 - En Route primary radars not required for normal ATC operations

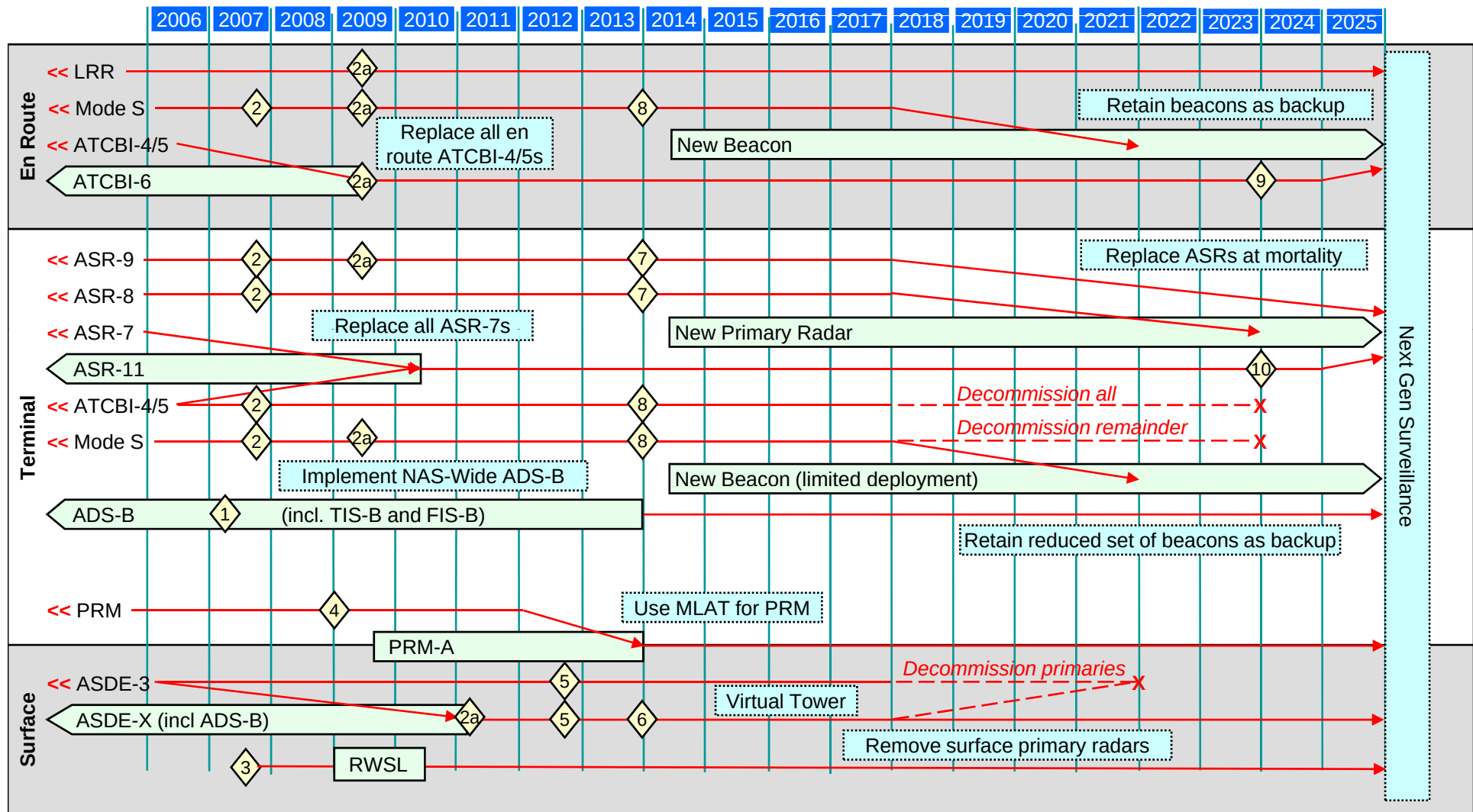


Transitioning from the Old to the New Implementing the Roadmap

- **Adding new Surveillance technologies with more complex formats require a change in the Automation Platforms**
 - FAA added Mode-S that contained more information about the aircraft movement states and was more accurate due to the Monopulse processing
 - Precision Runway Monitor, one second update that allowed planes to fly closer than 4300 feet
 - Surface Multilateration, SMR and Fusion had new formats that did not fit into OLD Automation



Surveillance Roadmap



Surveillance Roadmap Decisions

- 1 2007 - Investment decision for ADS-B/TIS-B/FIS-B Segment 2 (NAS wide) implementation, including backup strategy (limited secondary radar)
- 2 2007 - Investment decision for legacy radar/beacon (ASR-8/ATCBI-4/5, ASR-9/Mode S) low activity refresh through 2020 (limited extension ASR-11 deployment)
- 2a 2009 – Investment decision (SWIM) for implementing IP address at radar facilities for distribution to all users
- 3 2007 – Decision for JRC-2A approval of RWSL at selected airports
- 4 2009 - Decision for migration of PRM to PRM-A, based on multilateration
- 5 2012 – Decision for surveillance capability to support virtual tower implementation
- 6 2014 - Decision for removal of surface primary radars, based on implementation of ADS-B

Source: NAS Enterprise Architecture March 2007 briefing to ATO EC



Surveillance Roadmap Decisions (continued)

- 7 2014 - Decision for replacement of legacy primary radars (ASR-8, ASR-9), based on air traffic safety, weather, and DoD/DHS surveillance requirements
- 8 2014 - Decision for en route and limited terminal replacement of legacy beacons (Mode S), and removal of remaining systems (Mode S, ATCBI-4/5)
- 9 2024 - Decision for replacement of en route beacons (ATCBI-6)
- 10 2024 - Decision for replacement of terminal primary radars (ASR-11 PSR) and removal of terminal beacons (ASR-11 MSSR)

Source: NAS Enterprise Architecture March 2007 briefing to ATO EC



Automation Interfaces

- **Getting the new data into the existing platforms while “planning” for the new !**
- **Legacy Manufactures Automation**
 - Lockheed Martin
 - Thales
 - Indra
 - Raytheon
 - HITT
 - Aleneia



Legacy Surveillance

- **Radar and Surveillance Manufacturers all used their own formats.**
- **WHY !**
 - Their engineers are smarter than everyone else
 - They could charge more money for “proprietary”
 - This guarantees that you keep buying their equipment
 - Their customers (like the FAA) had specific requirements in the purchase specification, so they built what they were asked to, CD-2 for example.
 - FAA already owned Automation that could “read” CD-2
 - Once built, even while inferior, it continued to be specified



Interfacing ADS-B to Automation

- **Assumption; Legacy (existing) Automation platform does NOT decode the new ADS-B data.**
- **It will be expensive to add it !**
 - Who can add it, first ask, Who built the Equipment
 - Will the modification of the equipment fit your new requirements? STOP Proceed to next Page !



Requirments

- **Defining requirements is the single most important step in “Integration of surveillance data into Automation Platforms”**
- **What is the Surveillance Data that you wish to display?**
 - Interface Standard/Format; RS-232, RS-422, TCP/IP, Asterix cat XX,USB, etc...
 - What does your Automation Platform understand?



Implementation

- **System engineering must work on the interface between the legacy surveillance and the New/Legacy Automation**
 - ASR, ARSR, Beacon 4/5/6 and Mode-S Multilateration, ADS-A/B/C
 - Matching the formats may be as simple as converting new surveillance systems position determination, such as ADS-B, to what already exists, like CD-2.



Format Conversion/Translation

- **Radars; Primary and Secondary, output data in a rho,theta format, aligned to Magnetic or true North.**
- **ADS-B is in the WGS-84 format, an “Earth Centric reference volume”**
- **Conversion from one to the other is a well established and mathamatically comprehensive, but simple process.**
- **This allows taking ADS-B data and “making it look like a radar”**
- **One simple example is the FAA’s Alaska Program known as Capstone.**
 - ADS-B data was formated and displayed on a legacy Automation System.



Summary and Questions

- **Technically achievable with existing methods**
- **Very dependant on Automation Platform manufacturer, and Surveillance manufacturer.**
 - Integrating ADS-B into a new Automation platform can be as simple as making ADS-B look like a radar in one of the old formats.

