ASSAP MOPS Presentation

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26 Apr 06

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Agenda

- **ACSS Information**
  - **Company Background**
  - **ACSS SafeRoute Program**
- **ASSAP Functional Overview**
  - **ASA MASPS**
- **ASSAP Functional Implementation**
  - **Reference ASA MASPS**
  - **Discuss Issues**
  - **Assign Issue Papers if Necessary**

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ACSS Information

Innovative Solutions for Safe Flight

- **Our Avionics Improve Safety and Situational Awareness**
  - **Aircraft Collision Avoidance Systems**
  - **Terrain Collision Avoidance Systems**
  - **Aircraft-to-Aircraft Data Communication**
  - **Data Link Communications (Aircraft-to-Ground/Ground-to-Aircraft)**

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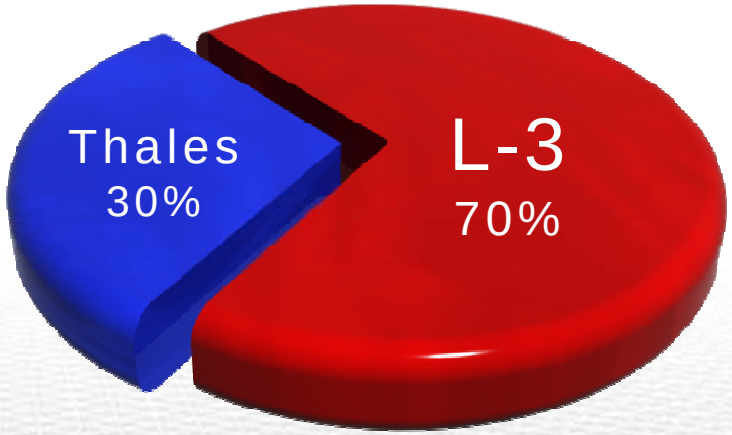
Structure

ACSS, an L-3 Communications & Thales Company

- Joint Venture Company
- Operated As L-3 Communications Company
- Managed by Board With Representatives From Both Companies



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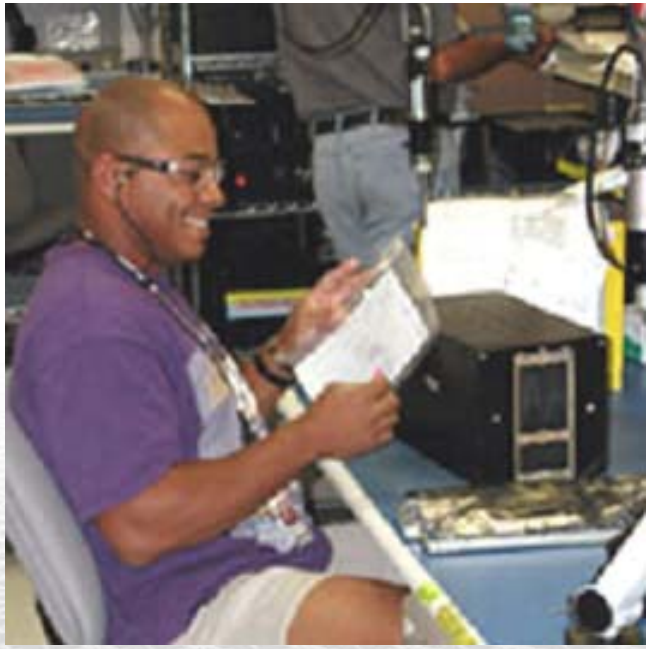
ACSS Headquarters

- **Location**
  - **Phoenix, Arizona**
- **ACSS Team**
  - **250 & Growing**
- **Facility**
  - **85,000 Square Feet**



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Advanced TCAS Solutions

- **MASS – Military Airborne Surveillance System**
  - **ADS-B Capabilities for Unique Military Requirements**
    - **Formation Operations**
    - **Tanker Rendezvous Operations**
    - **Cooperative Member Operations**
  - **Enables Military Cargo/Tanker Aircraft to Identify and Monitor Aircraft Participating in Formation and Rendezvous Operations**
  - **Ensures Interoperability With ETCAS Systems**
  - **Reduces Impact of TCAS 'Clusters' on ATC and Other TCAS Aircraft**

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ACSS SafeRoute Program

- **ADS-B Solutions for Approach & Taxi**

  - **Selected by UPS for fleet-wide installation (Launch Customer)**

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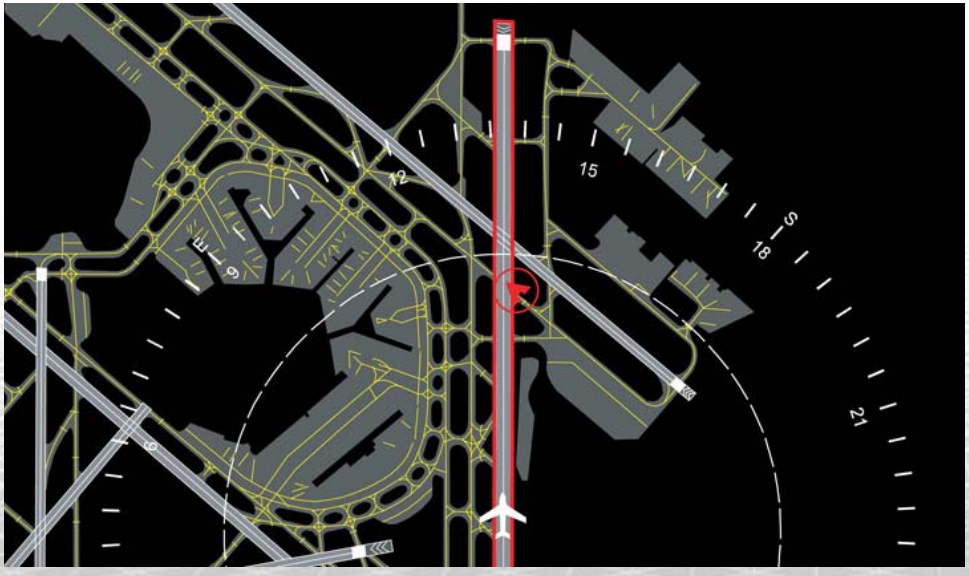
ACSS SafeRoute Program

SafeRoute Applications

- **Enhanced Visual Acquisition (EVAcq)**
  - **"…an aid to the aircraft visual search task of the flight crew,…" (excerpt from the ASA MASPS)**

- **Surface Area Movement Management (SAMM) (similar to ASSA)**
  - **Addresses pressing need for improved situational awareness during taxi and takeoff**



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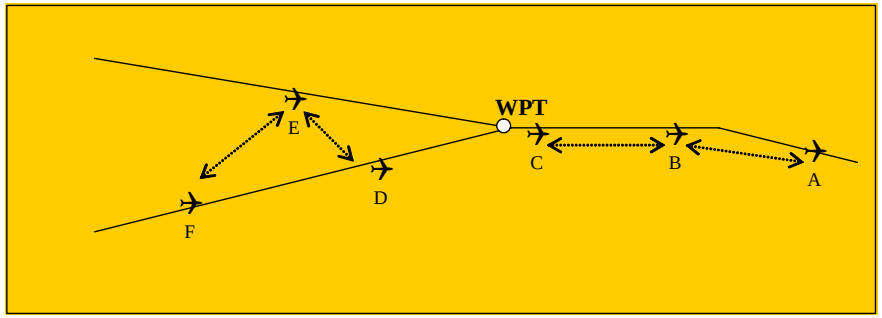
ACSS SafeRoute Program

- **Merging & Spacing (similar to ASIA)**
  - **Increases efficiency within the terminal airspace while reducing noise and emissions**



Provides Speed Guidance So Pilot of E Can Merge Behind D at Proper Interval and F Follows E

<u>No ATC Vectors or Speed Changes</u>

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ASSAP Functional Overview

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ASSAP Functional Overview

ASSAP Purpose

- **The ASA MASPS defines ASSAP as the processing of surveillance and other data in support of the ASA applications.**
  - **ASAS MOPS System Diagram (Reference ASA MASPS Figure 2-4, Page 35)**
  - **Single MOPS Document for the ASSAP and CDTI due to their Shared Interfaces**

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ASSAP Functional Overview

ADS-B / TIS-B Report Processing

- **This function provides the assembly of complete ADS-B/TIS-B reports.**
  - **Includes CPR decoding.**
  - **The MASPS strongly suggests that this subsystem does not track, extrapolate, or otherwise manipulate received surveillance data other than necessary to assemble ADS-B/TIS-B reports.**

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ASSAP Functional Overview

ASSAP Processing

- **The following is from the ASA MASP (Section 2.4.3.4, Page 46)**

- **ASSAP Surveillance Processing will:**
  - **Establish tracks from ADS-B and TIS-B traffic reports**
  - **Cross-reference traffic from different surveillance sources (ADS-B, TIS-B, and TCAS)**
  - **Estimate track state (e.g. position, velocity, …) and track quality**
  - **Delete tracks beyond maximum allowable coast time for the associated ASA application.**

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ASSAP Functional Overview

ASSAP Processing

- **The following is from the ASA MASP (Section 2.4.3.4, Page 47)**

- **ASSAP Application Processing will:**
  - **Determine the appropriateness of track information for various applications and forward data to the CDTI.**
  - **Perform Alerting functions (e.g. CD, ACM, and ICSPA) (see Issue #1)**
  - **Perform Guidance functions (see Issue #1)**

- ***Issue*: Where do we draw the line for defining minimum requirements for ASSAP application processing?**
  - **Reference ASSAP Components Drawing (ASA MASPS Figure 3-5, Page 107)**

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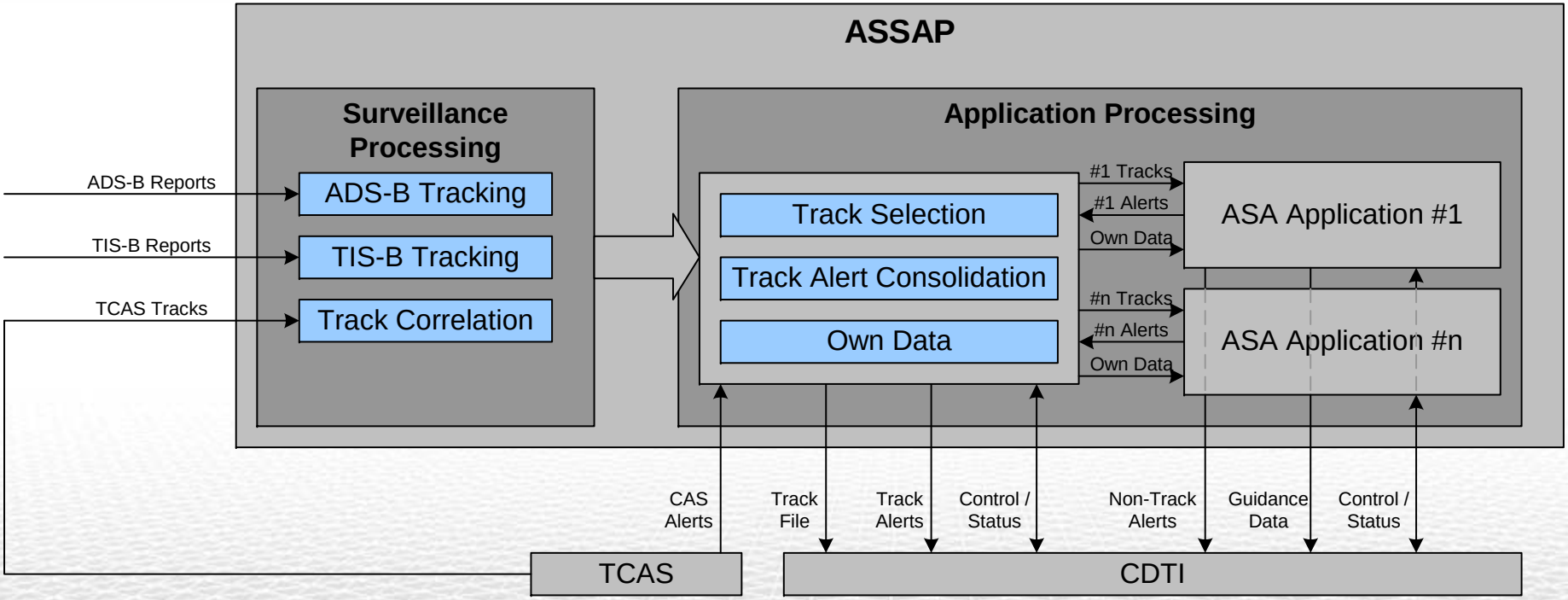
ASSAP Functional Overview

- **ASSAP Processing (ASA MASPS, Page 46)**



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ASSAP Functional Implementation

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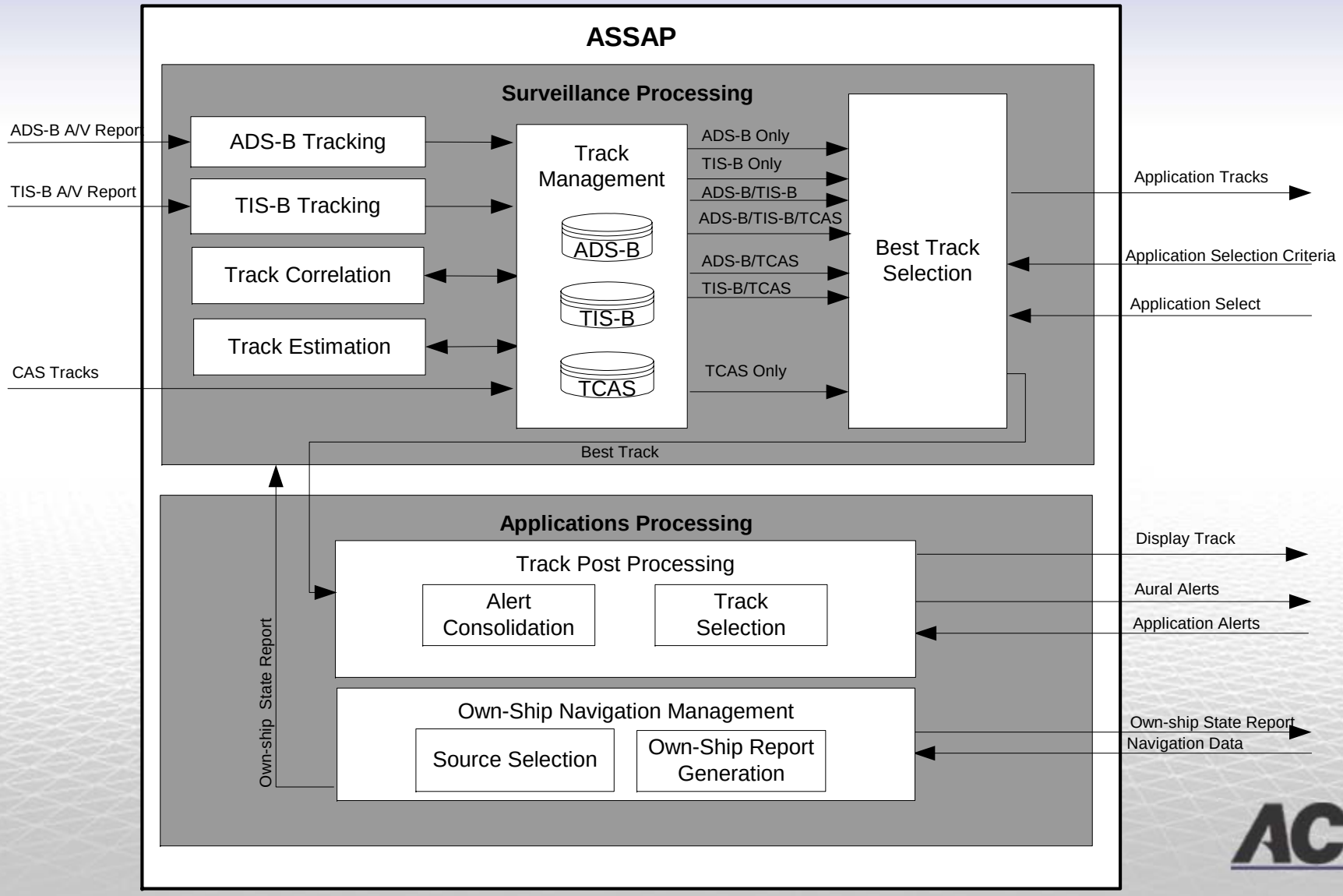
ASSAP Functional Implementation

- **ASSAP Processing**



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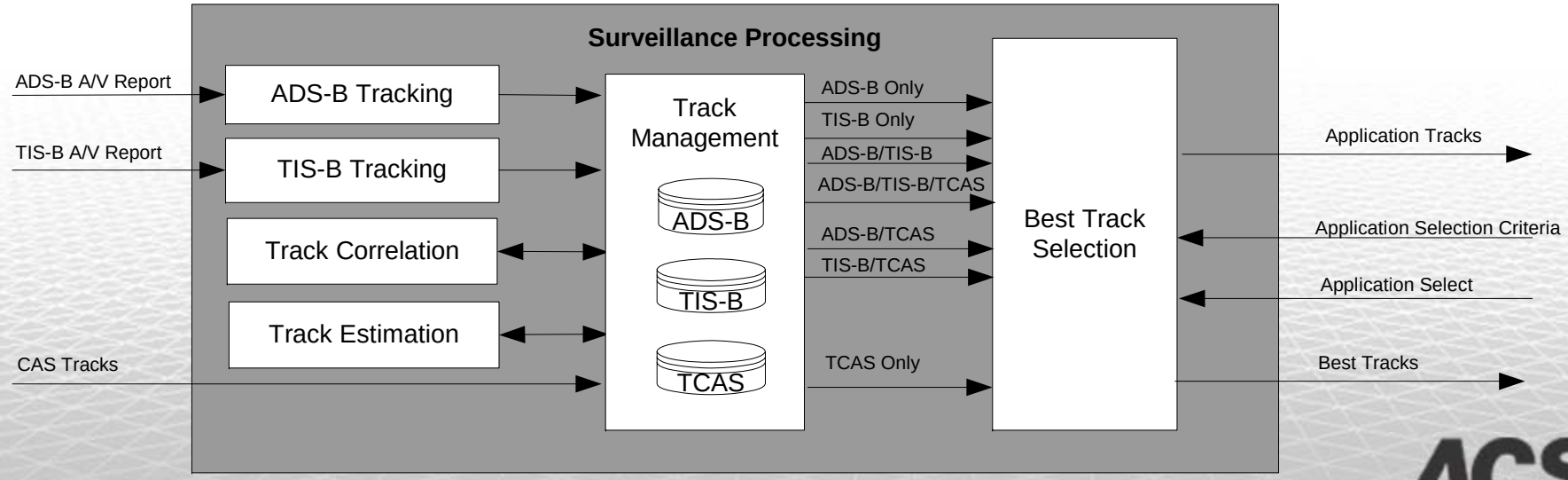
ASSAP Functional Implementation

ASSAP Surveillance Processing

- **ADS-B and TIS-B Tracking - Establish tracks from ADS-B and TIS-B traffic reports.**
- **Track Estimation - During operation, estimates the track state and track quality. This function performs track prediction between report updates and also terminates tracks that have coasted beyond the acceptability of the installed ASA applications.**
  - ***Issue*: How are Accuracy and Integrity represented in a degraded condition (reference ASA MASPS, Table 2-3)**
- **Track Correlation - Cross references traffic from ADS-B, TIS-B and TCAS surveillance sources in preparation for track selection which occurs within the Best Track Selection function.**
- **Best Track Selection - Determines and supplies the appropriate tracks to each ASA application including tracks intended for the CDTI.**



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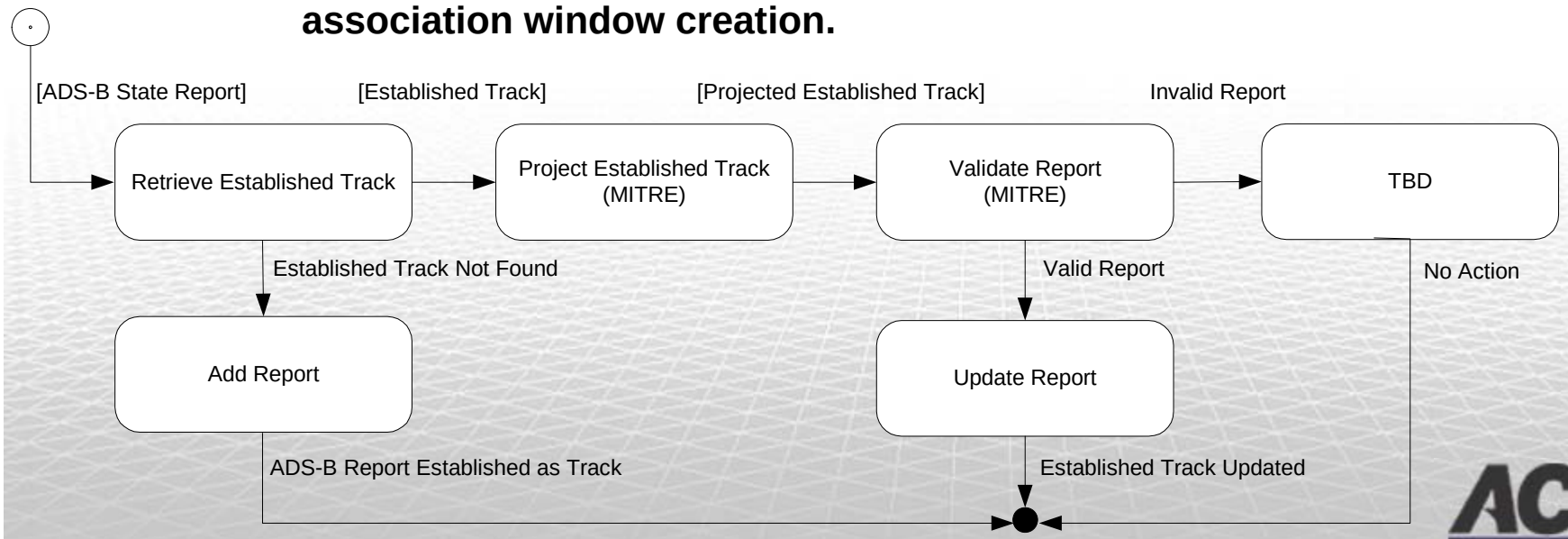
ASSAP Functional Implementation

ADS-B Tracking

- **Establish and update tracks using a degenerate Kalman filter (from MITRE's ASSAP Implementation)**
  - **A degenerate Kalman filter is commonly used in NAV systems for tracking and it also predicts state and state uncertainty to current time required for ASA applications.**
  - **An association window is used to provide spatial correlation for validation of the received report against the established track with the corresponding address. It is the intent to utilize the degenerate Kalman Filter equations provided by MITRE in the track prediction and association window creation.**



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ASSAP Functional Implementation

ADS-B Tracking

- ***Issue***: **Each ICAO address received on 1090 MHz is assumed to be unique within the operational domain per DO-260A, DO-181C, ED 73B, and ICAO Annex 10 Volume IV. Currently DO-260A relies on the reception of unambiguous addresses to assemble state reports. Data elements within the report are received on multiple squitter messages. If ambiguous addresses are encountered, the validity of the state report would be in question.**
- ***Issue***: **What is the tracking capacity? The ASA MASPS contains some requirements to support 90nm. The ASA MASPS contains some future traffic density estimates.**
- ***Issue***: **What is the minimum number of tracks sent to the CDTI? The ASA MASPS says a minimum of 30, based on supporting the minimum for TCAS. Is 30 based on clutter or TCAS surveillance range?**

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ASSAP Functional Implementation

TIS-B Tracking

- **Similar to ADS-B Tracking with the following exception:**
  - **TIS-B to TIS-B association will have to be considered. This will be required as overlapping service volumes that may result in multiple addresses for a single aircraft. MITRE's ASSAP implementation utilizes a candidate window that uses a course window for narrowing down multiple tracks for a single aircraft.**
    - **The TIS-B track with the best NAC will be used when multiple TIS-B tracks exist for a single aircraft (performed in Track Correlation)**
  - ***Issue*: As mentioned for ADS-B tracking, each ICAO address is assumed to be unique. DO260A report assembly will need to be addressed. Validity of state reports will be in question.**
  - **ADS-B to TIS-B association may also have to be considered.**

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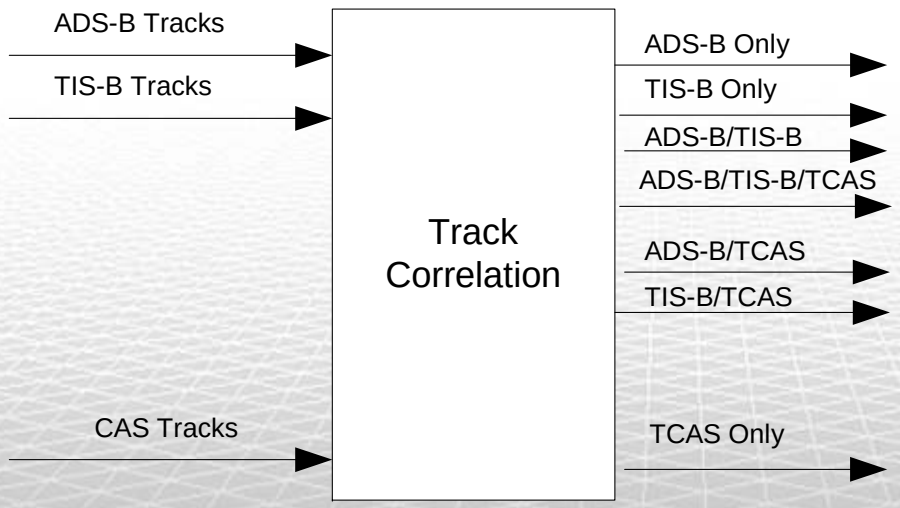
Track Correlation

- **Correlate ADS-B tracks with TCAS tracks based solely upon matching each tracks Mode S address.**
- **Correlate TIS-B with an ADS-B and/or TCAS track based solely upon matching Mode S address when the TIS-B track is designated with an ICAO address.**
- ***Issue*: Correlate TIS-B with an ADS-B and/or TCAS track based solely upon spatial correlation when the TIS-B track is NOT designated with an ICAO address. (from MITRE's ASSAP implementation).**



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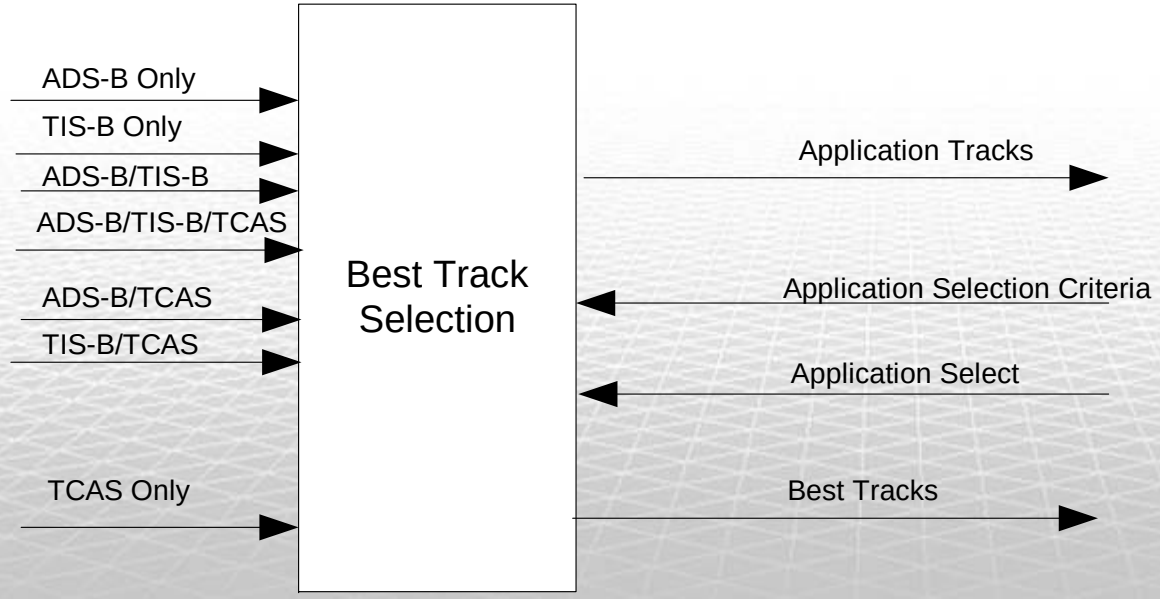
ASSAP Functional Implementation

Best Track Selection

- **Pass all uncorrelated tracks as best tracks.**
- **Select the ADS-B track as the best track when a cross-referenced TCAS track is within a window filter, regardless of the presence of a cross-referenced TIS-B track. (TCAS Alert information is Retained)**
  - ***Comment: The range, bearing, and altitude window is the same as used in the Hybrid Surveillance MOPS for ADS-B validation. When selecting between an ADS-B or TCAS track, NAC will not be considered. The NAC will be used for determining track degradation based on the selected ASA application's criteria.***



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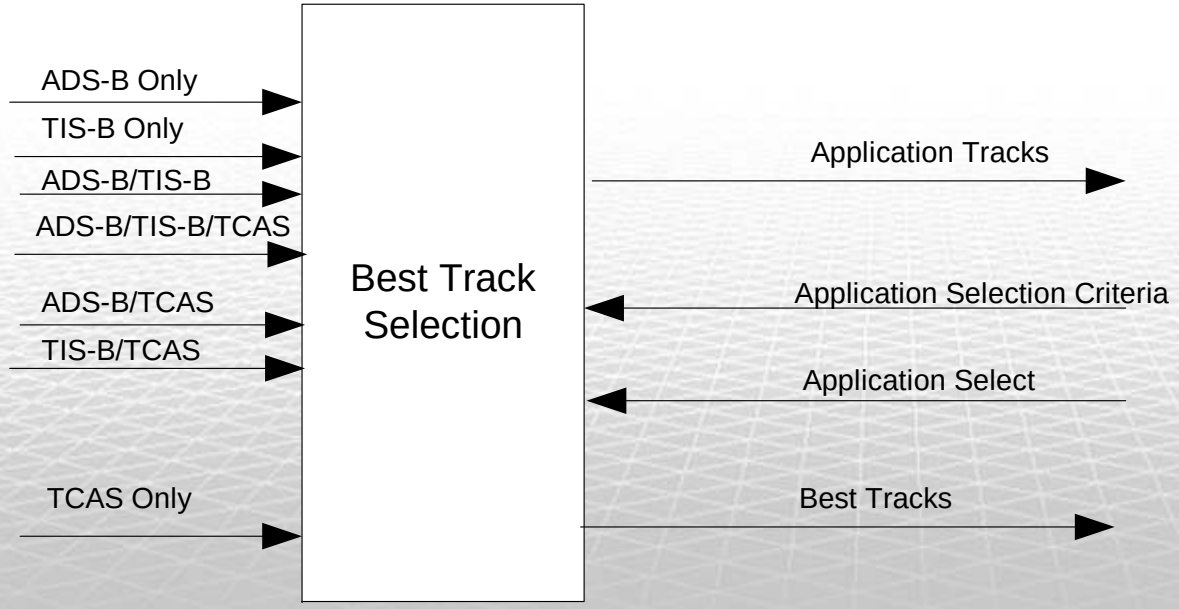
ASSAP Functional Implementation

Best Track Selection

- **Select the TIS-B track as the best track when a cross-referenced TCAS track is within a window filter and no ADS-B track is cross-referenced**
  - ***Issue**: The range, bearing, and altitude window may have to be modified for TIS-B tracks to account for latency.*
- **Only when a TIS-B and ADS-B track are cross-referenced:**
  - **Select the ADS-B track as the best track when the ADS-B NAC value is greater than 8 (TBC). *Issue*: This is done to account for TIS-B latency.**
  - **Select the track with the best NAC value when the ADS-B NAC value is NOT greater than 8 (TBC)**



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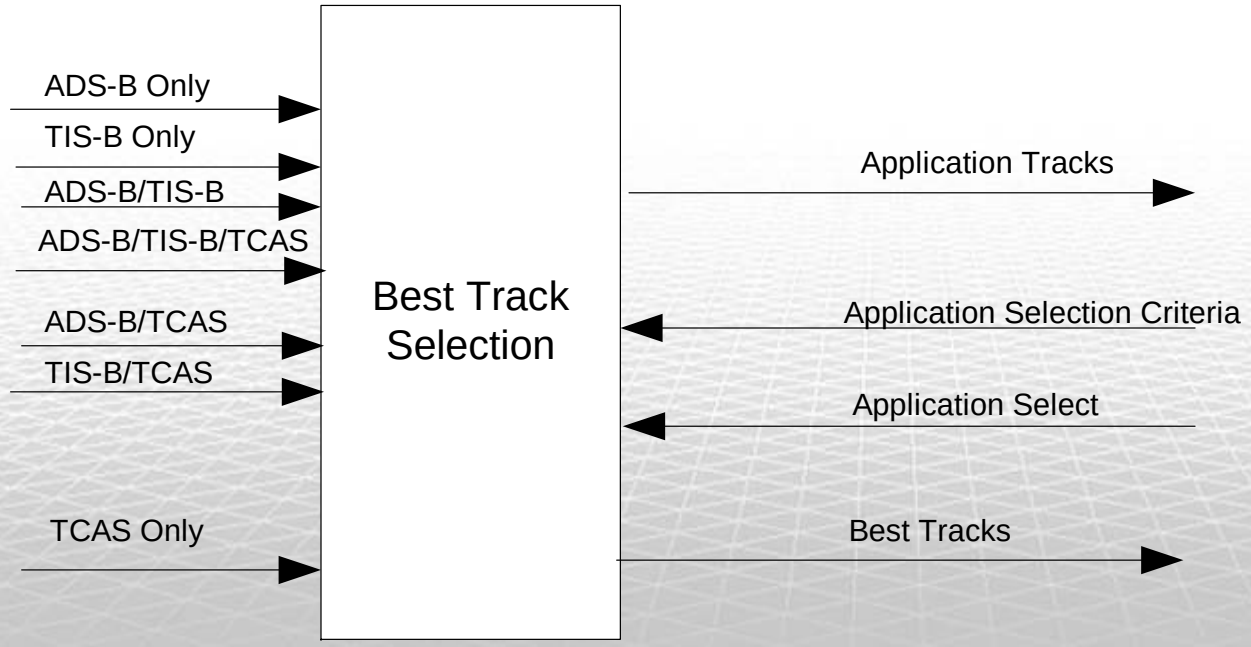
ASSAP Functional Implementation

Best Track Selection

- **Associate a TIS-B or ADS-B track with their cross-referenced TCAS Advisory status when the tracks are selected as the best track and were correlated with a TCAS track.**
  - ***Comment: TCAS Advisory status is for display purposes only. ADS-B and TIS-B track data are not used for CAS TA/RA logic functions.***
- **Pass the best tracks to the CDTI/TCAS displays.**
- **Pass filtered best tracks to each ASA applications based on application specific criteria.**



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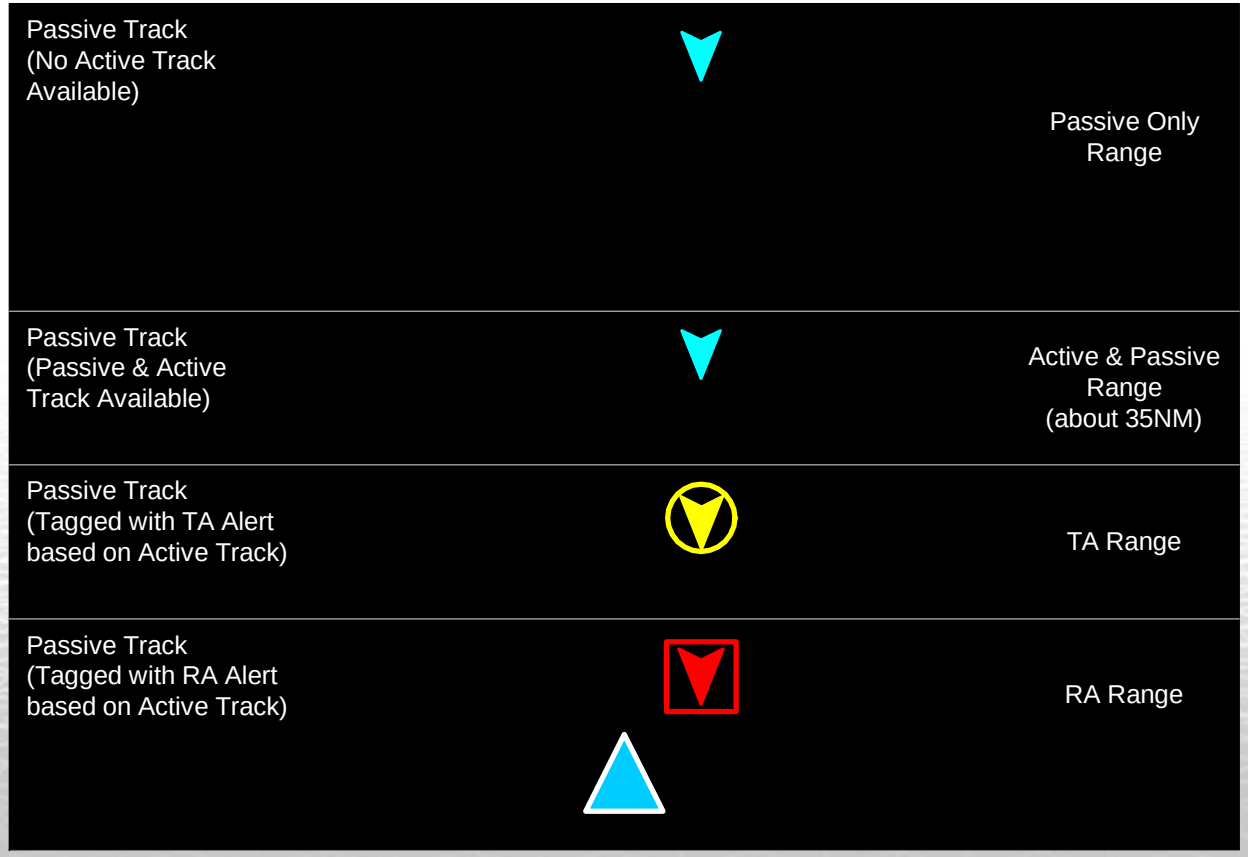
ASSAP Functional Implementation

Display Examples (based on UPS's symbol set)

- **Traffic Display Example #1 (Typical ADS-B Equipped Airborne Traffic):**
  - **ADS-B Equipped:** **Yes (within TCAS window filter)**
  - **TCAS Active Track:** **Yes (while In-Range)**
  - **TIS-B Track:** **No**



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ASSAP Functional Implementation

Display Examples (based on UPS's symbol set)

- **Traffic Display Example #2 (Typical Non ADS-B Equipped Airborne Traffic):**
  - **ADS-B Equipped:** **No**
  - **TCAS Active Track:** **Yes (while In-Range)**
  - **TIS-B Track:** **No**

No Passive or Active Track Available	**NO TRAFFIC SYMBOL**	Passive Only Range
Active Track (No Threat or Approximate Traffic)		Active & Passive Range (about 35NM)
Active Track (TA Alert)		TA Range
Active Track (RA Alert)		RA Range

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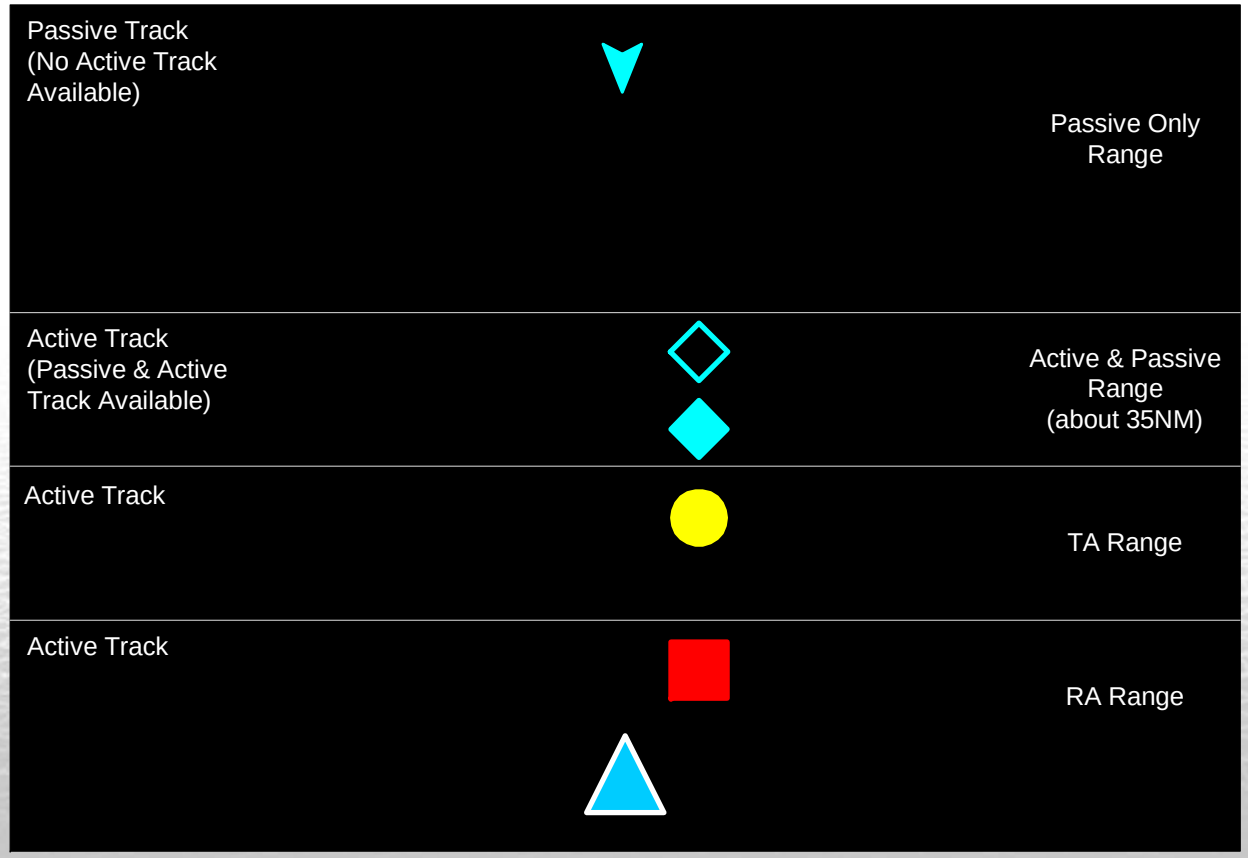
ASSAP Functional Implementation

Display Examples (based on UPS's symbol set)

- **"Not Typical" Traffic Display Example #3 (ADS-B Equipped Airborne Traffic NOT within TCAS window filter):**
  - **ADS-B Equipped:** **Yes (NOT within TCAS window filter)**
  - **TCAS Active Track:** **Yes (while In-Range)**
  - **TIS-B Track:** **No**



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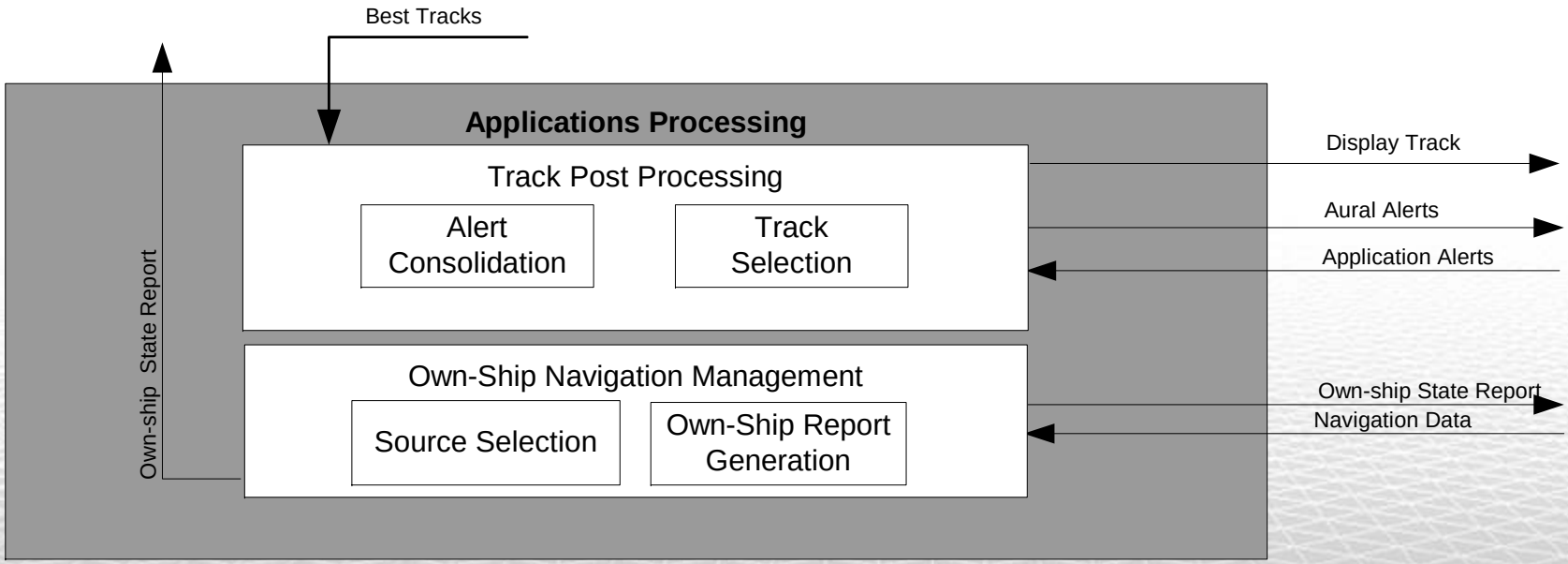
ASSAP Functional Implementation

- **ASSAP Application Processing**
  - **Track Post Processing – Prepares tracks for delivery to the CDTI**
  - **Own-Ship Navigation Management – Provides source selection from multiple navigational sources, generates and delivers Own-Ship State Reports.**



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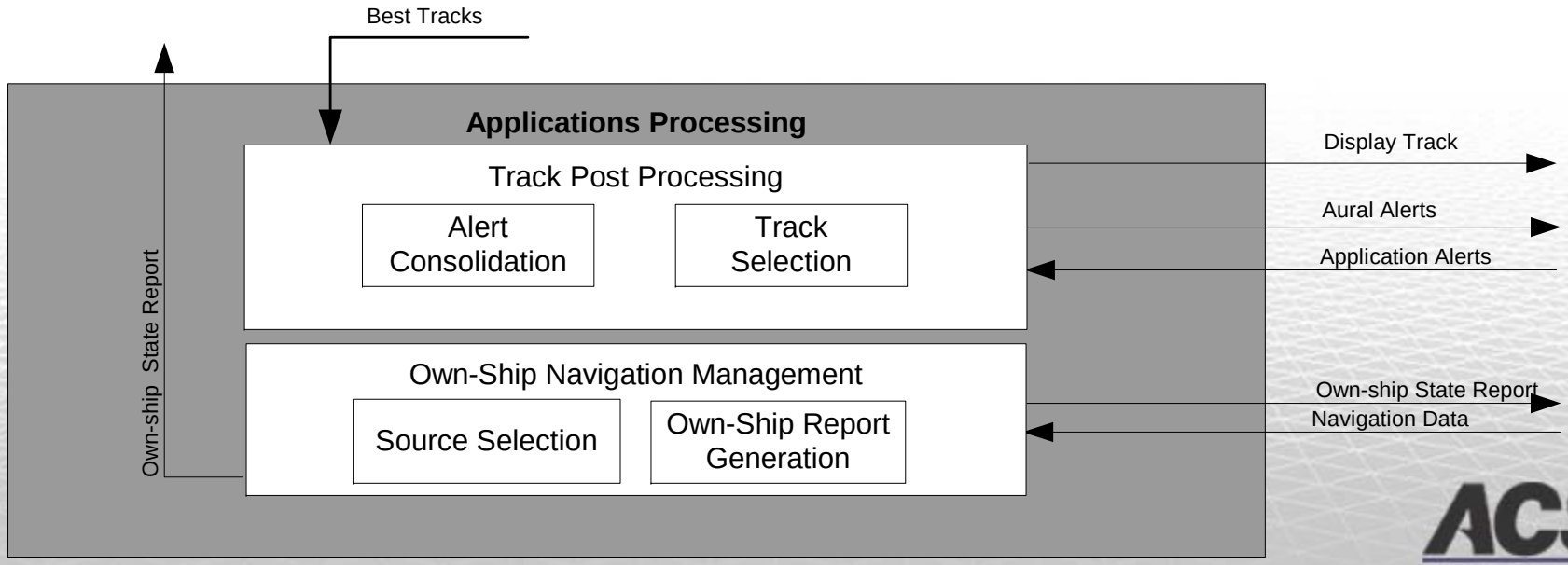
ASSAP Functional Implementation

Track Post Processing – Alert Consolidation

- **Aircraft Alerts supplied by the ASA applications are consolidated into the track reports**
- **TCAS/ACAS alerts shall have priority over all ASA alerts (MASPS Section 3.3.3.1.6.4)**
- ***Issue*: Alert Prioritization:**
  - **1. TCAS/ACAS**
  - **2. TO_BE_DETERMINED**
  - **3. TO_BE_DETERMINED**



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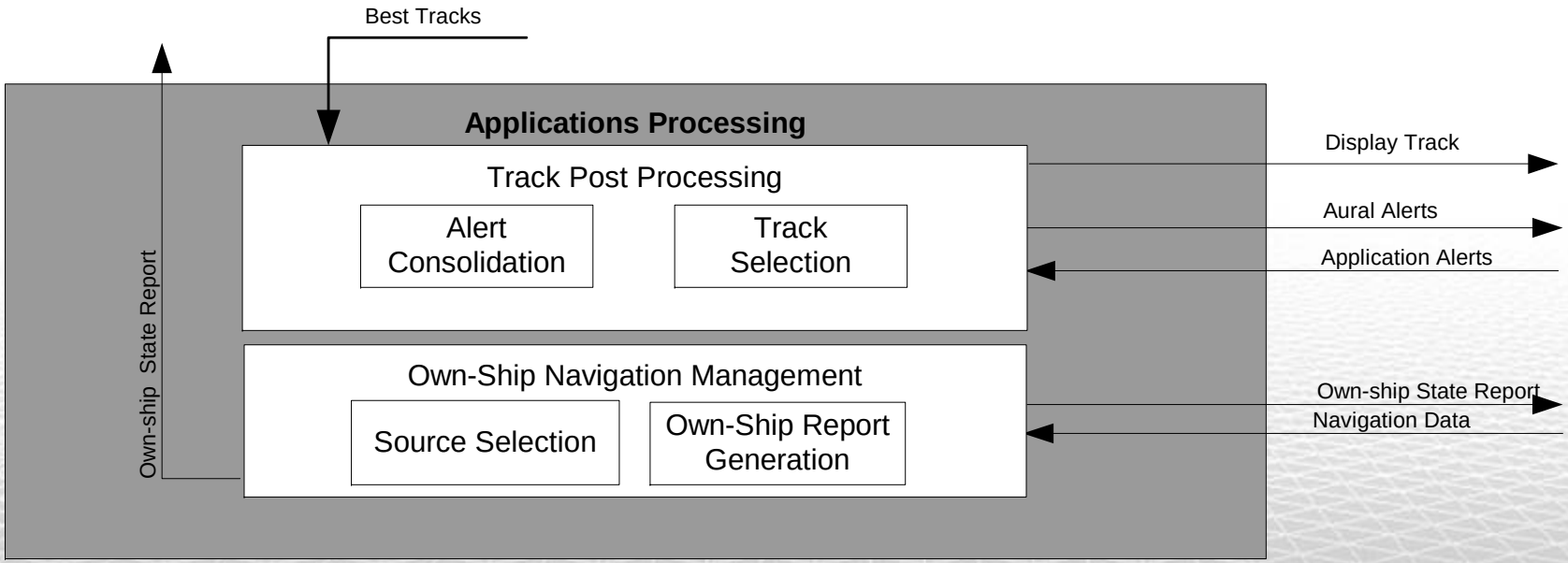
ASSAP Functional Implementation

Track Post Processing – Track Selection

- **Selects a subset number of tracks for the CDTI based on the highest priority**
- ***Issue*: How may tracks should be sent to the display? ASA MASPS currently says that the CDTI shall support a minimum of 30.**



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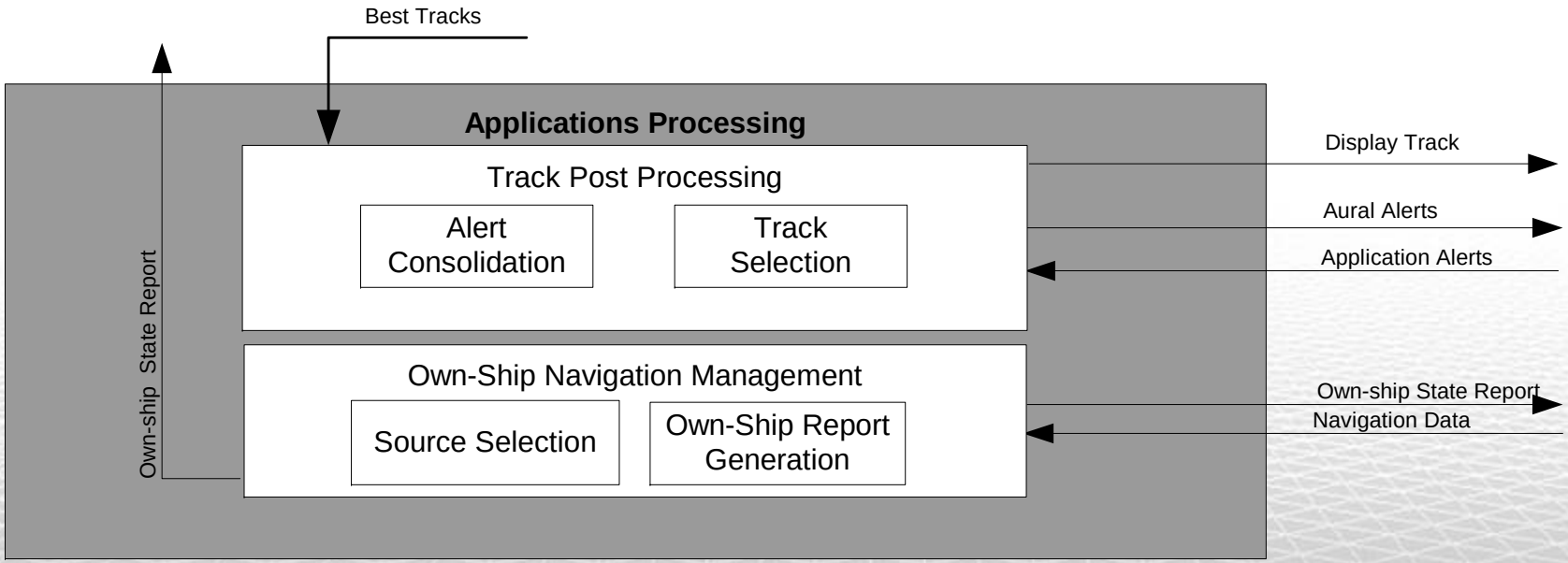
ASSAP Functional Implementation

Own-Ship Navigation Management – Source Selection

- **Selects positional reports from various sources (GPS, IRS, FMS, etc.) based on the sources integrity and accuracy data**
- ***Issue*: Propose to perform source selection based on the STP MOPS which is based on HPL (measurement of containment). This will keep the transmit and receive data sources similar.**



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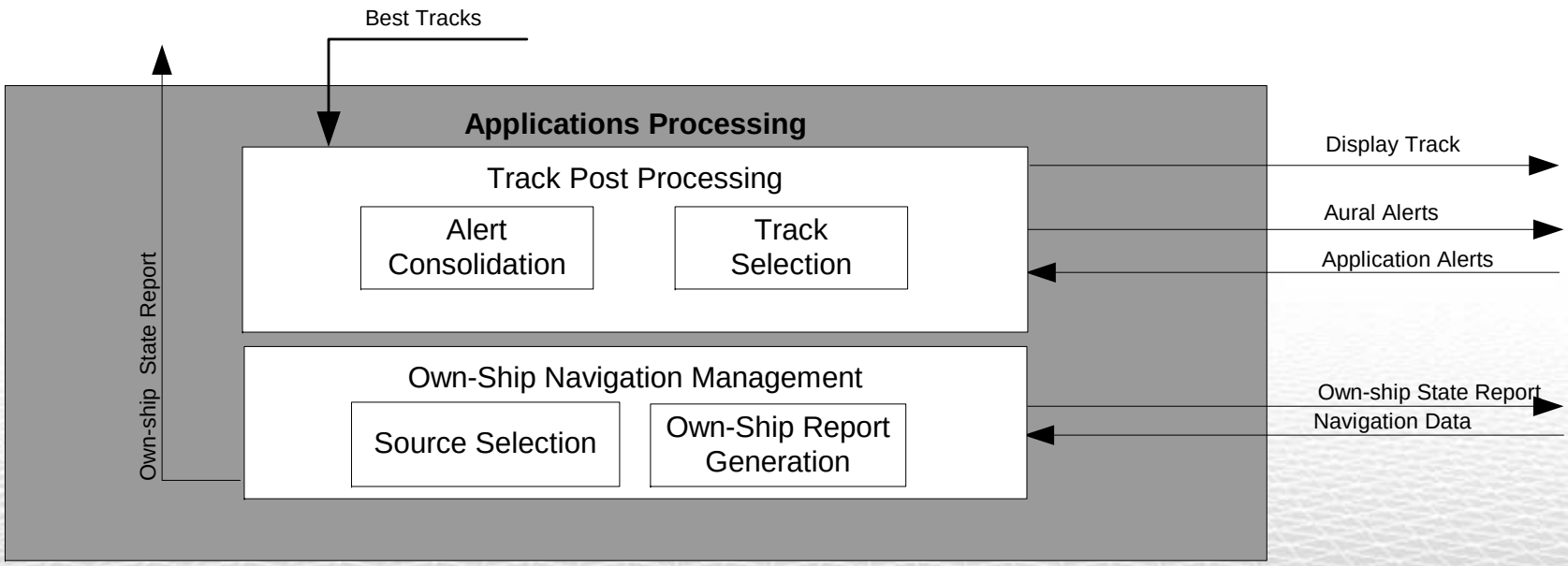
ASSAP Functional Implementation

- **Own-Ship Navigation Management – Own-Ship Report Generation**
  - **Provides Own-Ship State Reports to all installed ASA applications, Flight Crew Interface (CDTI), and ASSAP internal functions.**



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ASSAP Functional Implementation

- ***Issue*: Latency/Performance Issues**
  - **Latency for the combination of ASSAP and the CDTI shall (R3.210) be less than 400 ms for targets that are used by coupled applications, targets against which there is an alert, and the 10 highest priority targets.**
  - **Latency for the combination of ASSAP and the CDTI shall (R3.210) be less than 1 second for targets which are not intended for coupled applications, have no active alerts, and are not included in the highest 10 priority targets.**
  - **Track estimation shall (R3.188) extrapolate all established tracks to a common time within one-second of delivery to ASA applications or the CDTI interface.**
  - **The tracking function shall (R3.178) terminate a track when the maximum coast interval has been exceeded for all of the applications for which the track is potentially being used.**
  - **The maximum latency of the navigation data outputs to the ASA system will be less than 2 seconds (ASA MASPS, Page 144)**
  - **Selected App, Selected Target, flight crew selections, etc. performance?**
  - **TCAS availability when ASSAP is failed?**

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