Federal Aviation Administration

Situational Awareness (SA) Display System Concept of Operations

Federal Aviation Administration
800 Independence Avenue
Washington, D.C. 20591

Table of Contents

1. Introduction

This Concept of Operations (CONOPS) describes the characteristics for a proposed Situational Awareness (SA) Display system to support Airport Traffic Control Tower (ATCT) facilities not currently equipped or approved for a Standard Terminal Automation Replacement System (STARS) Certified Tower Radar Display (CTRD).

The SA Display systems will provide Air Traffic Control Specialists (ATCS) managing airspace typically defined as Class D[1,2] a means to visually acquire aircraft or ground vehicles by correlating their position with geographical references. This capability will increase situational awareness by providing identification of compliance and inadvertent non-compliance with controller instructions. In addition, it will add an increased awareness of previously unknown targets of interest. Use of the SA Display systems will be limited to the guidance currently defined in FAA Order 7110.65 Air Traffic Control: 3−1−9a. USE OF TOWER RADAR DISPLAYS. The added capability will assist controllers with the planning and workload management of airport traffic operations.

This CONOPS provides insight into the operational and functional characteristics of the proposed ATCT SA Display systems' solution and outlines the concept for its integration and use in National Airspace System (NAS) operations.

1.1. Background

There are currently 521 ATCTs in the NAS, ninety-two of which do not have a CTRD. Ninety of these facilities are Federal Contract Towers (FCT). STARS CTRDs are the only approved "real-time" situational awareness display monitor for ATCTs in the NAS [with the exception of the Micro-En Route Automated Radar Tracking System (MEARTS) outside the contiguous US]. Approximately half of the ATCTs without a CTRD do not have adequate radar coverage to support a STARS installation.

The Terminal Automation Modernization and Replacement (TAMR) Program Office (PO) is responsible for deployment and sustainment of STARS. Currently, there are no plans or available funding to add facilities to the TAMR baseline.

There are multiple towers that have operational SA Display systems in the NAS today. In September 2019, the Operational Policy & Implementation Team (AJT-2) released a memo informing FCT management to ensure that FCT facilities do not use these types of displays, as they are non-certified nor authorized for use. The CONOPS team has met with representatives who have experience using these uncertified systems to aid in the development of this CONOPS.

Today there are many government and commercial applications available that can display aircraft data including position, time stamp, identification, flight level, etc., but none are an approved alternative to a CTRD. Various government and commercial surveillance sources

[1] SA Displays are intended for use where RADAR separation services are not provided. Potential examples are temporary towers installed in Class E or G airspace (e.g., airshows), airspace planning a transition from Class E or G to Class D (e.g., new tower construction transitioning from Class E to Class D), or other Class E towers.

[2] All references to "Class D" throughout this document are intended to capture the intent of the first footnote.

supply the data displayed in such applications including Automatic Dependent Surveillance-Broadcast (ADS-B) receivers, Mode S receivers, and multi-lateration sensors, but none are approved as an alternative to a CTRD. Applications combine the data to produce a single display. The quality (including integrity, accuracy, and latency) of such data can vary depending on the coverage area and the different data sources fed into the application. The development of most of the applications were not for the purpose of providing air traffic services. While considered useful as an alternative to conventional and certified surveillance data, it is important to be careful and ensure that ATCS do not rely on un-certified data provided by SA Display applications for safety-related tasks in the delivery of an air traffic service.

The Mission Support Strategy Directorate (AJV-S) conducted an Operational Needs Assessment (ONA) to consider the necessity for SA Displays for ATCTs not equipped with CTRDs. The assessment, with input from stakeholder representatives from Air Traffic Services (AJT), Safety & Technical Training (AJI), TAMR Program Management Organization (PMO), Surveillance and Broadcast Services (SBS) PMO, Technical Operations (AJW), Western Service Center (AJV-W), Central Service Center (AJV-C), Eastern Service Center (AJV-E), and the National Air Traffic Controllers Association (NATCA), concluded an operational need. Findings from the assessment found that in ATCTs without a situational awareness display, controllers have limitations to acquisition and/or correlating aircraft position by visual observation only. This results in efficiency shortfalls including increased workload from time spent attempting to verify position, increased manual coordination with the approach control facility, and distraction from the operation.

On April 21, 2021, AJT presented the ONA findings to the ATO Directors Forum. The ATO Directors approved an operational need for:

> "An alternative to CTRDs to be used for situational awareness in FAA and Federal Contract Towers without a CTRD"

As a result, Management assigned AJW-121 to establish an effort to define a non-federal pathway to evaluate system design for an SA Display system to support ATCT operations that do not qualify for STARS CTRDs, ensuring safety, security, and performance standards. The effort includes:

- The development of operational requirements
- The evaluation of Commercial Off the Shelf (COTS) SA Display equipment against program established criteria/requirements, including:
    - FAA Safety Risk Management (SRM) assessments
    - FAA oversight requirements
- System Design Services Program approval/qualification of SA Display systems for use in the NAS

1.2. Problem Statement

The introduction of ADS-B to the NAS has potentially made many lower-cost commercial flight-tracking applications available publicly and, in some cases, is used by airports and airlines for flight planning. The availability of these services has led to increasing requests for their addition and use in FAA ATCT operations not qualified to receive CTRDs. The development of these applications was not specifically for providing air traffic services and may rely on uncertified surveillance data to support safety-related ATCT services. The FAA currently lacks guidance for approving and using these types of alternate CTRDs. This lack of guidance is causing a delay in

ATC access to potential SA Display systems solutions, which can benefit ATCTs currently operating without CTRDs.

1.2.1. Approved ONA Language

Provide additional traffic situational awareness with respect to aircraft operating within the Class D airspace to Airport Traffic Control Towers within that airspace that are not equipped with traffic information displays (e.g. STARS displays, Certified Tower Radar Displays). This additional situational awareness will aid in the visual acquisition and/or correlating aircraft position with respect to geographical references on the ground[3].

1.2.2. Shortfalls

The following is a list of identified shortfalls for ATCTs currently operating without the support of a SA Display system:

1. Lack of awareness of aircraft not in communication with tower

2. Decreased ability to assist distressed aircraft and direct emergency services in a timely manner

3. Decreased ability to foresee/prevent wrong airport landings

4. Decreased ability to visually locate aircraft or determine their spatial relationship to known geographical points in a timely manner

1.3. Concept Overview

The introduction of ADS-B and multi-lateration surveillance systems to the NAS made available commercial flight surveillance and aircraft/ground vehicle tracking applications for airport operations and commercial use. Airports offered to provide ATCT operations access to these SA systems to support ATCT operations that do not have access to CTRDs. The FAA is developing guidance and regulations to support the implementation and approved use of non-federally owned and operated uncertified SA Display systems for Class D ATCT operations. Controllers will only use the SA Display system as an aid to assist in visually locating the target or in determining their spatial relationship to known geographical points. Controllers will not rely on these SA Display systems to provide radar services or traffic advisories to pilots. The airport authority or another sponsoring organization will obtain, provide, and operate the systems or services supporting the SA function.

1.3.1. Definitions

1. Situational Awareness – A continuous extraction of environmental information, integration of this information with previous knowledge to form a coherent mental picture, and the use of that picture in directing further perception and anticipating future events. Simply put, situational awareness means knowing what is going on around you. (2-6-1 7210.3 Facility Operation and Administration).

---

[3] *Uncertified tower display workstations must be used only as an aid to assist controllers in visually locating aircraft or in determining their spatial relationship to known geographical points*. Radar services and traffic advisories are not to be provided using uncertified tower display workstations. General information may be given in an easy to understand manner, such as “to your right” or “ahead of you (7110.65 Air Traffic Control).

2. Controller mental model – Mental picture using out the window (OTW) view, communication, airspace knowledge, knowledge of all aircraft and ground vehicle positions, knowledge of landmarks, etc.

3. Target ID – A unique ID to identify an aircraft or ground vehicle. This may or may not be available on the SA tool.

4. Conventional Methods – This refers to standard practices defined in 7110.65 for ATC personnel to manage traffic.

1.4. Alignment

The FAA is to develop guidance and requirements for the qualification and use of SA Display systems for ATCT operations that currently do not qualify to receive and use a STARS CTRD. The program requires alignment with the April 27, 2021 (Updated May 2022) Directors Forum Decision for: Situational Awareness of Aircraft Position in Airport Traffic Control Towers without a Certified Tower Radar Display (CTRD). (Reference Appendix A: Situational Awareness of Aircraft Position in Airport Traffic Control Towers without a Certified Tower Radar Display (CTRD) Directors Forum Summary Report).

2. “As is” Operations

Contract towers are ATCTs staffed by employees of private companies rather than by FAA employees. FCTs “as is” operational environment is typically Class D with no radar services. The tower does not provide separation services to Visual Flight Rules (VFR) aircraft in these eligible FCTs. Stakeholders and users included are Air Traffic, pilots, the flying public, and airport operations including emergency services and operations.

3. Justification and Description of Changes

There are currently 92 ATCT in the NAS that do not qualify for a STARS CTRD. ATC operations for these airports do not benefit from the situational awareness a CTRD can provide air traffic controllers. Controllers rely on pilot/vehicle-operator reported positions, which can be erroneous and can lead to increased radio transmissions. This can impact the information a controller provides to a pilot or vehicle-operator. A query of voluntary safety reporting program (VSRP) data from January 2019 to January 2021 returned 78 Air Traffic Safety Action Program (ATSAP) and FCT SAFER reports citing a safety issue resulting from a lack of situational awareness in towers without a tower radar display. Forty-five of the reports explicitly recommend the installation of a tower radar/situational awareness display. The addition of FAA guidance and requirements for the qualification, approval, and use of SA Display systems for Class D ATCT operations will accelerate the implementation of the SA Display systems solution, help resolve the shortfalls defined in Section 1.2.1 and provide benefit to ATCTs operating without CTRDs today.

4. "To Be" Operations

4.1. Assumptions

The following assumptions relate to the nominal operations for an SA Display system.

1. All equipment within the ATCT is functioning as intended.

2. A facility SOP will be developed to include the use of SA displays during ATC operations supported by the facility.

3. Each installed SA Display system will have an approved local safety case relative to the specific installation and operational use.

4. Applicable training will be developed and administered prior to use.

5. It is assumed that the MEL equipment is functioning as intended.

4.2. Constraints

The constraints for the SA Display system are known limitations or factors that will impact the effectiveness or completeness of the solution.

1. Controllers must only use the SA Display system as an aid to assist in visually locating aircraft or in determining their spatial relationship to known geographical points (3-1-9a 7110.65 Use of Tower Radar Displays)[4].

2. Controllers must not provide radar services and traffic advisories using SA Display systems (3-1-9a 7110.65 Use of Tower Radar Displays).

3. At locations where SA Display systems are in use, controllers must not utilize the services and phraseology set forth in FAA Order JO 7110.65, Air Traffic Control, Chapter 5, Radar, (10-5-3 7210.3 Facility Operation and Administration).

4. All hazards associated with operational use of the system shall be fully mitigated using operational and procedural methods such that the equipment may be classified as having minimal safety effect (as defined in SRMGSA) or no safety effect (FDAL E in accordance with SAE ARP4754 Rev A).

5. If a sponsor proposes the use of an SA Display system that incorporates features or capabilities beyond those previously established, the FAA will require a system-specific safety assessment to enable those capabilities.

6. The SA Display system is not expected to detect all targets in the vicinity. A minimally acceptable percentage of detected targets is expected to be defined and required for display by the SA Display system during the development of the technical requirements.

[4] Situational awareness phraseology from 7110.65 and 7210.3 will be considered applicable to aircraft on the ground as well as in the air and ground vehicles.

7. The SA Display system will not connect to any FAA networks or systems through an unsecured interface.

8. The SA Display cannot be used as a means for RADAR separation.

4.3. Operational Environment

1. The sponsor will have the SA Display system installed at an ATCT for operations within airspace typically defined as Class D.

2. The sponsor will be responsible for providing training of personnel in the proper operation and use of the system. This is to include information on how personnel should not use the system.

3. The sponsor, in coordination with ATCS, will define their minimum geographical area required to support ATC operations expected to include the airspace Class associated with the airport.

4. The system limitations must be compatible with the intended operating environment (e.g., sunlight readable displays)

4.4. Concept Operations

Conceptually, the SA Display system will not necessarily be a specific system with a set of requirements, but instead a category of equipment that is highly customizable by both the applicant (equipment manufacturer) as well as by the air traffic controller (user).

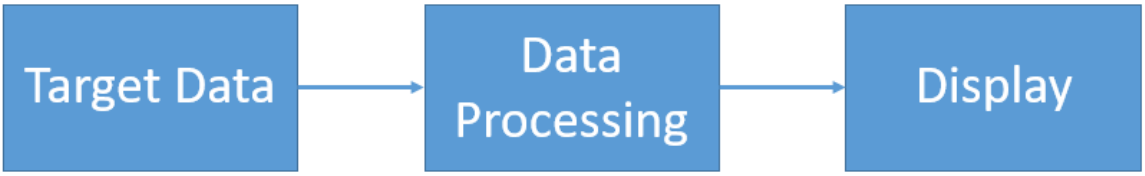

Figure 4-1 – SA Display system Functional Breakdown

1. **Target Data** will be a required function and may consist of one or more pieces of equipment such as an ADS-B ground system or no equipment at all, such as data made available from a service provider via the internet. The target data will minimally consist of lateral position data but may also include vertical position, call sign, etc.

2. **Data Processing** will be a required function whose scope will depend highly on the system configuration and may be divided between multiple processing platforms. This function fuses system data sources to produce a single set of data to be displayed.

3. **Display** will be a required function that may be contained in a device that includes some or all of the Data Processing and/or Display Options functions. This function is responsible for rendering the display for use by ATC personnel, projected on a map of the airport, resident within this function. The display may also include:

    a. Site-specific data will be an optional sub-function consisting of a user modifiable data set that may consist of items such as display overlays (e.g.,

runways, taxiways, facility buildings, etc.), aircraft track lines and standard flight paths.

b. Display options will be an optional function that allows user input to modify either the data content, scale or appearance of the display.

4.5. Supporting Infrastructure

Required infrastructure may vary depending on the equipment manufacturer and configuration.

1. System
    a. Display
    b. Cables
    c. Computer
        i. Hardware (such as keyboard, mouse and speakers) for human machine interface
2. Services (as required)
    a. ADS-B Data
        i. Antenna
        ii. ADS-B receiver
    b. A commercial service providing aircraft flight data
3. Infrastructure
    a. Power, typically from an electrical outlet
    b. Secured internet connection
    c. Hard, flat surface (such as a desk or console) for device(s) that may include computer, display, keyboard, mouse, etc. Consider airflow requirements (note: some locations may require seismic restraints for certain devices)
        i. Other options may include mounting hardware for a display (eye level)
            1. Wall that supports load capacity for a display
            2. Ceiling that supports load capacity for a display
    d. Cable connectors and extenders may be a requirement depending on cable routing and the distance between systems
        i. Distance of the display to the computer.
        ii. Distance of the computer to the computer hardware (such as keyboard, mouse and speakers).
    e. Hard, flat surface (such as a desk, rack or shelf) to place an ADS-B receiver. Consider airflow requirements. (Note: some locations may require seismic restraints).
    f. Mounting hardware and cables for antenna (Note: location of antenna varies by site for optimal coverage).

4.6. Benefits

The potential benefits expected with the use of a SA Display system are as follows:

- An increase in awareness of vehicle not in communication with the tower
- An increase of situational awareness
- An increase of time management
- Increased ability to assist in search and rescue operations
- An increase in the ability to assist distressed aircraft and direct emergency services in a timely manner
- An increase in the ability to foresee/prevent wrong airport landings

- Reduced controller workload

5. Operational Scenarios

5.1. Scenario 1 – Nominal Use Case

The controller utilizes a combination of out the window observations with pilot/vehicle-operator reported positions to form a mental model (picture) of the airspace. The SA Display system allows the controller to confirm the accuracy of their mental model. This scenario assumes a fault-free state where no equipment faults are present (i.e., SA Display system, communication radios, etc.) and no human errors occurred (i.e., misreported position or misunderstood radio message).

5.2. Scenario 2 – Wrong Airport Landings

The pilot of an aircraft provides a position report that is at a location visually observable by the tower controller. The controller cannot visually confirm the pilot's reported position. Following normal procedures, the controller will make further inquiries of the pilot relative to their position. The controller identifies an aircraft on the SA Display system at a comparable position, but to an adjacent airport. This information allows a more focused exchange with the pilot to confirm actual position and intent. (e.g., controller could inquire about landmarks that would be visible to the pilot at the nearby airport).

5.3. Scenario 3 – Target Not in Communication with Tower

ATC does not see a target within their airspace or on the ground, nor is that target in radio communications (e.g., airspace violator, NORDO, etc.). This target has either lost two-way radio communications or is communicating on the wrong frequency. ATC becomes aware of the unidentified target by means of another pilot/vehicle-operator report or by periodic scanning of the SA Display system. ATC uses SA Display system to confirm mental model of target not in communication with tower and other target positions in the area. ATC then proceeds with standard air traffic procedures for a target not in communication with tower.

5.4. Scenario 4 – Distressed Aircraft / Emergency Services

The pilot of an aircraft declares an emergency and will not be able to perform an emergency landing at the airfield. ATC uses the SA Display system to identify the last location of the aircraft before it makes an emergency landing attempt. ATC is able to use the information from the SA Display system to direct emergency rescue services to the last estimated location of the aircraft to assist in a well-timed response.

6. Summary of Impacts

The FAA is receiving regular requests from towers without CTRDs who wish to utilize surveillance technology to enhance situational awareness. SA Display systems would provide an alternative for these ATCTs. SA Display systems offer the potential to have a positive impact on the quality of air traffic control and the safety of operations in the NAS.

Appendices

Acronyms

ADS-B
Automatic Dependent Surveillance-Broadcast 2
AJI
Safety & Technical Training 2
AJT
Air Traffic Services 2
AJV-C
Central Service Center 2
AJV-E
Eastern Service Center 2
AJV-S
Mission Support Strategy Directorate 2
AJV-W
Western Service Center 2
AJW
Technical Operations 2
ATCS
Air Traffic Control Specialists 1
ATCT
Airport Traffic Control Tower 1
ATSAP
Air Traffic Safety Action Program 4
CONOPS
Concept of Operations 1
COTS
Commercial Off the Shelf 2
CTRD
Certified Tower Radar Display 1
FCT
Federal Contract Towers 1
MEARTS
Micro-En Route Automated Radar Tracking System 1
NAS
National Airspace System 1
NATCA
National Air Traffic Controllers Association 2
NORDO
No-Radio 8
ONA
Operational Needs Assessment 2
OTW
Out the Window 4
PMO
Program Management Organization 2
PO
Program Office 1
SA