

# IMPROVED SENTINEL – SENSE AND AVOID DISPLAY SYSTEM

Improving UAV flight safety in the global air space



EXTENDED AIR DEFENSE MISSIONS

AIR COMMAND AND CONTROL MISSIONS

BATTLEFIELD SURVEILLANCE AND COORDINATION MISSIONS

COMBINED COMMAND AND CONTROL MISSIONS

# IMPROVED SENTINEL – SENSE AND AVOID DISPLAY SYSTEM

## Description:

The Improved Sentinel Radar (AN/MPQ-64 F1) coupled with the Sense and Avoid Display System (SAVDS®) developed by SAVDS, Inc. of Mountain View, California, provides the next level of Unmanned Aerial Vehicle (UAV) Flight Safety for the world's Air Space. This new and innovative combination of the proven and highly capable 3-D, 360 degree Improved Sentinel air surveillance radar and the advanced computing power of the SAVDS provide the flight safety demanded for low altitude UAV missions under Visual Flight Rules (VFR) in the U.S. National Airspace System (NAS) as well as for nations around the world.

The Improved Sentinel Radar is a state of the art, three-dimensional, phased-array system that operates in the X-band frequency range. The radar will automatically detect, track, identify, and report airborne objects, including helicopters, high speed attack aircraft, cruise missiles, unmanned aerial vehicles (UAVs), hot air balloons, gliders, and ultralights from the nap of the earth to 55° in elevation and 360° azimuth within an airspace search range of more than 75 km. Future improvements to the radar will increase the range to more than 100 km, thereby extending Sentinel's early warning Sense and Avoid capability. This advanced tactical radar detects and tracks threat aircraft providing early warning to the SAVDS system and UAV pilots ensuring maximum range opportunity for collision avoidance.

The SAVDS System incorporates a data transmission system and wireless Communication link. It boasts a robust software system that is compatible with Mac OS X and Windows NT/XP operating systems. SAVDS algorithms compute potential air traffic conflict. With the SAVDS display co-located with the UAV pilot, aircraft conflict data is available for immediate viewing and action.

Audio and visual warnings enable the UAV operator to perform the modifications of the UAV flight path needed to maintain safe separation distances, well beyond visual range.

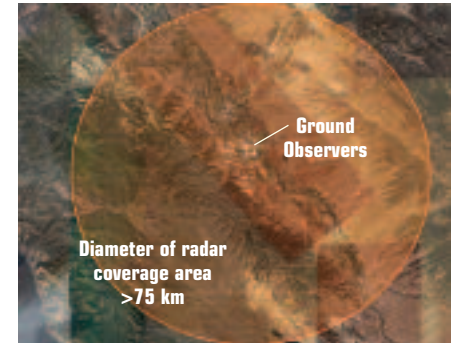
## Enabling Low Altitude UAV Flights Beyond Visual Range

The Improved Sentinel Radar integrated with SAVDS provides 360 degree situational awareness of the Air Traffic environment for UAV pilots operating under VFR. Georectified topographical digital base maps displayed on a high resolution LCD monitor are overlaid with symbology showing location, heading and speed of airborne objects detected by the Improved Sentinel radar. These airborne objects are shown in relation to the location, heading and speed of the UAV. The flight safety provided by SAVDS and the Improved Sentinel radar far exceeds the level of safety provided by chase planes currently used for UAV flight operations.



UAV Mobile Control Station equipped with Sentinel-SAVDS Display

## Sentinel-SAVDS Airspace Monitoring



Airspace viewing range ~100 times greater than unaided ground observers

### AN/MPQ-64F1 Improved Sentinel SAVDS

#### Features

#### SAVDS

- Fuses UAV GPS location data with target data from the ground-based Sentinel
- Easily co-located adjacent to any UAV ground control station. Aircraft conflict data available for immediate viewing by UAV pilot
- Audible and visual warnings informing UAV pilot of potential air traffic conflict
- Warnings triggered on basis of computations applied to heading and velocity of UAV and intruding aircraft
- Enhanced collision avoidance of manned aircraft, UAVs, hot air balloons and gliders in the Global Airspace

#### Sentinel Radar

- The Sentinel Radar can be located kilometers away from the SAVDS computing system using wireless communication link
- X-Band, 3 dimensional with a 2 second update rate. It scans in phase and frequency with an acquisition range of 75 km, with planned range improvement to >100 km
- The radar's precision 3-D track data optimizes the SAVDS system
- A proven operational air surveillance radar with enhanced UAV target detection at extended and beyond visual ranges

Elevation Profile



Aerial View

UAV in conflict with an intruding aircraft in shared airspace

**ThalesRaytheonSystems**  
1801 Hughes Dr.  
P.O. Box 34055  
Fullerton, California  
92834 - 9455 USA  
Tel.: +1 714 446 3118  
Fax: +1 714 446 3260

**ThalesRaytheonSystems**  
1, avenue Carnot  
91883 Massy Cedex France  
Tel.: +33 (0)1 69 75 50 00  
Fax: +33 (0)1 69 75 51 00

[www.thalesraytheon.com](http://www.thalesraytheon.com)