SATCAS
Standard Air Traffic Control Automation System
SATCAS (Standard Air Traffic Control Automation System) is the latest generation of Selex ES ATC Systems, which integrates a wide range of products and tools to comply with heterogeneous operational requirements and Air Traffic Management environments, ranging from large, nationwide, En Route Area Control Centres to small Approach Control Units.

**THE CONTEXT**

The increase of ATM performance requirements, due to the growth of air traffic and its complexity, rises the necessity to develop more distributed decision making processes in support to ATC operational personnel.

This is why currently Air Traffic Control is moving towards strategic Air Traffic Management, while at the same time Air Navigation Service Providers need to be supported for improving their services in terms of efficiency and safety. In order to face with this more and more complex scenario, Selex ES has developed SATCAS that provides a seamless support to ATM.

**THE SOLUTION**

SATCAS is the result of the long-standing experience matured by the company in the Air Traffic Management domain, through the supply of ATC systems to more than 100 Customers as well as through the active participation in international R&D and standardization initiatives, working groups and task forces promoted by ICAO, EUROCONTROL, and EUROCAE.

The suite of SATCAS products and tools provides the following main features:

- Heterogeneous surveillance data integration
- Accurate trajectory prediction
- Advanced ATC tools
- Air-ground data exchange
- Two-ways interoperability for civil and military missions
- Advanced operational display.

**HETEROGENEOUS SURVEILLANCE DATA INTEGRATION**

SATCAS Surveillance Data Processing System can manage different data sources, such as conventional primary and secondary surveillance radars, surface movement radars, ADS-B and ADS-C reports, in order to create a complete, consistent and seamless traffic picture covering from airport gates to en route pathways and vice versa. Moreover, wherever surveillance information is not available, Flight Plan Tracks (FPT) can be generated to fill the surveillance gaps.

The SATCAS Surveillance Data Processing System integrates ARTAS and offers degraded modes of operation in order to meet the most demanding system availability requirements.

**ACCURATE TRAJECTORY PREDICTION**

An accurate prediction of the flight trajectory is mandatory for using sophisticated solutions, such as tools supporting the controller’s work for Arrival Management and Medium Term Conflict Detection.

Trajectory prediction is largely affected by the ability of the algorithm to take into account the operational decisions at strategic, planning and tactical level and to apply the flight intents estimating the progress of the flight.

An appropriate model of the flight movements along horizontal and vertical dimensions, using forecasted meteorological information, is also necessary.

All these constraints led to a tight integration of the Flight Data Processing System, the Operational Display System and the Air-Ground Data Exchange System to achieve a continuous and consistent update of the trajectory data after controller’s inputs, reception of flight updates from adjacent units and reception of flight intent information.

**ADVANCED ATC TOOLS**

The increasing traffic demands for ATC Operational Personnel to be provided with a set of ATC support Tools.

Through on-field experiences, Selex ES has developed and improved a number of advanced ATC Tools that are now an integral part of the SATCAS solution, in addition to the traditionally available Safety Nets for the detection of short-term conflicts and special volumes infringements. The set of advanced SATCAS ATC tools includes:

- MONA (MONitoring Aids) provides the Flight Progress Monitoring, either triggering trajectory estimates recalculations or, when automatic recalculation is not possible, the intervention of the ATC Controllers.
- MTCD (Medium Term Conflict Detection) predicts possible losses of 4D separations between aircraft in a configurable prediction horizon, normally from 5 to 20 minutes. Position uncertainty models are applied to the flight trajectories in order to estimate the occurrence of
flight conflicts and a risk classification scheme is applied to associate urgency attributes to the processing results. A “what if” probing facility is also available.

- AMAN (Arrival Manager) provides sequencing and scheduling of arrivals as well as advices for all the controllers involved. This sequencing solution is highly configurable and expandable through add-ons, in order to better match local operational procedures and sitespecific requirements.

**AIR-GROUND DATA EXCHANGE**

SATCAS supports interfaces, regulated by international standards, for the following datalink applications:

- FANS1/A - ATS Facility Notification (AFN)
- ATN Context Management (CM)
- FANS1/A – ATN Controller/Pilot Datalink Communications (CPDLC)
- FANS1/A – Automatic Dependent Surveillance – Contract (ADS-C)
- ACARS – Departure Clearance (DCL)
- ACARS – Datalink Automatic Terminal Information Service (D-ATIS)

SATCAS includes several applications designed to fully exploit on ground side the information received from the airborne systems.

**SATCAS KEY POINTS**

A long-standing experience with a consolidated leadership in ATM, the active participation in international standardization programmes, the wide gamma of systems and tools, the integration capability into a seamless solution for ATM represent the foundation of the SATCAS solution. In particular SATCAS:

- Puts safety and efficiency in ATM at the very heart of any design and technological system solution.
- Supports civil-military coordination within a continuum airspace.
- Supports the increasing complexity of air traffic control through the integration of heterogeneous data sources into a unique traffic picture
- Provides a continuous and consistent update of trajectory data after controllers’ inputs thanks to sophisticated prediction algorithms
- Represents a modular and flexible solution able to follow any local procedures and site-specific requirements
Airspace should be managed as one continuum, to be exploited in a flexible way both for civil and military purposes, on a day-by-day basis. Consequently, any segregation of airspace for civil and military air traffic should be only temporary. In this context, SATCAS represents a widely tested solution able to guarantee the two-ways interoperability requested in multi-missions environment.

This solution includes the following features, resulting in an improvement of the traffic management effectiveness with no reduction of the safety levels:

- Feeding of both Civil and Military sectors within co-located or not co-located operational rooms
- Distribution and notification rules for GAT/OAT flights in order to improve the mutual awareness of current and predicted traffic scenarios
- Management of Special Usage Airspaces, in particular Temporary Segregated Areas
- Automated support, through messages exchange, for coordinating the flexible and exceptional penetration of civil air traffic on otherwise reserved military areas, and vice versa.
SATCAS Operational Display System (ODS) has been designed in order to provide the operational personnel with a user-friendly, flexible and modular support system, at the same time maintaining and guaranteeing the required performances and safety.

To this aim the ODS features have been specified thanks to a close cooperation with the final users. In SATCAS ODS, all the “dialogues” through graphical objects may be accessed in different ways, e.g. track labels, flight lists and dedicated menus.

Moreover, the mechanisms to drag maps, lists, tables and windows are intuitively simple and regulated by common principles. Similarly, the graphical objects and their states representing the traffic situation in its environment are consistently presented in each ODS placeholder.

The ODS can be easily modified to fit the target operational environment, without any software or hardware change. To this aim, SATCAS includes an Interface Editor System enabling different levels of ODS configuration, e.g. the colours of the graphical objects, the contents of the flight lists, the presentation of traffic information, the shapes of
the windows. The ODS HMI and the information set can be adapted to different environments and different user roles (e.g., executive, planning, multi-sector planning area, approach and tower controllers).

The ODS can guarantee quick response times even in extreme conditions; to this aim, the ODS applies all the cutting edge techniques to efficiently manage graphical objects.

At the same time, safety is achieved through the development of a reliable representation of the traffic scenarios, which avoid critical information hiding and screen data pollution, for any environment situation.

**SYSTEM ARCHITECTURE**

Air Traffic Control is one of the most demanding activities for all the software-intensive systems. It is safety critical, near real time and highly distributed. In this respect, SATCAS has been designed as a distributed system where:

- **High Availability** is achieved by fault tolerance tactics implemented through HW and SW redundancy. Fault Detection functions permit stand-by roles to take over failed applications. Several degraded mode solutions are also applied to minimize the impact of services unavailability on the ATC operations
- **High Performance** is achieved increasing the efficiency through the maximum distribution of the computational load on the nodes. The availability on each node of the up-to-date set of ATC information (replicated database) is also an enabler of high per formance
- **Usability and modifiability** are achieved separating the ATC business applications from the general purpose ones (e.g. middleware). Moreover, every user interface is separated from the rest of the applications and supplied with a complete set of customisation tools allowing its perfect adaptation to the operational environment.

**SEAMLESS INTEGRATION WITH REMOTE TOWER ATC AND A-SMGCS**

Due to the steady growth of air traffic in the last years, Control Tower and Remote TMA have gained a central role in improving the efficiency and the safety of the air traffic control.

In order to maximise the operational returns of the functionalities available in Control Tower and Remote TMA systems, a seamless integration with the ACC system is not only desirable but every day more and more necessary.

In the SATCAS, the Control Towers and Remote TMA can be interconnected with the ACC as an integral part of the system, operating with the same modalities as in any controlled sector within the ACC itself.

Control Towers and Remote TMA systems exchange radar and flight data with the ACC system so that any operation performed by controllers in any centres updates the status of the affected objects in the others. This implies a seamless control capability between the Control Centre and the Remote Towers and TMA and their full interoperability regardless of the geographical distance.
FALL BACK & DISASTER RECOVERY SOLUTIONS
Multilevel failback logics are implemented providing high availability of data processing and consistency through different levels of redundancy. Local hardware or application failures are managed through hot/stand-by configurations, available for any central processing units. Radar data are distributed for multi-radar processing and for direct access as well, providing the powerful capability to maintain track/flight plan correlations after any system state transition.

Most of flight data management, performed by centralised applications during nominal operation, can also be executed in degraded mode at any controller working position, satisfying elementary requirements for safe air traffic navigation.

SATCAS can also be configured in order to accomplish “Fall Back” or “Disaster Recovery” task.

An Operational-to-Fall Back system active gateway aligns operational configuration, flight and surveillance data. Complete and immediate recovery of air traffic control capability is thus guaranteed in case of total failure of the operational system.

An Operational-to-Disaster Recovery System active gateway is available as well. Through a complete alignment of operational configuration, flight and surveillance data, an immediate and full recover of air traffic control capacity is possible at a remote location in case of disastrous events affecting the operational site.