GAINS™
Ground-Air INtegrated Solution

Selex ES
A Finmeccanica Company

GAINS™ is the Selex ES solution that integrates actual and predicted traffic information from air-side and land-side sources, in order to improve operational efficiency and situational awareness at airport.

Within the Air Traffic Management network, airports are turning out to be the main bottlenecks; the capacity crunch at airports poses to all stakeholders a threat to safety, efficiency, and competitiveness in the air transport domain. The predicted increase in the global air traffic demand will be met only if radical changes are introduced in the airport management tasks, as their efficiency depends on the cooperation of several actors, whose tasks are currently executed on different separate systems even if they are strictly inter-dependent. As a consequence, airport stakeholders are nowadays requiring integrated systems enabling a higher degree of automation and interoperability with respect to current scenarios.

THE SOLUTION

Within this context, Selex ES has developed an integrated solution for Air to Land management, that exchanges airport operational information quickly and reliably and shares it consistently among all stakeholders, by means of user-tailored representations of airport processes.

Based on a System-of-Systems approach and pointed towards a seamless ATM, the GAINS solution integrates A-SMGCS services, on field and communication infrastructures, interoperability services and tower working positions.

A-SMGCS SERVICES

A suite of products and tools provides the following A-SMGCS services:

- Integrated Ground/Air Surveillance
- Ground Safety Nets
- Ground Route and Departure Planning
- Aircraft and Vehicles Guidance.

INTEGRATED GROUND/AIR SURVEILLANCE

Ground Surveillance services are based on high-performance multi-sensor fusion algorithms providing targets with reliable positions and unambiguous identifications; track/call sign association is based on multilateration data (thus allowing association already at the gates), Mode-S data as well as traditional SSR code. They can integrate sensor data from:

- ADAM - Advanced Airport Multilateration
- WAM - Wide Area Multilateration
- SMR - Surface Movement Radars
- MXC - ADS-B Ground stations network
- APP - Approach Radars
- ENR - En Route Surveillance Sensors, including Mode-S Radars.

GROUND SAFETY NETS

The purpose of the Ground Safety Nets is to support tower and ground controllers in the prevention of hazardous situations during the taxi, take-off and landing phases, monitoring actual aircraft positions, as reported by the Ground Surveillance, against a set of predefined rules characterising the operations at the given aerodrome.

GAINS is able to automatically detect the following types of conflicts, or risks of conflict, on runways and taxiways:

- Runway incursion
- Wrong direction
- Opposite direction
- Roll up conflict
- Crossing conflict
- Restricted area violation
- Sensitive area infringement
- Speed limit
- Stop-bar crossing.

These advanced Ground Safety Nets also provide a Path Monitoring service, which periodically checks the actual aircraft positions against their cleared ground paths (assigned taxi routes); in case of detected deviations, it distributes warnings/alarms to the controllers and triggers the automatic re-planning of ground routes.

GROUND ROUTE AND DEPARTURE PLANNING

Typically, runway operations and turnaround processes are administered by separate airport authorities, through separate tools; as they rely on interdependent milestones and on shared resources, their disjoint optimisation hinders efficiency of airport traffic flows.

The objective of Ground Route Planning services is to bridge these two processes, thus improving the predictability of departures schedule and its harmonisation with arrivals operations.

This leads to a better adherence between actual and planned traffic flows, reducing the need of corrective actions.

The Ground Route Planning service supports the controllers in the management of the aircraft traffic flow at the airport by:

- Proposing an optimised and conflict-free route from gate to runway and vice versa for each aircraft
- Allowing controllers to interact with the proposed ground route in order to accept/reject/modify it, also inserting intermediate constraints or a new route
- Automatically updating the routes in case of deviations, detected by Ground Safety Nets, from the assigned taxi routes or in case of arrival/departure schedule changes.

The Departure Management (DMAN) provides sequencing and metering capability for an optimal use of the runway(s) and departure sectors capacities.

The integrated DMAN allows to improve the pre-departure sequence and taxi route calculation exploiting planning information on both air path (trajectory after the take-off) and ground path (from Route Planner).

AIRCRAFT AND VEHICLES GUIDANCE

The Guidance services support aircraft pilots in safely complying to “follow-the-green” clearances, translating cleared ground routes into visual instructions for pilots taxiing from gate to runway and vice versa.

Exploiting surveillance information, the guidance service dynamically controls the status of visual aids according to aircraft progress along their cleared taxi routes.

GAINS allows guiding each aircraft by:

- Automatically controlling stop-bars, taxiway centrelines and runway lights
- Manually switching taxiway centrelines and runway lights
- Manually switching stop-bars
- Displaying the status of visual aids on the Integrated Tower Working Position.

The system provides Guidance services to vehicles drivers as well, through direct link with on-board mobile devices showing them the cleared ground routes as well as the dynamic surrounding traffic. In addition, the on-board devices are able to provide the drivers with the up to date status of the services to be performed during the turnaround procedures, allowing them to report, as foreseen in CDM process, the actual start/end of each service.

ON FIELD AND COMMUNICATIONS SERVICES

The GAINS system also integrates infrastructures for navigation and landing aids, all–weather operations products and aeronautical communications.

NAVIGATION AND LANDING AIDS

Navigation and landing aids provide a complete line of ground-based equipment:

- VOR - VHF Omni-Directional Range
- ILS - Instrument Landing Systems
- DME - Distance Measuring Equipment.

ALL–WEATHER OPERATIONS PRODUCTS

This set of integrated products provides reliable weather data for meteorological aviation services:

Airport Weather Observation System (AWOS)

- Forecaster Workstation
- Airport Weather Display
- Graphical Situation Display
- Message Dispatching System
- Sensor Fusion Module and Alert System
- Web-based Airport Weather Display
- Pilot Briefing System.

Runway Weather Sensors

- Forecaster Workstation
- Visibilimeter
- Ceilometer
- Transmissometer
- Forward Scatter Meter.

Low Level Wind Shear (LL WAS)

- Wind shear phenomena detection and warning
- Microburst phenomena detection and warning.

Other Weather Sensors

- Meteorological Garden Equipment
- Advanced Doppler Weather Radar Systems
- Lightning Detection System
- Radiosonde
- Wind Profiler.

AERONAUTICAL COMMUNICATIONS

Aeronautical communications support ATM air-ground voice and data communications, including:

- VHF/UHF radio systems
- VDL4/VDL2 radio systems
- Voice Communication Switching Systems (VCSS)
- Telephone Systems (PABX/PAX)
- AMHS systems, allowing the exchange of ATS messages over ATN.

INTEROPERABILITY SERVICES

Interoperability services allow real-time information sharing among Air Traffic Service Provider, Aircraft Crews, Airport Operators and Airlines, enabling as well the Collaborative Decision Making (CDM) process through the exchange of flight, surveillance and operational information among the different airport stakeholders.

GROUND - GROUND INTEROPERABILITY

ATM systems cover different phases of flight and control different airspaces, and are usually located at different control centres.

Ground-to-Ground interoperability guarantees, in a unique ATM
System:

- Seamless gate-to-gate ATM
- Full integration of ground and air surveillance
- Flight plan availability
- Silent tower coordination with Approach and Area Control Centres
- Transfer of Control (TOC) among tower controllers.

AIRSIDE - LANDSIDE INTEROPERABILITY

Airport Operation System (AOS) is an innovative platform based on client/server architecture, designed to cover the needs of stakeholders operating on the airport landside (e.g. catering, refuelling, baggage handling, de-icing, passengers boarding and disembarking). Its tight integration with GAINS and its high configurability make AOS the ideal platform to support interoperability among different actors like Air Traffic Service Providers, Airport Operators, Airport Handlers and Airline Operators. AOS features:

- Shared and consistent use of the exchanged information, enabling interoperability among airport operators' and stakeholders' processes
- Coordinated planning of airport resources, facilities, systems and services for the end-users
- Faster reaction to critical traffic situations
- Integration of different communication systems, facilitating the overall coordination of airport activities.

The AOS server provides the users with a set of web-based services to manage airport landside operations, ensuring both planned and real time monitoring of airport airside resources:

- Stand and Gate management for Airport Operators
- Planning and control of handling services for turnaround
- Vehicle fleet management.

The main strength of the AOS client is its high operational configurability, allowing each stakeholder (and even each operator) to build its own "process view" on the main mission-critical information, guiding him through the natural flows of daily, midterm and long-term tasks.

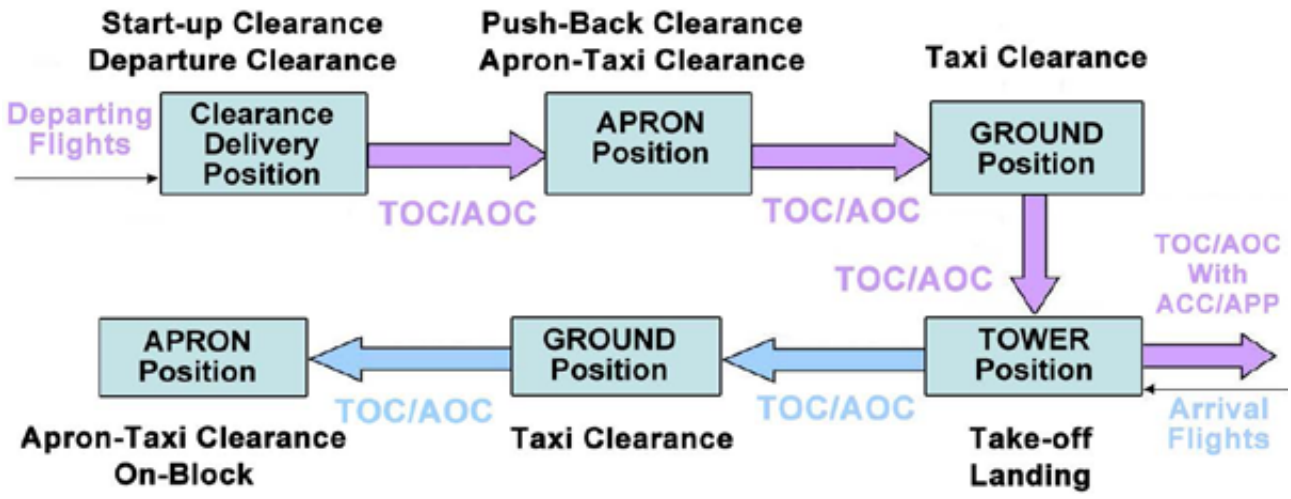
AIR - GROUND INTEROPERABILITY

The data-link implementation improves the ATM efficiency, capacity and communication in order to accommodate the expected growth in air traffic demand.

This capability can mitigate voice channel congestion.

This services includes Air-Ground Data-Link (AGDL) services supporting the following applications:

- AFN (ATS Facility Notification)/CM (Context Management) Application
  - Management of the link to ACARS or ATN Service Provider network
  - Management of Logon and Contact functions (through the DLIC service).
- CPDLC (Controller Pilot Data Link Communication) Application
  - Management of Connection/Disconnection, Transfer of aircraft control between sectors/FIRs, Uplink/Downlink message handling, Dialogues and Archiving (through ACM and ACL services)
  - Dialogues interaction on Integrated Tower Working Position.
- DCL (Departure Clearance) Application
  - Management of DCL Uplink/Downlink messages (RCD, CLD, CDA, FSM)
  - Clearances interaction on Integrated Tower Working Position.
- D-ATI S (Data-link Automatic Terminal Information Service) Application
  - Management of contract request (demand and update mode)
  - Transmission of ATIS information via data-link.



INTEGRATED TOWER WORKING POSITION

The Integrated Tower Working Position (ITWP) provides a fully integrated presentation of airport traffic, encompassing surrounding airspace and surface movements, through an innovative Human Machine Interface. Human factors are taken into account in the HMI design to allow controllers to perform each operational task in a user-friendly and efficient way. The major features provided by the ITWP are:

- Flexibility for different operational sectors layouts (Clearance Delivery, Ground, Tower, etc.)
- Presentation of surveillance and flight plan data in a seamless ATM scenario (e.g. labelling continuity)
- Integrated operational procedures, as silent coordination between Tower and APP/ACC centres
- Availability of Departure Clearance (DCL) via air/ground data-link
- Support for ground procedures (start up, push back, taxi, line up, take off, landing clearance, on block, etc.)
- Provision of free handwriting notes, actualizing the replacement of paper strips with electronic strips
- High configurability of screen layout and controllers' actions flow.

Flight data are displayed by means of flight lists and electronic flight strips, organized in configurable bays and sub-bays setting apart the strips depending on their state (pending bay, transfer bay, taxi bay, etc.). This event-driven presentation guides the controllers on performing the correct sequence of operations through an intuitive interface in which automatic strips movements are driven by configurable system events (transfer procedures, clearances, etc.) while manual strip movements (drag and drop) drive configurable system actions.

KEY POINTS

From meteorological systems to surveillance sensors, from ground stations to en route ATM Systems, Selex ES offers a total capability portfolio. Based upon this wide experience, also matured in the framework of international programmes such as SESAR (Single European Sky ATM Research), the GAINS solution stands out for the following major features:

- Fully compliance with safety and security standards, as well as sustainability by limiting environmental impacts
- Enhanced airport situational awareness by means of integrated traffic picture
- Safe movements on airport surface through automated guidance information for pilots and drivers
- Protection against a wide set of critical scenarios, based on reliable control functions
- Optimized routing and runway occupancy, determined by sophisticated algorithms
- Improved airport efficiency based on collaborative planning of shared resources.

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