GAINS

GROUND-AIR
INTEGRATED SOLUTION

Within the Air Traffic Management network, airports appear the main bottlenecks. As the capacity crunches, congestion raises threats to safety, efficiency, and competitiveness of air transport. The predicted increase in global air traffic demand will be met only if radical changes will be introduced in the airport management. Airport efficiency is the result of cooperation of several actors, whose tasks are currently executed on different separate systems, although they will be strictly inter-dependent. As a consequence, airport stakeholders are nowadays requiring integrated systems enabling a higher degree of automation and interoperability.

Within this context, Leonardo has developed an integrated solution for Air-Land management. This exchanges airport operational information quickly and reliably, sharing data among stakeholders by means of user-tailored representations of processes.

GAINS™ is the Leonardo solution that integrates actual and predicted traffic information from airside and landside sources. Operational efficiency and situational awareness are improved based on the following key elements:
· Fully compliance with safety and security standards
· Sustainability achieved by limiting environmental impacts
· Enhanced airport situational awareness by means of integrated traffic pictures
· Innovative and flexible Surface Working Positions for Tower and Ground Controllers

· Enhanced situational awareness through seamless integration of a wide range of surveillance sensors and communication technologies
· Safe and efficient movements on airport surface through automated route planning services, conflicts detection/alerting, and guidance information for pilots and service vehicle drivers
· Protection against a wide set of critical scenarios based on reliable control functions
· Optimised routing/runway occupancy
· Departure sequences organized by sophisticated algorithms
· Improved airport efficiency based on collaborative planning of shared resources

Based on a System-of-Systems approach aimed to a seamless ATM, GAINS integrates A-SMGCS services, on-field communication infrastructures, Tower Working Positions and Approach/En-Route Traffic Control Units.
GAINS is a constantly evolving platform with the primary objective to maintain full compliance to international standards, and implement most state-of-the-art operational concepts. The platform is backed by extensive participation in R&D initiatives, such as SESAR Industrial Research Projects.

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A-SMGCS SERVICES

A suite of products and tools provides A-SMGCS services:
- Integrated Ground/Air Surveillance
- Ground Safety Nets
- Ground Route and Departure Planning
- Aircraft and Vehicles Guidance
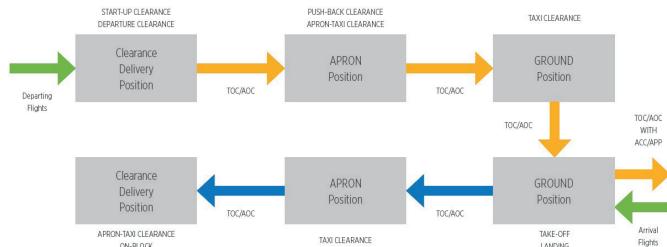
INTEGRATED GROUND/AIR SURVEILLANCE

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 (allowing association already at gates), Mode-S data, and traditional SSR code. The integrated ground/air surveillance can fuse data from:
- ADAM-Advanced Airport Multilateration
- WAM-Wide Area Multilateration
- SMR-Surface Movement Radars
- MXC /ADS-B Ground stations
- APP-Approach Radars
- ENR–En-Route Surveillance Sensors, including Mode-S Radars

GROUND SAFETY NETS

Ground Safety Nets support Tower and Ground Controllers in the prevention of hazardous situations during taxi, take-off, and landing phases. Ground Safety Nets monitor actual aircraft positions, as reported by Ground Surveillance, against a set of predefined rules characterising operations. GAINS automatically detects the following conflicts, or risks of conflict, on runways and taxiways:
- Runway incursion
- Wrong direction
- Opposite direction
- Taxiway 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 that periodically checks the actual aircraft positions against the cleared ground paths (assigned taxi routes). In case of detected deviations, GAINS sends warnings/alarms to Controllers and triggers automatic replanning of ground routes.

GROUND ROUTE AND DEPARTURE PLANNING (DMAN)

Runway operations and turnaround processes are administered by separate airport authorities through distinct tools. As they rely on interdependent milestones and on shared resources, their disjoint operation hinders efficiency of airport traffic flows. The objective of Ground Route Planning services is to link those processes, thus improving predictability of departure schedule and its harmonisation with arrivals. This leads to a better adherence between actual and planned traffic flow, reducing needs of corrective actions. Ground Route Planning supports Controllers in the management of aircraft traffic flow by means of:
- Proposing optimised and conflict-free routes from gate to runway and vice-versa
- Controller interaction with the proposed ground route in order to accept/reject/modify plans, insert intermediate constraints, generate new routes
- Automatically updating routes in case of deviations (detected by Ground Safety Nets) from the assigned taxi routes or in case of arrival/departure schedule variation

The Departure Management (DMAN) provides sequencing and metering capability for an optimal use of runways and departure sector capabilities. The integrated DMAN improves pre-departure sequence and taxi route calculation, exploiting planning information on air paths (trajectory after take-off) and ground paths (generated by Route Planner).

AIRCRAFT AND VEHICLES GUIDANCE

Guidance supports pilots in safely complying "follow-the-green" clearances. It translates cleared ground routes into visual instructions for pilots taxiing from gate to runway and viceversa. Based on surveillance information, guidance dynamically controls the status of visual aids according to the aircraft progress along the cleared taxi routes. Guidance is exploited by:
- Automatically controlling stop-bars, taxiway centrelines, and runway lights
- Manually switching taxiway centrelines and runway lights
- Manually switching stop-bars
- Displaying status of visual aids on the Integrated Tower Working Positions

The system provides Guidance services to service vehicle drivers as well, through direct link with on-board mobile devices that show cleared ground routes and dynamic surrounding traffic. In addition, on-board devices can provide drivers with up-to-date status of their schedules to be performed during turnaround procedures.

INTEROPERABILITY SERVICES

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

GROUND-GROUND INTEROPERABILITY

ATM systems cover different phases of flight control of bordering airspaces usually under control of different ATM centres. In detail Ground-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 of 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. It has been designed to cover 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, and Airline Operators. AOS provides:

· Shared and consistent use of exchanged information, enabling interoperability among Airports
· Operator and Stakeholder processes
· Coordinated planning of airport resources, facilities, and services
· Faster reaction to critical traffic situations
· Integration of different communication systems facilitating the overall coordination of airport activities

The AOS server provides a set of web-based services to manage airport landside operations and ensure planned and real time monitoring of airport airside resources, namely:

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

The main strength of AOS clients is their high operational configurability which allows Stakeholders and Operators to build their own "process view" on the main mission-critical operations.

AIR-GROUND INTEROPERABILITY

Air-Ground interoperability improves ATM efficiency, capacity, and communication to mitigate voice channel congestion. The services includes Air-Ground Data-Link (AGDL) services supporting the following applications:

· AFN (ATS Facility Notification) and CM (Context Management):
  - Link to ACARS or ATN Service Provider network
  - Management of Logon and Contact functions (through DLIC services)

· CPDLC (Controller Pilot Data Link Communication):
  - 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 Positions

· DCL (Departure Clearance):
  - Management of DCL Uplink/Downlink messages (RCD, CLD, CDA, FSM)
  - Clearances on Integrated Tower Working Positions

· D-ATIS (Data-link Automatic Terminal Information Service):
  - 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 in performing each operational task in a user-friendly and efficient way.

The event-driven presentation guides Controllers in performing the correct sequence of operations through an intuitive interface. Electronic strips are organized by configurable system events (transfer procedures, clearances, etc.). Major features:

- 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 like silent coordination and Transfer of Control (ToC) between Tower and APP/ACC centres

- Departure Clearance (DCL) via air/ground Data-Link
- Ground procedures (start up, push back, taxi, line up, take off, landing clearance, etc.)
- Enhanced configuration capabilities of screen layout and Controller action flow

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