Implementation of A-SMGCS including Routing, Planning and Safety at airports
Airport environment

- Data and trend report a traffic growth in the next years
- Airports need to support this trend assuring always high level of safety and passenger services
- Technology can support in improving throughput and safety, as well as reducing ATCO workload
- Tower digitalization is the key enabler
Airport vision

- AGL Multilateration
- SMR & Multilateration
- A-SMGCS & E-strip
- Departure management
- Digital tower
- Communications
- Vehicle Management
- A-CDM/AOP
GAINS: Leonardo A-SMGCS solution

- GAINS key elements:
  - High usability
    - Less, quick and intuitive clicks/information
  - «Focus on information»
    - Many data don’t mean many available information
  - Monitor rationalization for supporting strip-less solution

- GAINS was developed according with SESAR concepts having been involved in several validation activities at Milano Malpensal Airport and Sofia Airport
GAINS Working Position

- Overlapping information (≈85%)
- ATCO up and down

- ATCO focus on radar situation awareness
- Main orders directly on label
- Main information on label
- Further information hidden but quickly available
- One screen
- Integration further applications
GAINS Working Position

Track label cetic

<table>
<thead>
<tr>
<th>Callsign</th>
<th>Next Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSR Code</td>
<td></td>
</tr>
</tbody>
</table>

Ground Route

Aircraft type

EP

TSAT/TTOT

Alarm/warning
GAINS Working Position

All order can be graphically performed

Change Parking Bay

Color coding approach

Open/close Segments
GAINS: Vehicle Management

- Vehicle management:
  - Proceed To
  - HOLD
  - Enter/Vacate Runway
  - TOW
  - Follow Me

Modify route

Taxi HP-by-HP
GAINS: SURVEILLANCE

- All ASTERIX categories are displayed on the WP
  - Different ASTERIX category are shown with different over-symbols
  - Aircraft and Vehicle are shown with different symbols
  - All surveillance information, such as speed and heading, are provided on label
  - Different over-symbols and lists are shown for track status: active, pending, and cost
GAINS: SURVEILLANCE
GAINS SAFETY ALERT NET

- GAINS convers the three level of safety alert:
  - Runway Monitoring Conflict Alert (RMCA)
  - Conflict ATC Clearance (CATC)
  - Conformance Monitoring Alert for controller (CMAC)
- Safety alerts are available for all mobiles
- Different thresholds can be set for L-VP and VP procedure
- **Safety Alert** detects anomalous situations on ground, based on different kinds of inputs:
  - Surveillance data
  - Planning information (e.g. the taxi route computed by the Route Planning tool)
  - Inputs and orders received from the CWP (e.g. clearances)
- Alerting conditions depend from a number of parameters and thresholds set on mobiles behaviour, such as:
  - distances
  - speeds
  - times
- **Goals**
  - Increased level of safety felt by ATCO
  - Decreased pressure/workload felt by ATCO
- More than **200 types of alerts** can be configured
- Sound can be added for each alert
GAINS SAFETY ALERT NET

- **SCA** considers the airport as geometrically partitioned into several areas:
  - Runways
  - Taxiways
  - Movement areas
  - Approach cones
  - Line-up areas
  - Obstacle free zones
  - Crossings
- On each area SCA can be **selectively** configured in order to perform monitoring for conflicts via on-line application
GAINS SAFETY ALERT NET

- The SCA computation engine is based on a mixed “time-based” and “distance-based” algorithm founded on the so-called “safety bubble”
- Safety Bubble depends from the geometry and the cynematics of the target itself
GAINS SAFETY ALERT NET: Examples

Max time stationary after takeoff clearance = 60 sec
Max time stationary (at the holding point) after lineup clearance = 60 sec
Max time stationary after taxi clearance = 60 sec
Max time stationary after pushback clearance = 120 sec

Stationary speed threshold = 2 kts (anyway, less than pushback and towing speed!!)
GAINS SAFETY ALERT NET: Examples

- No CLR Land
- No Takeoff
- No Taxi
- Taxi Dev
- No Taxi
GAINS: Routing Service

- Routing service is handled for all mobiles (flights and vehicles)
  - Aircraft route: Parking Bay $\leftrightarrow$ Runway
  - Vehicle route: from any airport know-point (HP, entry/exit-point, and PB)
- Routing function is based on the realization of a full graph of the airport based on:
  - Holding points;
  - Parking Bay;
  - Taxiways;
  - Entry/Exit Point
- Optimization is performed through the graph and the ground route is created as union of segments and Holding Point
  - ETO (Estimation Time Over) is provided on each HP along the ground route
GAINS: Routing Service

- GAINS routing function can be set to have different target:
  - Minimize time
  - Minimize distance
  - Free-conflicts over HP
- Automatic **re-routing** functionality is implemented when mobiles divert from the planned route
  - Calculate a new route to reach the destination from its actual position

Re-routing just crossing over the last HP
GAINS: Routing Service

• Route status:
  • Planned (dashed)
  • Cleared (continuous)
  • Reported
• Taxi Clearance can be provided step-by-step via Holding points
• Manual modify route can be graphically performed to change the proposed one
GAINS: Routing Service

- GAINS monitors the mobiles position and apply a report function each time they are close to a known points (e.g. Holding Point, Parking Bay, Entry/exit Point)
  - Report function does:
    - ETO updates along the route;
    - the remaining taxi-time calculation;
    - remove part of the cleared ground route already taxed.

- Ground route is automatically re-calculated each time that the segments closure action is performed
  - Re-opening or status change is detected and re-calculation is performed only for mobiles previously impacted from the new segment status;

- At Vehicle “Vacate Runway” order, GAINS automatically:
  - provides the close exit point from the current position;
  - Automatically calculate the ground route from the above exit point up to destination point;

- Each deviation from the nominal ground route is cautiously detected, and a new “best” ground route is generated to reduce the ATCO workload, as well as warning is raised to ATCO awareness
Thank you for your attention.