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The SESAR Airport Concept
The Future Airport Operations Concept

1.1 Airports

The aim of the future airport concept is to facilitate the safe and efficient movement of aircraft in the Air Traffic Management (ATM) system, whilst meeting environmental targets. This is achieved through deploying new procedures, technologies and tools that will increase the performance of the airport systems in both normal and adverse conditions.

The airport operations planning processes will be improved to ensure maximum utilisation of airport resources and, in periods when demand exceeds capacity, to manage demand fairly and transparently. At less busy airports, the priority is cost efficiency, and the new capabilities will be configured to support the safe, remote operation of airports. The concept will be scalable to cope with different airport needs and operational complexity, thus ensuring a flexible and economically viable solution.

- Lack of **Airport capacity** in general and under low visibility in particular
- Drop in capacity without proper action taken (**Crisis management**)  
- Level of **safety** related to **runway** operations
- **Sustainability** - Societal need versus societal constraints
- Lack of **integration of airports** into the Air Transport Network
- **Complex Terminal** airspace around major cities
The aim is to continuously monitor key aspects of airport operations against agreed performance targets. This will ensure that all stakeholders have a common understanding of the service to be provided by the airport and, in cases where this performance may not be met, will assure pro-active action in response to the situation and provide timely notification to all the stakeholders concerned of the likely impact.

The business trajectory (airborne and surface) will be the baseline shared data that will be used by all airport stakeholders to build a common situational awareness and measure quality of service. For the airport, the critical elements of the trajectory are the times of key airport events.

The base performance of airport systems will be improved in four areas:

- Development of new procedures, e.g. collaborative procedures for turnaround, surface and runway management, to meet environmental targets and to support remote operation of airports;
• Implementation of support tools to improve operator efficiency (productivity), provide safety benefits and reduce separation minima in final approach and initial climb;

• Improved situational awareness on the flight deck improving safety;

• Deployment and exploitation of new technologies such as Laser Detection and Ranging (LIDAR), Brake to Vacate, surface safety nets and Ground Based Augmentation System (GBAS).

The efficient utilisation of the airport resources will be enabled by airport planning and management processes including improved communication. These processes will be supported by the Airport Operations Plan (AOP) that provides the common situational awareness of the airport status for stakeholders, including, through the Network Operations Plan (NOP), the network and local Air Navigation Service Provider (ANSP).

At the airport, accurate trajectory information will be ensured through engagement of stakeholders to the same event times. Airport systems will ensure robust linkage of trajectories for inbound and outbound flights using the same airframe. A common plan will ensure that airport and individual stakeholder business targets are known to all; that the targets can be achieved and that decisions taken are based on the best information available. This includes an Airport Operations Centre (APOC) to monitor airport performance and raise alerts when deterioration is detected or other critical changes occur.

Decisions to resolve these problems will be supported by 'what-if' tools that can forecast the impact of proposed solutions on all stakeholders affected. Collaborative Decision Making (CDM), based on information sharing in real time, will be fundamental to all phases of airport operations.
AOP and NOP integration

Different airports:
- Same shared data
- Same quality of data
- Different local complexity
- Different support systems

The architecture for updating the AOP

Network Operations Plan

Decision supp tools

Network Manager

Collaborative processes

Airport OPS Centre (APOC)

Agreed scenarios

KPIs

Performance Monitoring Service (CJM)

Alerts

Local ATC

Flight Updates

AOP N

Updates

Data

Local A/O

Airport Operator

Ground handling
Airport stakeholders, with the Network Manager, will participate in the decision making process. At times of severe capacity reduction, the User Defined Prioritisation Process will support users in sharing this scarce resource. All airports will be integrated into the overall European ATM system through agreed performance targets and an agreed minimum set of data to be shared.

1.2 Surface Management

Many of the future improvements and benefits at an airport revolve around the development of the Advanced-Surface Movement Guidance and Control System (A-SMGCS), which in simple terms is the Air Traffic Control Ground Radar. A-SMGCS is already in operation providing surveillance and limited alerting, but the introduction of the following functionality routing, guidance, control (alerting) and planning (Departure Manager DMAN) in the future will mean that ATC has a system that will help to increase capacity, safety, efficiency and predictability whilst reducing delays, workload and emissions.

Surface Management

Future Improvements will be based on A-SMGCS

A-SMGCS is an Air Traffic Control ground radar that comprises of several different functions (surveillance and some control are already in operation)

- Surveillance (Aircraft position and identification)
- Control (Alerting)
- Routing and planning (Planned route and taxi times)
- Guidance (Cleared route – DTXI – AGL – Cockpit systems)
The Flight Crew of arriving flights will receive their planned taxi in route well before landing allowing them time to brief and plan for their arrival. The taxi route calculation will take into account many constraints such as assigned runway, aircraft type, parking stand, taxiway rules, closed or unsuitable taxiways.

After vacating the runway at the exit that has been coordinated using the enhanced braking systems, the Flight Crew will receive taxi instructions via data link that will be displayed in the cockpit in textual format and on a moving map, which will improve the Flight Crew’s situational awareness especially at unfamiliar airports and/or low visibility conditions.

Certain aircraft will be able to turn off their engines when clear of the runway and perform the taxi to stand under electrical power provided by the aircraft, leading to a decrease in engine time, emissions and noise pollution.
Routing and Planning

When aircraft commences movement the Route Function shows cleared route in solid green to clearance limit (Holding Point) and then dashed green – Link to the EFS clearances.

Engine Off Taxiing

Certain aircraft will be able to taxi to and from the runway with their engines turned off using electrical power. An example is the WheelTug system being developed and tested on Boeing 737-800

The WheelTug® System
The A-SMGCS will also provide accurate information that will be fed into the Airport CDM platform which will improve predictability and efficiency at an airport. The information includes:

- taxi times that will enhance the in block and take off estimates
- events such as In/Off block, take off and landing.

The A-SMGCS will use the position of the aircraft or vehicles and the knowledge of the cleared route to monitor progress of the movement and alert the **Air Traffic Controller (ATCO)** of any non conformance to procedures or instructions.

A wide range of alerts can be detected such as conflicting clearances, route deviations, crossing of red stop bars, aircraft taking off or landing without a clearance and runway incursions.
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Increased safety will not be the only benefit of A-SMGCS, energy costs can be reduced by being able to

- switch on and off segments of taxiway lights
- and control stop bars

for individual mobiles according to the clearances given by the ATCOs, this will mean that an airport doesn’t need to have all of the taxiway lights turned on permanently at night or low visibility conditions wasting electricity.
Automated Switching of AGL

AGL (taxiway lighting) is lit up to 300m ahead of the mobile and is linked to the cleared route taking into account the ATCOs clearances. Dark Green is the AGL and Light Green is the cleared route.

RWSL – Runway Status Lights

As a flight departs, lights are triggered automatically based on surveillance to warn other mobiles that the runway is occupied.
The Flight Crew of departure flights will also benefit from the improvements mentioned above and in addition data link will be used for non-time critical instructions like start up approval, push back / taxi instructions and frequency changes. This will not only lead to less workload by reducing the Radio Telephony (R/T) congestion on busy ground frequencies, but it will enhance the quality of communication between ATCOs and Flight Crew resulting in fewer misunderstandings.

Departure Managers will be coupled with arrival managers in order that an accurate runway sequence can be calculated. The ATCOs will use the Target Start Up Times (TSAT) and Target Take Off Times (TTOT) to control flights in order to respect the optimised sequence and at the same time the Flight Crew and Airlines will have a clear overview of what is planned for their aircraft.

In poor weather conditions Flight Crew will use Enhanced Vision Systems to assist them with guidance during taxiing and ATCOs will use A-SMGCS and superimposed infrared images of the position of aircraft, runways, taxiways and other features on the airport to help them increase capacity whilst performing their tasks safely.

1.3 Tower Management

The introduction of any new tool or function to an ATCOs working position has to take into account the existing tools and procedures. The largest foreseen benefit of the development of the A-SMGCS integrated with the information on the clearances input by the ATCOs will be safety. ATCOs will be alerted whenever there is a non conformance to a procedure or instruction and this will help prevent runway incursions and ground incidents. Controller workload is also foreseen to decrease as automated actions (e.g. D-TAXI messages, switching taxiway lights) assist the ATCO.
The Integrated Tower Working Position (ITWP) will incorporate the new runway management concept where Runway Occupancy Times (ROT) and varying wake vortex criteria play a big role in determining the runway sequence, so ATCOs will need to have information presented to them in a user friendly way, so that they are able to control safely and efficiently whilst still having the flexibility to react to unforeseen situations.

New technology will also play a big role with the introduction of larger touch screens, remotely operated cameras and external sensors and synthetic vision systems. This could lead to the large towers that we see today becoming redundant as the external view is no longer mandatory to perform Air Traffic Control (ATC) at an airport, and control rooms could be situated at ground level and at remote locations.
Remote Tower Management

New technology will play a big role with the introduction of large touch screens, remotely operated cameras and external sensors and synthetic vision systems.

Remote Tower Management

Large Control Towers that we see today could become redundant as the external view is no longer mandatory to perform Air Traffic Control at an airport, this could lead to control rooms being situated at ground level and/or at remote locations.
In order to optimise the use of available runway capacity, three areas are being addressed:

- The Runway Occupancy Time

- The required minimum radar separation of final approach

- The required Wake Vortex Separation.

**Runway Occupancy Time**

Enhanced Braking Systems (automatic braking systems) will control braking to smoothly decelerate the aircraft to a predetermined point on a runway in preparation for exiting. Lower and more consistent ROT will be possible with greater certainty that the predetermined exit will be used.
Runway Occupancy Time, Arrivals, triggered by Airborne system

1. Receive D-ATIS
2. Arm Enhanced Braking System
3. Calculate ROT and exit

No changes after TOD, unless triggered by incident (e.g., change to runway, runway condition, exit blocked etc)

Uplink Taxi route, stand etc

Pre-determined accurate ROT and confirmed exit shared by Ground and Airborne Systems

GS calculates taxi route

Accurate, predicted ROT and exit now available for use by NOP, AMAN/DMAN and ASMGCS

Runway Occupancy Time, Arrivals, triggered by Taxi-In uplink

1. Receive Taxi-In (with proposed exit)
2. Arm Enhanced Braking System
3. Calculate ROT

No changes after TOD, unless triggered by incident (e.g., change to runway, runway condition, exit blocked etc)

Uplinks exit within Taxi-In message

Pre-determined accurate ROT and confirmed exit shared by Ground and Airborne Systems

GS calculates taxi route

Accurate, predicted ROT and exit now available for use by NOP, AMAN/DMAN and ASMGCS
The airborne system will downlink the expected ROT for each landing together with the intended runway exit before Top Of Descent (TOD). This will enable the ground ATM system to link the airborne trajectory with a computed time-based ground trajectory from runway to parking stand. The ROT information will also be integrated into the Arrival Manager (AMAN) and factored into the calculation of separation on final approach.

Similarly, is envisaged that for departures, an on board system will automatically take the flight from line up to take off, with an accurate and pre-notified departure ROT. This will link the ground to the airborne trajectory and will provide accurate runway occupancy predictions for AMAN/DMAN.
Radar Separation

It is envisaged that the radar separation minima can be reduced from today’s 2.5 NM to 2.0NM under certain conditions, most notably in periods of strong headwind on final approach.

Wake Vortex Separation

Wake Vortices are one of the most constraining factors for runway throughput in major airports. Today’s minima were developed more than 40 years ago. Since then, the understanding of the phenomena has increased considerably, and we are today able to both detect the presence of wake vortices as well as model their behavior. This will allow for a far more precise determination of the required vortex separation.

As a first step, the current classification of aircraft will be adjusted to have more classes and better reflect the current fleet mix. This will eventually lead to a situation where airports will be able to group aircraft in the
most optimal way for their particular traffic mix depending on the performance of their ATC system.

As a next step, dynamic factors such as the wind, the turbulence and instability of the air mass as well as certain aircraft parameters will be included when determining the required separation.

The long term goal is to use the knowledge about the exact position and severity of the Wake vortex generated by a leading aircraft, coupled with the trailing aircraft’s ability to navigate very precisely so as to avoid the vortex. Specific techniques such as displaced rotation or touchdown points on the runway as well as off-set climb and descent paths will also be exploited.

The next pictures show the results of a wake vortex data collection campaign at Paris Charles de Gaulle airport using Laser Imaging Detection and Ranging (LIDAR) equipment. Based on the collected data, concepts of operation can be developed that allow a reduction of required separation.

Figure 3 : - EUROCONTROL LIDAR data collection

LIDAR campaign conducted between May and December 2007 for supporting WIDAO (14.000 flights analysed)
Paris CDG parallel runways

8.74 million simulation runs conducted

Figure 4: Example of a WAKE 4D simulation run

Figure 7: Example LIDAR Dataset
Low visibility

Low visibility operations have a negative impact on Airport Capacity. This impact mainly relates to two root causes. The performance of the Instrument Landing System (ILS) requiring added spacing between landing aircraft and increased line-up times for departing aircraft, and the need to apply separation to aircraft manoeuvring on the airport surface.

Satellite based navigation systems, working either independently or as augmentation systems for other navigation systems are under validation. The aim is to use these systems to reduce the protection area around the runway.

Surface routing and guidance systems are under development within SESAR, as mentioned above. These systems will facilitate an increased surface movement capacity.

2 EUROCONTROL - Overview
ATM Today
Air Transport – Air Navigation - Europe

**ICAO:** The contracting States recognize that every State has complete an exclusive sovereignty over the airspace above its territory.

**EUROCONTROL**
- 39 Member States, typically each with its own ANSP
- Approximately 65 Area Control Centres (ACC)
- Over 600 sectors when at full capacity
- Approx. 16,000 Air Traffic Controllers
- Approx. 36,000 support staff

Total Employees 52,000
Total revenue €7.6/year

World Traffic in 2006

Europe: 44%
North America: 22%
Central South America: 2% (7%)

Other International Routes: 1%
ATM in Europe – looking forward

Regulate
- EC
- EASA
- NSAs

Operate/Coordinate
- Network Manager
- FABs

Research
- SJU (to 2016)

EUROCONTROL role
- Technical support
- Performance review
- Network management
- Deployment coordination
- Route charges
- Founding member
- Major contributor
- Longer term research

EUROCONTROL – New Structure

SINGLE SKY
- Support the development of regulations
- Support the SES II performance scheme
- Support the development of ATM safety regulatory functions
- Support States and NSAs as requested
- Network Oversight Function
- Support military coordination and cooperation

NETWORK MANAGEMENT
- Implement the Pan-European Network Management Functions
- Meet the SES II performance targets for Network Management
- Deliver operational services
- Develop a coherent Network Management work programme
- Ensure effective co-ordination of network deployment
- Provide other services as agreed

SESAR and RESEARCH
- Represent the interests of EUROCONTROL in the SESAR programme
- Deliver the Agency contribution as agreed
- Support the transition of improvements from development to deployment
- Co-ordinate the ATM Master Plan updates
- Ensure excellence in SESAR delivery