JANUARY 2011

FLIGHT
AIRWORTHINESS
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TECHNOLOGY

FAST 47

AIRBUS TECHNICAL MAGAZINE

FAST 47

Customer Services
events

Just happened

Material, Logistics, Suppliers & Warranty symposium

This event was held in October 2010, gathering 97 customers and 39 suppliers in Paris, France. Various presentations, live demos and interactive sessions highlighted the latest innovative developments and initiatives in the material, logistics, suppliers and warranty fields. A very active exchange of views took place during the 12 interactive sessions and caucus discussions on different material management topics. Together, the attendees had the opportunity to shape the future requirements and business models in the material, logistics, suppliers and warranty domains.

A380 symposium

This symposium took place in Singapore, in November, and featured an airline caucus where the operators were able to provide detailed feedback on their A380 operational experience and expectations, for a review by Airbus and the suppliers.

Airbus representatives responded that the ongoing enhancement of maintenance and operational procedures were well on the way to meeting its objective of 98.5% operational reliability for the A380 fleet, by the middle of 2011. The operators recognized the efforts made by Airbus teams, pointing out their exceptional support, commitment and excellent work.

Airbus Leasing Support conference

The 7th Airbus Leasing Support conference took place last December in Miami, U.S.A., with more than 130 participants coming from 43 different leasing companies.

A particular focus was put on upcoming rules and regulations and the associated upgrade solutions. The A320, A330/A340 and A300/A310 families' issues, solutions and new developments were presented.

Airbus detailed all the new services for lessors to ease aircraft transfers. An Flight Hour Services-Tailored Support Package (FHS-TSP) presentation was given to highlight the benefits of Airbus services to lessors and the positive impact of such services on the aircraft residual value. A very productive lessors' caucus emphasized our ability to react quickly to lessors' queries and specific requirements. Finally, a satisfaction questionnaire showed that lessors were very satisfied with Airbus' customer support and by its special consideration for leasing companies.

Coming soon

Airbus Corporate Jet (ACJ) forum

The next Airbus Corporate Jet forum will be held in Hong Kong, China, from 29 to 31 March 2011. The invitations and programmes will be sent at the beginning of 2011.

Performance and Operations conference

The 17th Performance and Operations conference will take place in Dubai, from 9 to 13 May 2011. Organized by Airbus Flight Operations Support and Services since 1980, this biennial event provides flight crews, operations specialists, flight operations engineers and performance specialists with a unique opportunity to constructively exchange views and information, and increase mutual cooperation and communication. The invitations will soon be sent out.

A320 Family symposium

The next Airbus A320 Family symposium will be held in Toronto, Canada, from the 23rd to 26th May 2011. An Operators Information Telex (OIT) with the programme will be sent out at the beginning of 2011.

Airbus Family symposiums are held for each Airbus programme every two years and target airline engineering and maintenance managers. The prime function of these meetings is to enable two-way communication, leading to an ever safer and more efficient fleet.

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Publisher: Bruno PIQUET
Editor: Lucas BLUMENFELD
Page layout: Quat'coul

Cover: Optical fibre used on aircraft
Picture from Hervé GOUSSE
E_XM Company

Authorization for reprint of FAST Magazine articles should be requested from the editor at the FAST Magazine e-mail address given below

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Printer: Amadio

FAST Magazine may be read on Internet
http://www.airbus.com/en/services/publications/
under '**Quick references**'
ISSN 1293-5476

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Every little helps!

Demonstrating the green trajectory

Fuel efficient trajectory management tested on revenue flights

At the 5th Aviation and Environment Summit in Geneva, Switzerland, in September 2010, one could get an impression of the multitude of initiatives which our industry is pursuing, to fulfil its engagement for an environmental compatible growth. Besides research looking typically into improved airframe, engine designs and alternative fuels, the optimization of the flight trajectory is identified as an area where quick wins can be obtained when airlines, airports and Air Navigation Service Providers work hand in hand, often with the support of the aircraft manufacturer. This article depicts, through examples, how revenue flights can be instrumental to trial more fuel efficient Air Traffic Management procedures with the objective to implement them on a regular basis.

Tom MAIER
Senior Manager CNS/ATM
System Sales & Marketing
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Background

One of the programmes which takes systematically advantage of revenue flights is the Atlantic Interoperability Initiative to Reduce Emissions (AIRE), which was signed on highest level at the Paris Air Show in 2007, between the Administrator of the FAA (Federal Aviation Administration) and the European Union Vice President/EC Transport Commissioner. This initiative aims to reduce CO_2 emissions and to accelerate the pace of change by taking advantage of best Air Traffic Management (ATM) practices, as shown in figure 1. It enables the implementation of fuel efficient procedures for all phases of flights, taking full advantage of present aircraft capabilities in the Communication, Navigation and Surveillance (CNS) domain. The Asia and Pacific Initiative to Reduce Emissions (ASPIRE) is the equivalent programme for that region and was launched in February 2008.

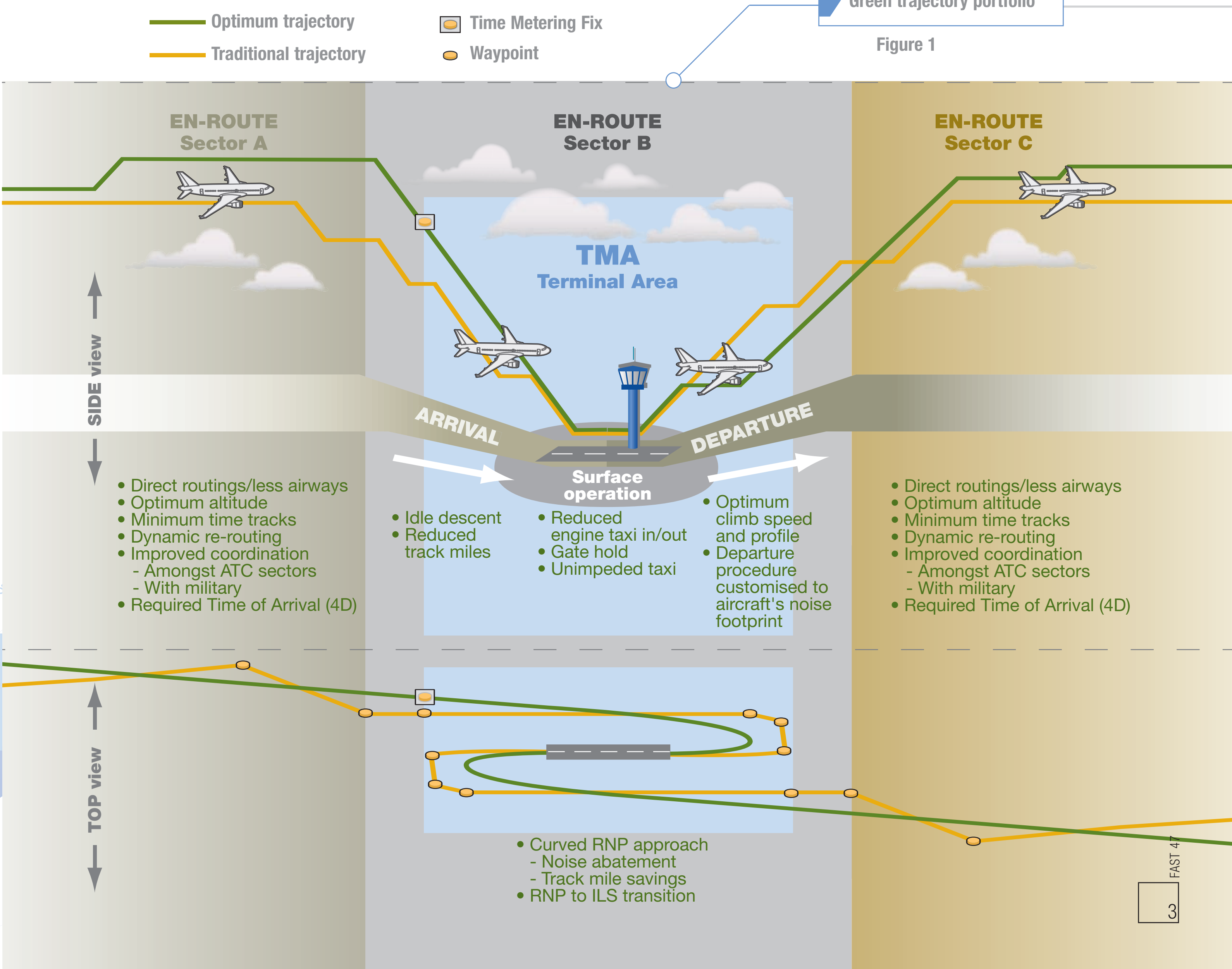
These programmes have to be seen in the wider context of SESAR (Single European Sky ATM Research) and NextGen, its sister initiative in the United States. Both started their respective development work for redesigning the ATM airborne and ground system, with the objective to enable sustained air traffic growth at a reduced service unit cost for the airspace user, reducing the impact on the environment without compromising safety.

glossary

ATC: Air Traffic Control
RNP: Required Navigation Performance
ILS: Instrument Landing System

Green trajectory portfolio

Figure 1



SESAR and NextGen put the business trajectory in the centre of their operational concepts, which implies that the airspace user's preferred way of flying is compromised to a minimum by Air Traffic Management (ATM). Enabled by enhanced on-board and ground systems, the adherence to the most efficient trajectory becomes the baseline for all flights.

In the light to ensure a smooth transition to this target concept, revenue flight trials started in the meantime to demonstrate locally some of the concept elements - as far as current equipment levels allow - under involvement of small but representative stakeholder consortia.

On the European side, the AIRE flight trials are overseen by the SESAR Joint Undertaking (SJU) - the management body which was set-up by the European Commission and Eurocontrol as founding members and which counts now 15 more members coming from air navigation service providers, airports and industries-, including Airbus - with a strong involvement from airlines. AIRE is building the first blocks of the SESAR Concept of Operations by testing 4D trajectory-based operations and Performance-Based Navigation (PBN). A batch of six revenue flight trial projects was executed in 2009 involving 18 partners and accumulating more than 1,000 trial flights (known as the European AIRE1 Exercise). This article will exemplary look at one of them, namely the Minimum CO_2 in Terminal area (MINT) project, in which Airbus had a partner role.

In May 2010, the SJU awarded another 18 contracts for the 'Performance of flight trials validating solutions for the reduction of CO_2 emissions'. This second wave of AIRE revenue flight trials (AIRE2) started in fall 2010 and involves 42 partners, with Airbus leading one of the projects (A380 Transatlantic Green Flights) and contributing as a partner to two further (Green Shuttle and VINGA).

A380 Transatlantic Green Flights

This project addresses shortfalls caused by congestion on ground and in oceanic airspace on Air France flights from New-York to Paris. The average departure taxi time at JFK is more than 40 minutes long which justifies a two, instead of four engines taxi in most cases, saving typically 23kg of fuel per minute. However, a prerequisite for this procedure is to inform the flight crew on the estimated take-off time which is provided in the frame of this trial to demonstrate one benefit of the airport Collaborative Decision Making (CDM) concept.

In the oceanic phase of flight, the most efficient trajectory is compromised by the North Atlantic Oceanic Track System (OTS), which imposes to stick to one of the predefined lateral tracks. Climbing to an optimum flight level is frequently hindered by other traffic. The A380 Transatlantic Green Flight trial takes advantage of the A380's rather high optimum cruise level (between FL390 to FL430) where little other traffic is encountered. The oceanic Air Traffic Control Centres of Gander (NAV CANADA) and Shanwick (NATS) make arrangements to free the aircraft from the OTS. This allows planning the flight on a minimum time track and to choose the most economic speed and cruise level.

Arrival flight phase with a high potential for optimization

The arrival is often the most constrained phase of the whole flight. Speed and altitude restrictions are frequent to manage the traffic flow within the Terminal Area (TMA) as well as the transition from the En-route Sector to the TMA. Noise avoidance often results in a considerable stretching of the flight path; 360° holdings or lengthy lateral ‘trombones’ are the ultimate Air Traffic Control (ATC) means to get the landing sequence built up. Successive clearances to lower altitudes and vectoring put the flight crew in a reactive ‘open loop’ situation, in which the arrival trajectory is not fixed, neither vertically, nor laterally. This prevents following a predefined route which is a prerequisite for properly planning and executing the most energy efficient descent profiles.

The 'Minimum CO_2 in Terminal area' (MINT) project addressed a good part of these issues. It used for the first time in Europe the aircraft’s Required Navigation Performance with Authorization Required (RNP AR) for a +/- 0.3 nautical miles lateral accuracy in a curved approach (RNP AR 0.3) for the purpose of noise abatement at Stockholm, Sweden (see approach chart in figure 2). Before publishing the procedure, Airbus contributed with fly-ability analysis through simulator sessions and ensured that speed and altitude constraints are not compromising the most fuel efficient descent.

Novair, the airline partner in the MINT project, recently upgraded the Flight Management System (FMS) on their A321 fleet to the latest ‘Release 1A’ standard, which allows flying the RNP AR 0.3 procedure in combination with their first generation Electronic Flight Instrument System (EFIS).

The lateral trajectory of the 10 MINT flights was agreed with the ATC sectors of Stockholm and Malmö (Sweden), well before leaving the cruise flight level and the ATC enabled a Continuous Descent Operation (CDO) by avoiding altitude instructions. Therefore, the aircraft could follow the most efficient vertical profile with engines at idle, saving in an average 145kg of fuel per arrival. Further, 20kg were saved through reduced track miles when compared to the standard Instrument Landing System (ILS) procedure.

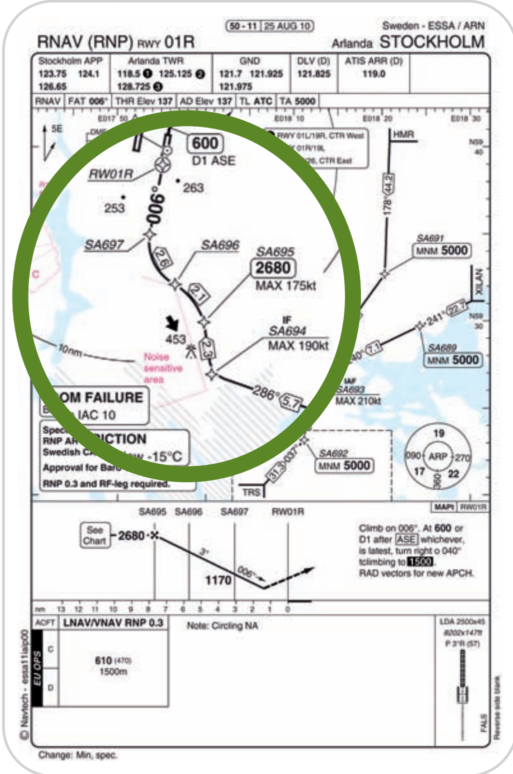
Combining Performance-Based Navigation (PBN) with Continuous Descent Operations (CDO) constitutes an operational concept which is feasible for many regional airports or for major airports at low traffic hours. Often, the main hurdles are more of an institutional nature and a question of changing habits, rather than technical. Suggesting a revenue flight trial project can be a good means for the airline to improve the situation and obtain buy-in from the Air Navigation Service Providers (ANSP) and airports.

Time as the 4th navigation dimension

For both, airborne and ground sides in high traffic situations, the optimization of the arrival trajectory is more complex and requires additional means which are developed in SESAR and NextGen. Some of these technical enablers are related to the addition of the time aspect for trajectory management.

Stockholm RNP AR 0.3 approach chart

Figure 2



Courtesy of Navtech

Curved noise abatement approach into Stockholm: After having been tested in the MINT project, the procedure was published and is now applied on a regular basis.

Required Time of Arrival (RTA) page on MCDU

Figure 3

This capability is rarely used today but will increase in importance as operational concepts emerge based on 4D trajectory management.

As the Continuous Descent Operation (CDO) prevents the Air Traffic Controller (ATCO) to apply the traditional altitude and heading instructions during the descent, the concept previews that additional information be provided in return, in the form of arrival time for a significant metering fix. This waypoint is defined from a traffic flow management point of view and may typically be a merging point or a Terminal Area (TMA) entry point. On-board, the adherence to the trajectory's time schedule is ensured within a certain tolerance by the Required Time of Arrival (RTA) function, which is accessible through the Multi-purpose Control and Display Unit (MCDU), via the Flight Plan (FLP) menu pages, as shown in figure 3. On the ground side, the ATCO is assisted by an Arrival Management (AMAN) tool which helps to build up, at an early stage, the sequence of incoming traffic and which alerts in case of conflicts.

In anticipation of this operational concept, the MINT trials looked also at the adherence to the estimated time of arrival over a waypoint which was chosen around an altitude of FL100, representing a typical altitude for entering the TMA. The observed deviation was below 10 seconds compared with what has been predicted about 20 minutes earlier, well before leaving the cruise level. More flight trials will be undertaken building up confidence in the aircraft time performance, in order to start using it for the sake of a smooth transition to the initial 4D operational concept of SESAR and NextGen.

Optimization from En-route to En-route

VINGA (Validation and Improvement of Next Generation Airspace) addresses all flight phases, arriving at and departing from Gothenburg Landvetter airport, in Sweden. En-route, the flight follows a planned direct routing, which becomes now possible with the implementation of the Free Route Airspace Sweden concept. Improved service level agreements amongst adjacent control sectors, including the Danish Air Traffic Control, shall enable that the arrival trajectory be known to the flight crew already before the end of the En-route phase. The crew then plans an idle continuous descent choosing the optimum top of descent point. Considering the traffic situation, vertical ATC clearances shall not compromise the most fuel efficient vertical profile.

The arrival trajectory leads then into a noise and fuel optimized RNP AR 0.3 procedure, followed by a transition to the Instrument Landing System (ILS) approach. Through this new combination, it is ensured that even under conditions of low approach minima, the most efficient arrival trajectory can be followed. Another particularity is that a RNP procedure will be designed, not based as usual on very conservative theoretical wind models, but on observed statistical winds which results in a further optimization. Comprising an important Performance Based Navigation (PBN) element, partners to the VINGA project are not only the typical revenue flight trial triplet consisting of the airline (Novair), airport (Swedavia) and Air Navigation Service Provider (LFV), but also Quovadis, the PBN service company. This recently formed Airbus subsidiary provides a complete set of RNP services including RNP procedure design and testing, flight operation safety assessment, documenting airworthiness compliance, training, RNP monitoring, and cost-benefit analysis.

The optimization of ground movements is addressed in the trial through single engine taxi-in and out, whenever feasible. In case of delays, 'gate holding' with engines off will be preferred over queuing-up on the taxiway.

VINGA looks also into the feasibility of more flexible and efficient departure trajectories, which shall be tailored to the noise footprint of the individual aircraft type. Instead of applying an unique Standard Instrument Departure (SID), aircraft with better noise values shall be allowed to accelerate earlier to the most economic climb speed and to turn earlier to the target heading.

Gothenburg, Sweden, could be taken as representative for a typical single runway regional airport and the described measures are certainly worthwhile to be studied in similar circumstances.

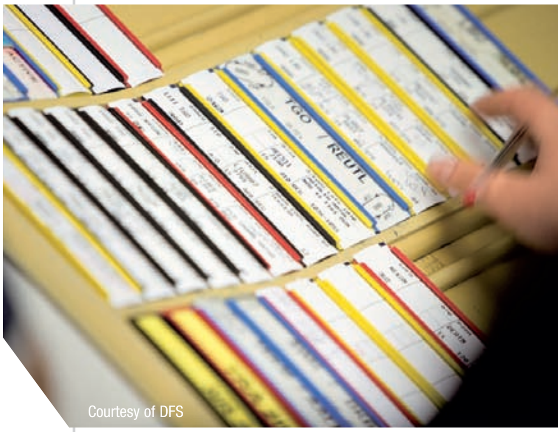
The Green Shuttle

The context is more challenging in the busy parts of central Europe, such as between the French cities of Paris-Orly and Toulouse, where Air France operates up to almost 50 flights a day with an A320 Family fleet. Although each flight duration is only around one hour, three ATC En-route Sectors are concerned and the shuttle flights are kept on sub-optimal lower altitudes, in favour of overflying long haul traffic. Here again, an improved coordination between the national ATC sectors managed by the French Air Navigation Service Provider DGAC/DSNA was key to obtain a more fuel efficient trajectory.

The Green Shuttle trials which were undertaken in fall 2010, demonstrated the feasibility to obtain under certain conditions optimum cruising levels and more direct routings, thanks also to a better coordination with the military stakeholder. Continuous Descent Operation (CDO) could also be demonstrated from top of descent into both, Paris-Orly and Toulouse. Airbus contributed with 'CDO fly-ability' analysis and advised on best speed and vertical windows for the hand-over between ATC sectors in descent.

Quantified findings of the fuel savings obtained in the AIRE2 exercise will be published by the SJU through a dedicated dissemination event in the first half of 2011. It is expected that the tested ATM procedures have a saving potential, which justifies their consideration in any airline's fuel saving action plan.

Air Traffic Controller strips



Courtesy of DFS

information

Quovadis
a 100% Airbus subsidiary, was launched in July 2009 to support airlines, airports, air navigation service providers and authorities in Performance-Based Navigation (PBN) deployment, as well as to provide related services.
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Conclusion

Revenue flight trials are an excellent means to experience and adjust more efficient Air Traffic Management (ATM) procedures, in a perspective to transit smoothly to their application on a daily basis. Airbus in general and Quovadis specifically for matters related to Performance-Based Navigation (PBN), are prepared to support revenue flight trials through customer services and expertise. There is a whole register of measures for bringing a flight nearer to the most fuel efficient trajectory throughout the different flight phases. Partnerships between the main stakeholders - airlines, Air Navigation Service Providers and airports - is the key for improvements.
The current context of ongoing major ATM development programmes such as SESAR and NextGen favours to challenge legacy operations in order to migrate to more efficient target operational concepts, which will be enabled by new technologies on-ground and on-board.

AIRBUS

Automatic Dependent Surveillance Broadcast (ADS-B)

Surveillance development for Air Traffic Management

As air traffic is predicted to increase steadily over the coming years, there is a clear need to ensure that standards of safety and efficiency are maintained, or even enhanced. This is recognized by the Single European Sky programme in Europe (SESAR) and the NextGen programme in the U.S.A. (read FAST article - Demonstrating the green trajectory), the two major bodies driving the Air Traffic Management (ATM) development over the coming years.

Automatic Dependent Surveillance Broadcast (ADS-B) is all about communications between aircraft, and also between aircraft and ground. Both are vital in ensuring safe flights and efficiency in terms of fuel use, time and emissions. ADS-B is an integral part of the planned efficiency drive towards 2020.

Taking advantage of the latest technology, ADS-B is designed to be retrofit on aircraft flying today. Here, we will look at aspects associated with the retrofit and take a look at the developments that are planned for the future.

Christine VIGIER
Design Management Avionics
Airbus Upgrade Services

ADS-B summary

In its final form, ADS-B is designed to ease Air Traffic Control (ATC) as the number of approaches grows, enhancing safety and increasing airport capacity.
In the air, the information provided by ADS-B enhances the pilots' traffic awareness, allowing more optimal flight levels leading to fuel savings.
ADS-B is considered in two parts as described:

- ADS-B OUT provides a means of automated aircraft parameter transmission between the aircraft and the ATC.

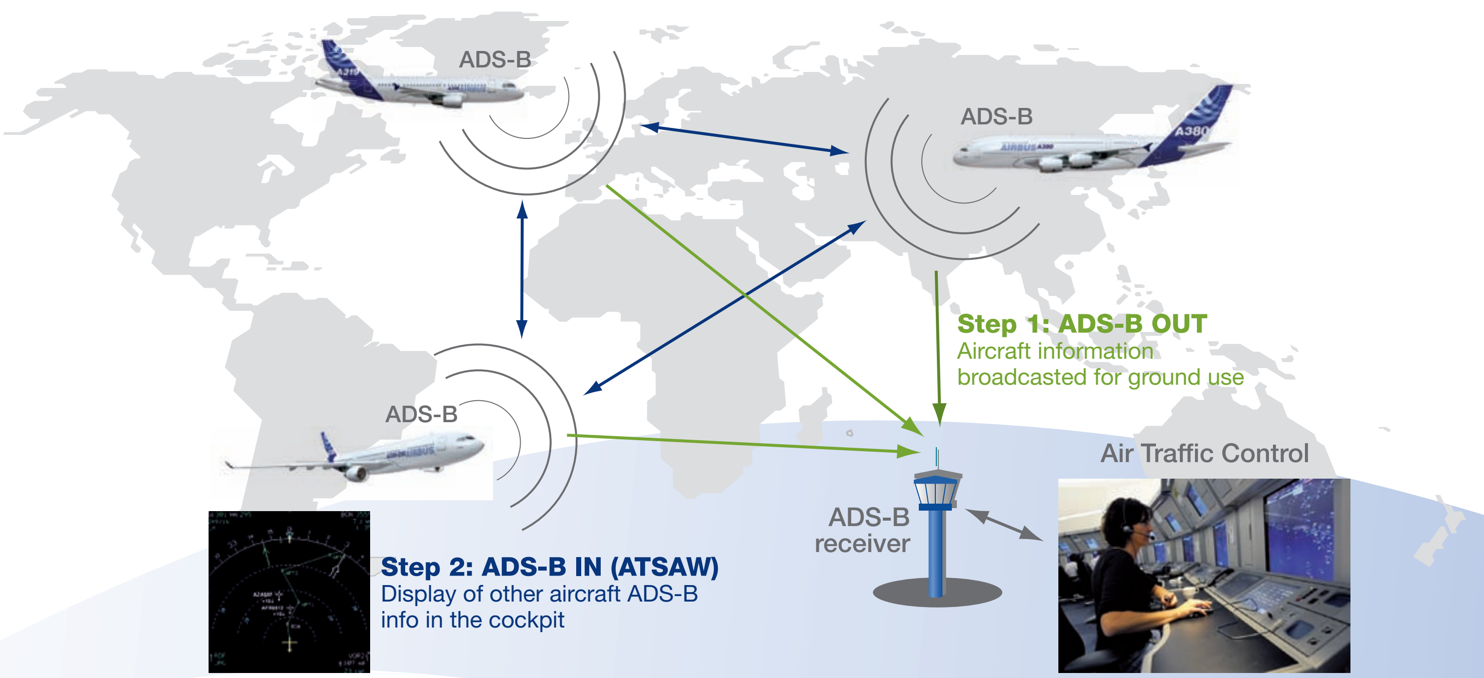
- ADS-B IN provides automated aircraft parameter transmission between aircraft themselves.

glossary

ADC: Air Data Computer
ADIRS: Air Data/Inertial Reference System
ATC: Air Traffic Control
ATSAW: Air Traffic Situational Awareness
DMC: Display Management Computer
EHS: Enhanced Surveillance
EIS: Electronic Instrument System
FCOM: Flight Crew Operating Manual
FM: Flight Manual
FMS: Flight Management System
FWC: Flight Warning Computer
GPS: Global Positioning System
HFDR: High Frequency Data Radio
IRS: Inertial Reference System
MCDU: Multi-purpose Control Display Unit
MMR: Multi-Mode Receiver
NRA: Non-Radar Airspace
OANC: On-board Airport Navigation Computer
OANS: On-board Airport Navigation System
OMS: On-board Maintenance System
SATCOM: Satellite Communication
SPI: Special Position Identification

First steps involved in ADS-B

Figure 1



STEP 1: ADS-B OUT

ADS-B OUT automatically transmits aircraft parameters from the aircraft to the ATC on ground. There is no need for the pilot's action and it conforms to EASA regulations on ADS-B OUT, for Non-Radar Airspace (NRA) operations. The capability must be declared in the FCOM and the FM shall be updated (see figure 2).

ADS-B OUT

Figure 2

	DO-260	DO-260B
Equipment required	• ATC transponder enhanced capable • MMR (with GPS capability) • Wiring provision EHS	• ADS-B OUT DO-260B • FWC
Availability date	Now	As per mandate (refer to figure 10)

Example on MCDU

Figure 3

In this example, the MCDU (Multi-purpose Control and Display Unit) shows the identity and the relative horizontal position of three aircraft. The pilot can see immediately that a flight level change to FL370 is not possible until 1412Z time, as computed by the TCAS (Traffic alert and Collision Avoidance System).

A different flight level can be requested as clearly indicated, taking into account the surrounding aircraft positions, trajectories and speeds.

STEP 2: ADS-B IN (ATSAW)

The Airbus approach to ADS-B IN is named the Air Traffic Situational Awareness (ATSAW) which enables the reception of ADS-B information from other aircraft in the vicinity. As for the ADS-B OUT, the capability must also be declared in the FCOM and the FM updated (figure 4).

ATSAW is splited in two steps:
- Step 2A: ATSAW operation in flight
- Step 2B: ATSAW operation on ground

STEP 2A: ATSAW OPERATION IN FLIGHT

a) ATSAW
- Improves cooperation with ATC (better understanding of ATC instructions),
- Improves the detection of opportunities for flight level changes in standard separation for reduced fuel savings and a reduction of CO_2 emissions,
- Improved efficiency on approach,
- Enhances identification and information on target aircraft,
- Increases runway capacity.

b) ATSAW with ITP (In Trail Procedures) today defined on the North Atlantic ocean (see figure 3):
- Enables more frequent altitude changes by temporarily reducing standard separation,
- Enables flying at the optimum flight level,
- Provides significant fuel savings.

STEP 2B: ATSAW ON THE GROUND

- Enhanced situational awareness during surface operations.

NEXT STEPS

STEP 3: SEQUENCING AND MERGING

The objective of the future step is to enable the flight crews to achieve and maintain automatically a given spacing with designated aircraft.
The two principle maneuvers are 'remain behind' and 'merge behind'.
The operational benefit will be the enhanced traffic regularity during the approach to airports with heavy traffic allowing increased airport capacity.

ADS-B IN (ATSAW)

Figure 4

	Step 2A	Step 2B
Equipment required	• ATC transponder EHS • MMR (with GPS capability) • EIS2 • Wiring provision • EHS traffic selector • FWC standard	As for Step 2A + OANC
Availability date	Early 2011	2013 TBC

How does ADS-B work?

ADS-B OUT

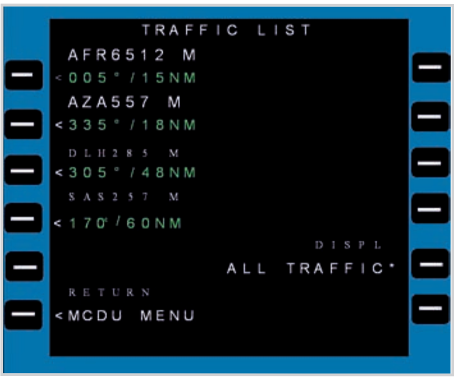
It uses ATC transponders to transmit aircraft information to the ground, using the Mode S 1090 MHz Extended Squitter with a refresh rate of 0.5 seconds.

Example on Navigation Display and MCDU

Figure 5

The Navigation Display (ND) shows the aircraft orientation and relative information from aircraft in the vicinity.

Figure 6



Additional information shown on the MCDU.

Figure 7

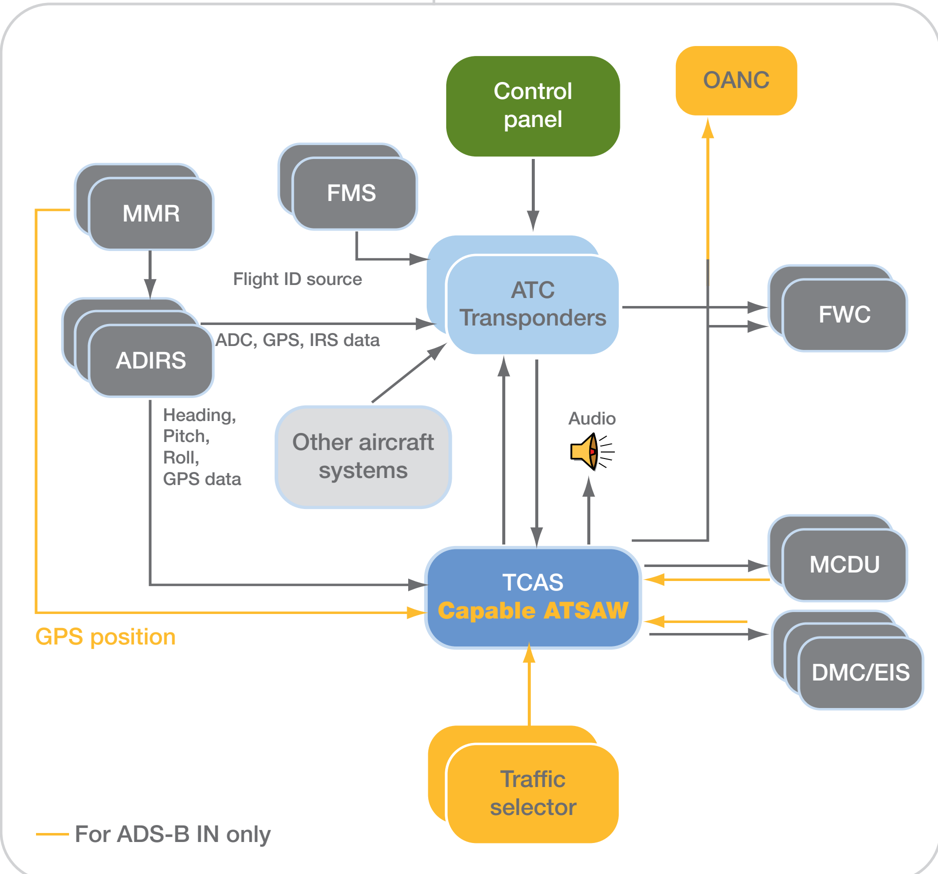
The Pilot elects to see more information on AFR6512 by the menu selection.

Figure 8

The ND indicates the position and trajectory of other aircraft on taxiways

Architecture for ADS-B OUT and for ADS-B IN

Figure 9



ADS-B IN

On aircraft, it is the TCAS computer that receives and treats the ADS-B information coming from ATC transponders of surrounding aircraft. The information is then displayed on the Navigation Display (ND) and the MCDU (see figures 5, 6 & 7). When ATSAW is activated and if the ADS-B information is available from aircraft in the vicinity, the following information is available for each pilot:

- Aircraft identification
- Absolute bearing/2D distance
- Heading/Tracking
- Wake vortex category
- Relative altitude/Absolute altitude
- Ground speed
- Vertical velocity

Aircraft architecture required for ADS-B OUT

ADS-B OUT NEEDS

- ATC transponders at minimum DO-260 standard.
- Additional wiring associated with peripheral equipment,
- MMR in hybrid architecture with GPS capability.

CURRENT FLEET STATUS

Aircraft currently flying in Europe are generally well equipped for the transition to ADS-B OUT as the prerequisite ATC transponders Mode S (DO-260) are already required to meet the former enhanced surveillance mandate. Aircraft greater than five years of age and operating outside of Europe are more likely to need a new transponder in order to achieve ADS-B capability.

ADS-B IN

STEP 2A

- TCAS capable
- Additional wiring
- Traffic selector in cockpit
- EIS2 capable

STEP 2B

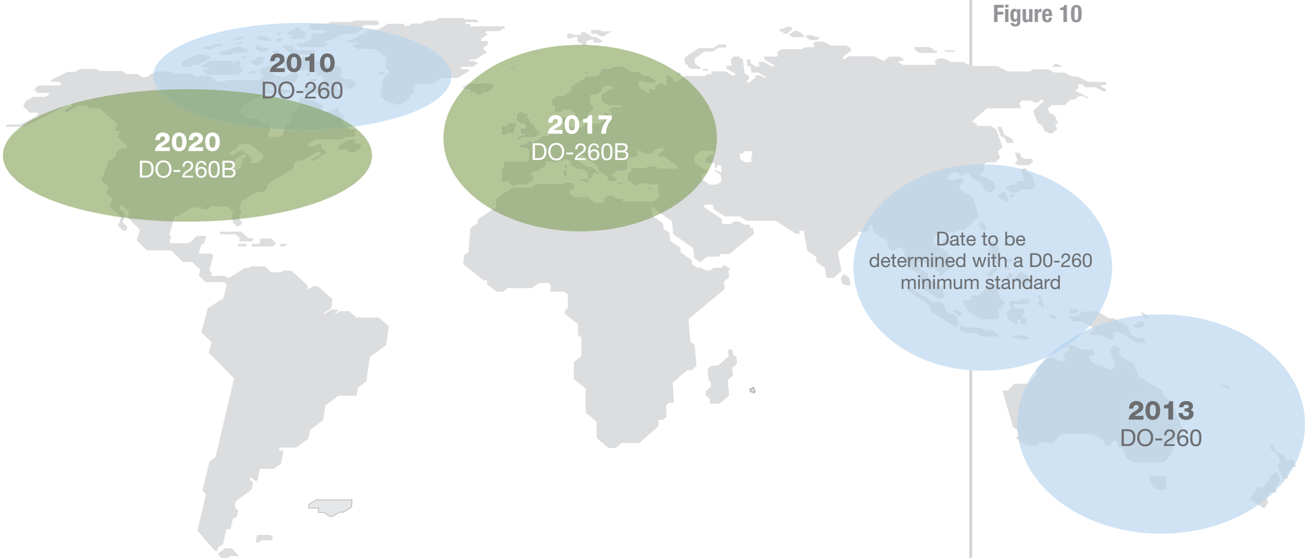
Step 2A + OANC
(On-board Airport Navigation Computer)

ADS-B IN TRIALS

To pioneer and test the new functions associated with ADS-B IN, trials are scheduled with the involvement of Eurocontrol and certain airlines which will have the ATSAW capability, some from production and others by retrofit. The European trials will commence in early 2011.

Mandates

Figure 10



ADS-B OUT MANDATES

Current operational requirements or mandates are already in service and others are anticipated. The figure 10 shows areas where a mandate already exists, such as the Hudson Bay, and also shows anticipated mandates in other regions. The upcoming mandates in Europe and North America require a new standard (DO-260B) which implies an upgrade to the FWC and connections between the MMR and the ATC transponder. This will enable additional benefits in terms of safety, flight efficiency and situational awareness, thanks to the GPS data enabling the transmission of more accurate information on aircraft positions and the improved latency in broadcasts.

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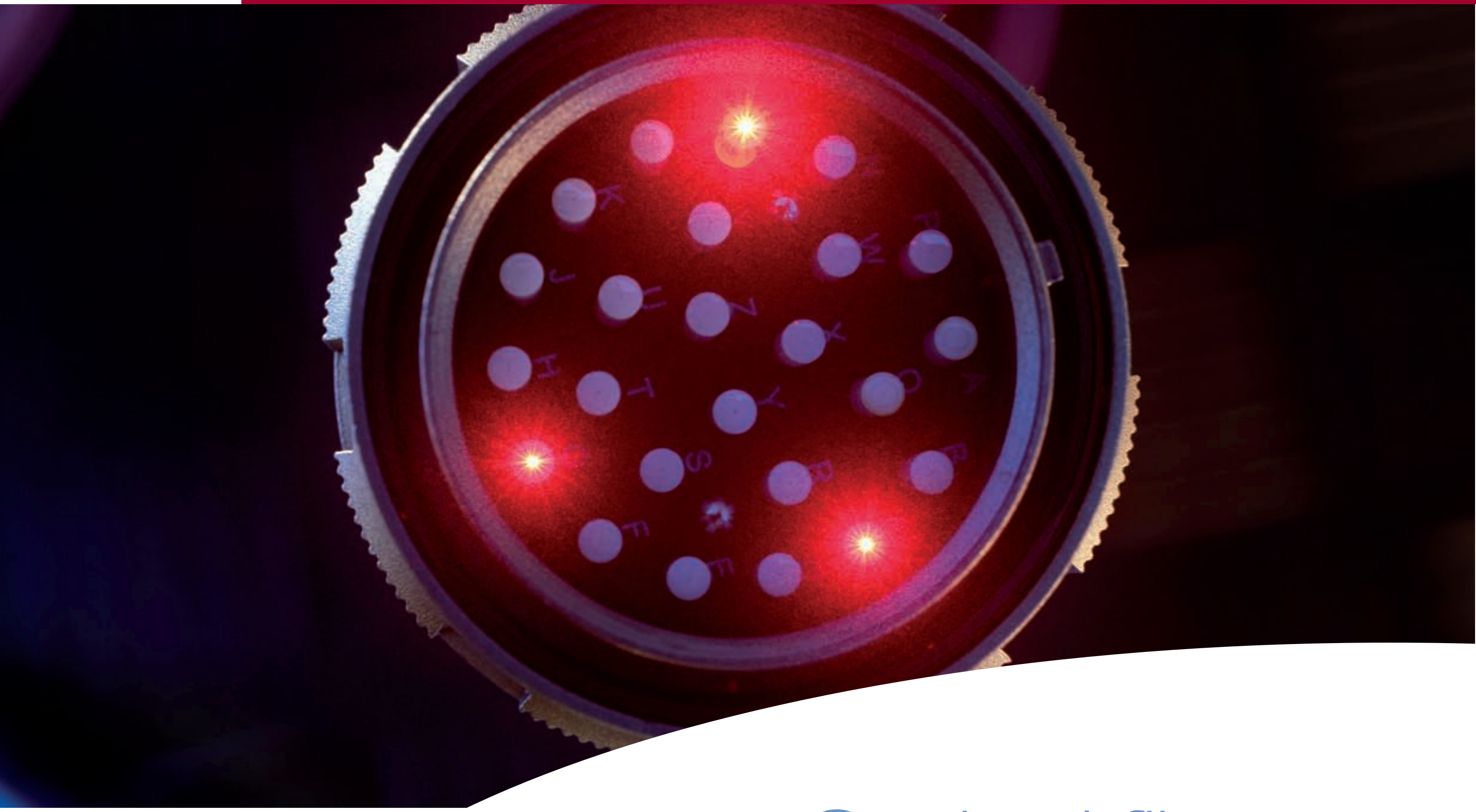
Conclusion

Whilst the initial drivers from SESAR and NextGen are motivated by the need to maintain and where possible enhance safety standards, the commercial implications for operators are not forgotten. The benefits from the Automatic Dependent Surveillance Broadcast (ADS-B) are not only for Air Traffic Control (ATC), but also for the airlines, flight crew and passengers.

ADS-B OUT eases the flight crew and ATC workload, resulting in fuel and time savings thanks to more efficient approaches.

ADS-B IN presents additional opportunities for fuel and time savings, in particular by the utilization of 'In Trial Procedures' for long range flights in the oceanic airspace, maintaining safety.

ADS-B is in the early stages of a roadmap vision up until 2020 and has been adopted by SESAR and NextGen. Airbus Upgrade Services will continue to develop new solutions to ease flight operations, thus contributing to reduce the congestion in future Air Traffic Management.



Optical fibre on aircraft

When the light speed serves data transmission

As more and more electronic systems are installed on aircraft, the quantity of electrical cable is inclined to increase significantly. Aeronautical electrical installations have been for many years based on copper conductors which are firstly expensive in terms of weight and secondly, have some constraints in relation to their characteristics such as Electro-Magnetic Interferences (EMI) and bandwidth limitations. The introduction by Airbus of aluminium wiring allowed saving weight but had no better effects on the characteristic constraints.

Therefore, electrical installation designs introduced the optical fibre technology instead of copper cables for data signal transmissions. The use of optical fibre provides large benefits in terms of a large bandwidth capacity, EMI insensibility, complete electrical isolations, signal attenuations lesser than electrical cables and last but not least, lightweight compared to an electrical cable (4kg/km).

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Aircraft Electrical Installation
Electrical Standard Items
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What is an optical transmission assembly?

The principle is to convert the electrical signal to a light wave signal, then to transmit it through a physical pipe used as a wave guide, so called ‘optical fibre’. Therefore, an optical fibre transmission assembly is composed of a transmitter, optical fibre, connectors and a receiver (figure 1).

As a reminder, light is characterized by its ‘spectrum’ which is the whole set of wavelengths from ultraviolet to the infrared (including visible light) and by its ‘index of refraction (n)’ which is an intrinsic property of a material corresponding to the ratio between the speed of light in vacuum and its speed in the material. When light encounters an environment, the light ray is reflected and refracted. The refracted ray (meaning transmitted inside the medium with a change of directions) depends on:
- The refraction index of the parameters which are the medium,
- The angle of the light ray (figures 2 and 3).

This is defined per the Snell Descartes Law: n1sinΘ1= n2sinΘ2.
Another physical phenomenon is when an object bumps on a plane surface, its incidence ray angle is the same as the reflection ray angle.

To date, the optical fibre application in Airbus aircraft are:

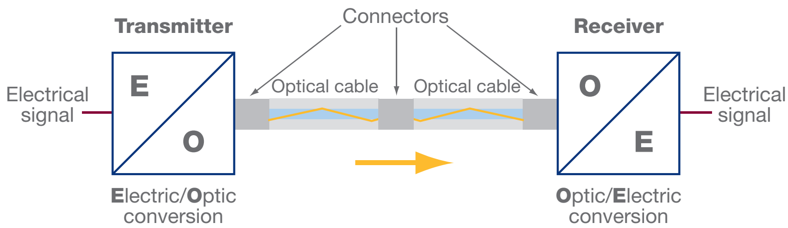
Aircraft Family	A320	A330/A340	A380	A350
Cockpit Display System (CDS)			•	
Large displays (under development)				•
Head-Up Display (HUD)	•	•	•	•
On-board Airport Navigation System (OANS)	•	•	•	•
Taxi Aid Camera System (TACS)		•	•	•
Concentrator Multiplexing Video (CMV)			•	
Network Server System/On-board Information System (NSS/OIS)				•
Cabin Video Monitoring System (CVMS)			•	
Cockpit Door Surveillance System (CDSS)			•	
In-Flight Entertainment (IFE)		•	•	•

Aircraft Family	A320	A330/A340	A380	A350
Cable length*	Following chosen options	565 m*	2.4 km	TBD
Nombre of links	Following chosen options	41*	171	TBD

*average following chosen options

Optical transmission assembly

Figure 1



However, it is possible to obtain a complete reflexion (see figure 4) if the above both conditions are gathered, which will give us:
- n1 value > n2 value (n1 and n2 refraction value of both medium).
- Incident angle 1 trends towards 90° (low-angled beams).

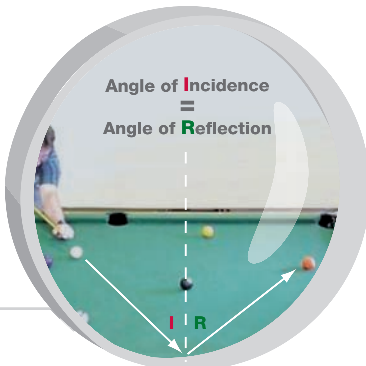
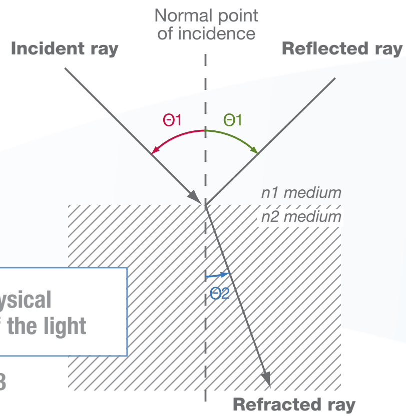
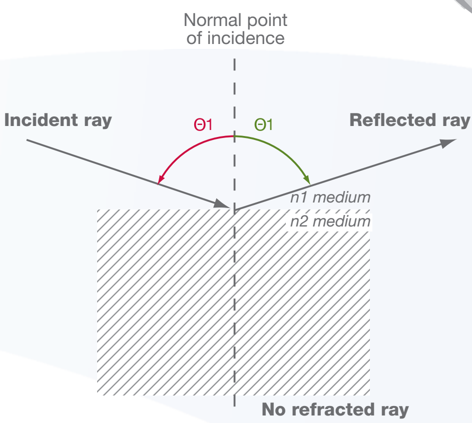


Figure 2



General physical behavior of the light

Figure 3



Condition for a complete reflection

Figure 4

information

Regarding optical fibre in telecommunication, cladding is one or more layers of material of a lower refractive index, in intimate contact with a core material of a higher refractive index. The cladding causes light to be confined to the core of the fibre by total internal reflection at the boundary between the two.

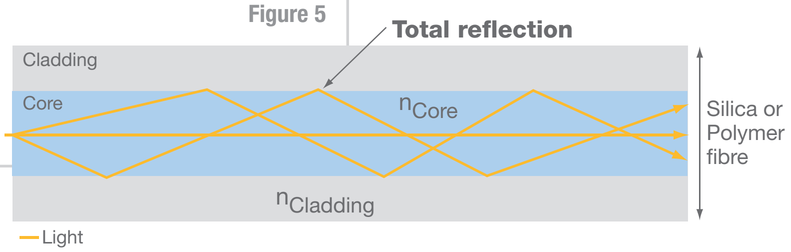
Optical fibre

An optical fibre is a wave guide allowing transmission of a reflected light signal between two equipments. This wave guide is made of two basic elements which are the core and the cladding. Each of them is composed of the same material with different refraction indexes which are chosen in order to have ‘ncore value > ncladding value’. Then the light is transmitted inside the core with a low angle to ensure the light wave will be totally reflected by the cladding and transmitted along the core (figure 5).

The fibre can be made out of Silica or Polymer. Airbus qualified a Silica (glass) optical fibre P/N ABS0963-003 Type LF (see figure 6).

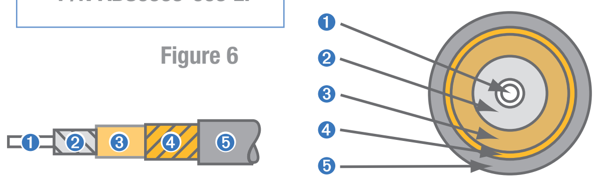
Fibre

Figure 5



Airbus Optical Fibre P/N ABS0963-003 LF

Figure 6



Jacket N°	ELEMENTS		MATERIAL	DIAMETER Ø
1	Fibre	Core Cladding	Silica	62.5 µm ± 3 µm 125 µm ± 2 µm
2	Primary coating		Silicone	400 µm ± 25 µm
3	Primary jacket		Copolymer OHAL high temperature	900 µm ± 50 µm
4	Mechanical strength braid		Polymer aromatic fibre braid	N/A
5	Outer jacket		Copolymer OHAL high temperature	1.8 µm ± 0.1 µm

µm: micrometre
1.000×10–6 m = 1.0000 µm

Light spectrum

Figure 7

CAUTION: Even in an infrared spectrum (not visible to the eye), the light ray could cause serious eye damage, therefore never look an optical fibre contact in front view.

Transmitter and receiver

The transmitter and receiver modules are included in the equipment using the optical fibre technology and manufactured directly by the equipment suppliers.

The transmitter has to convert electrical data signal to light data signal. The signal is specified by its power (<1mW) and its wave length. Wave lengths used by Airbus are 850nm and 1300nm (figure 7). The conversion is ensured by laser diodes or the Light Emitting Diode (LED) technology. At the end of the line, the receiver has to collect the light data signal and reverse it to electric data signal. This conversion is done using the Photodiode technology.

Optical contacts and connectors

The optical connector is a mechanical element which allows the connection of two optical fibre links. The optical fibre link is an optical fibre fitted with contacts at each end, allowing the installation of the optical cable in a connector. The connector implementation has to ensure the optical signal propagation with the minimum of attenuation. In consequence, the connectors have been designed to ensure a perfect alignment of both optical fibre contact end faces, but also a constant contact between both fibres whatever the environmental conditions (figure 8).

Two contacts, ABS1906-01 and ABS1379-003, allowing the installation of optical fibre in the connectors have been qualified by Airbus.

The particularity of the optical contacts, compared to electrical contacts, is that they are 'hermaphrodite', meaning that the contact is the same on both sides of the connector. The contact alignment is ensured by a specific additional sleeve fitted in the female connector.

Since the A350 design, Airbus' philosophy is to use only ABS1379-003 (the best one in terms of installation facilities, cleaning and installation on the optical fibre) and to design connectors in accordance with existing supports (rectangular, circular or square connectors, as shown in figure 9).

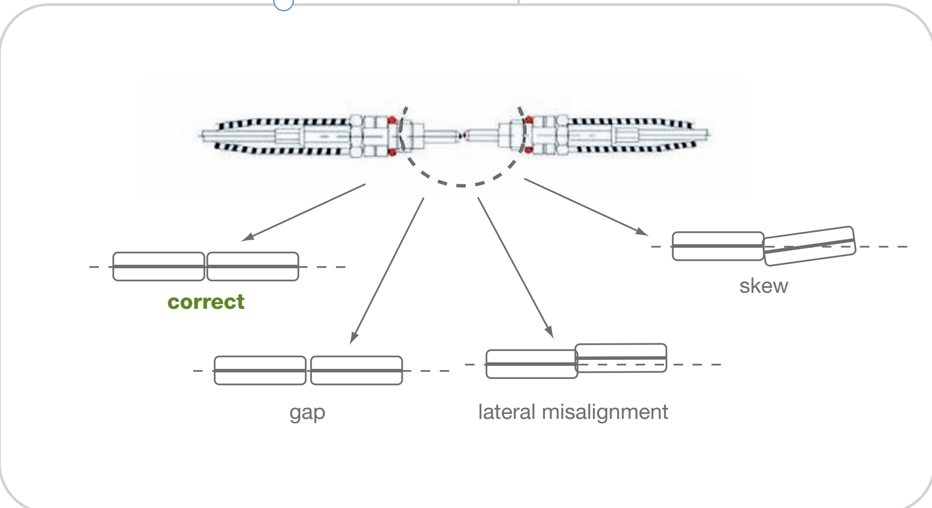
Optical link manufacturing

The manufacturing of an optical link consists in fitting the optical contacts on each side of the optical fibre. This process is complex due to some critical steps as the gluing of the ferrule with the fibre (contact robustness is highly dependent of this step) or the polishing (where the surface of the fibre needs to be plane). In case of a damaged optical fibre, operators have the possibility to order a new optical fibre link through Airbus Spares. Depending on the programme, the optical cable has its own Part Number (P/N) recorded in the Illustrated Parts Catalogue (IPC) and retrieved with the wire number as entry point (A350, A380, A340 TACS), or it is possible to request Airbus customers support to get the P/N associated to the wire number.

In addition, optical link manufacturing requires some specific tooling (oven, polish machine, interferometer, etc.). The on-shop process is described in the Process and Material Specification manual 01-05-63.

Optical fibre contact alignment

Figure 8



Airbus optical components

Figure 9

Usage of optical fibre for In-Flight Entertainment

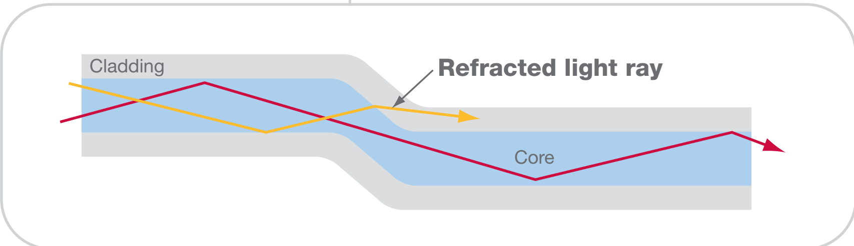
Optical fibre installation and connection on the aircraft

Optical fibre can be routed alone but also on a bundle with electrical wire. Due to the optical cable specifications (-55° to 125°C), no optical cable is routed in fire or high temperature areas.
As for electrical wires, a minimum bend radius has to be respected due to the light's reflection properties. Indeed a short bend radius will modify the incidence angle of the light ray, thus the total reflection conditions will no longer be respected, resulting to some refraction of the light ray and attenuation of the signal (figure 10).

During maintenance actions on the aircraft or during its installation phase, the optical fibre should not be crushed at the attachment point. In case of over tightening, effects could occur on the fibre leading to an attenuation of the signal.

Over-bent radius effects

Figure 10



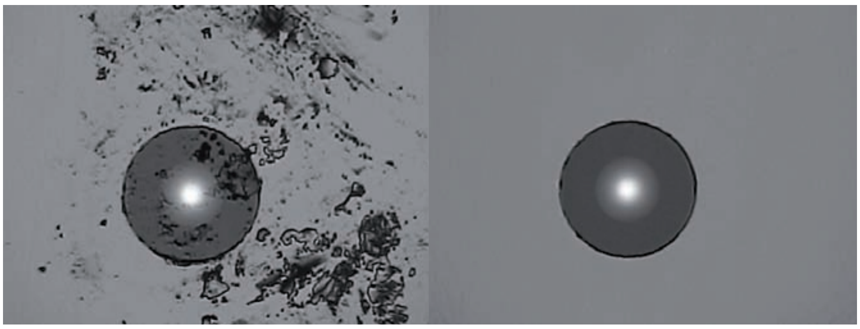
To prevent such attenuation, either bobbin or tape must firstly be applied at each attachment point of the optical fibre installation. Information concerning the installation of the optical fibre is available in the ESPM 20-33-11 (Electrical Standard Practices Manual).

A major difference with the electrical wiring installations with a high impact on the optical assembly performance concerns the cleanliness of the connection. Due to the diameter of the optical fibre's core (62.5µm, about the thickness of a human hair), contamination of the optical contact surface generates optical attenuations or even, a complete loss of the signal. This is why cleaning and protecting the optical cable contact surface is mandatory at each step of the optical fibre handling, to avoid contamination of the contact surface (figure 11). For the cleaning, Airbus proposes three techniques: Dry, wet and dry air cleaning, and two processes: Contact alone or contact fitted in a connector.

In addition, to allow the detection of an optical contact end face contaminated, a microscope with a minimum magnification of 200 can be used. All the above is widely detailed in ESPM 20-55-60.

Optical fibre cleanliness

Figure 11



Dirty optical fibre

Clean optical fibre

Optical fibre troubleshooting and repair

In order to ease the operator's task for the optical fibre's malfunction troubleshooting, some specific tools were designed in strong partnership with the manufacturers. The troubleshooting is similar to one that would be done for an electrical cable, by performing a continuity check. It is performed using the Visual Fault Locator (visible light source emitter) or a Power Meter, with or without a calibrated light source (figure 12).

To determine where the default is located on the optical fibre line, the use of the Optical Time Domain Reflectometer (OTDR) is the most reliable and accurate way.

The OTDR LOR220, using the photon counting method (see the information box below), was specifically designed by Luciol Instruments to provide high precision measures in the aircraft environment and can be used on wing.

With one screenshot, the tool provides a curve showing the optical signal's attenuation at each distance point of the cable. By such, it is possible to find with high accuracy where the damage is localized on the line in order to perform the repair.

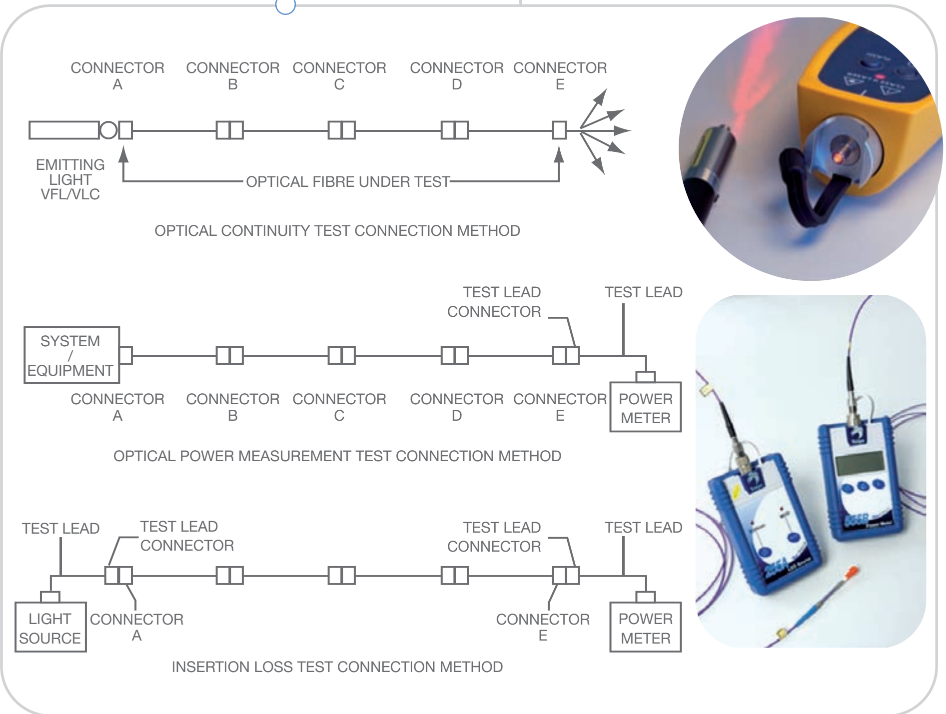
The displayed result curve (figure 13) allows to make the difference between the return loss (light reflection due to the optical line cut-off at the level of the connectors) and the insertion loss (signal attenuation resulting of the defect on the line). The OTDR offers the possibility to record the curve, allowing the operator to send the curve directly to Airbus specialists for interpretation.

Airbus broken optical fibre can be repaired. Airbus qualified a specific tooling developed by the manufacturer Diamonds allowing this kind of repairs called the 'Fusion Splice' which uses the fusion technology.

An electrical arc is generated welding two optical fibre ends facing each other (figure 14). The result is a complete continuity of the fibre. The tool kit contains also a 'tension test' system, checking the correct fusion of the cable. A kind of protective sleeve P/N ABS1632-003 - called 'crocodile' in relation to its shape and specifically designed for this application - is then glued on the splice to ensure a mechanical protection.

Extracted from the Electrical Standard Practices Manual (ESPM 20-52-25)

Figure 12

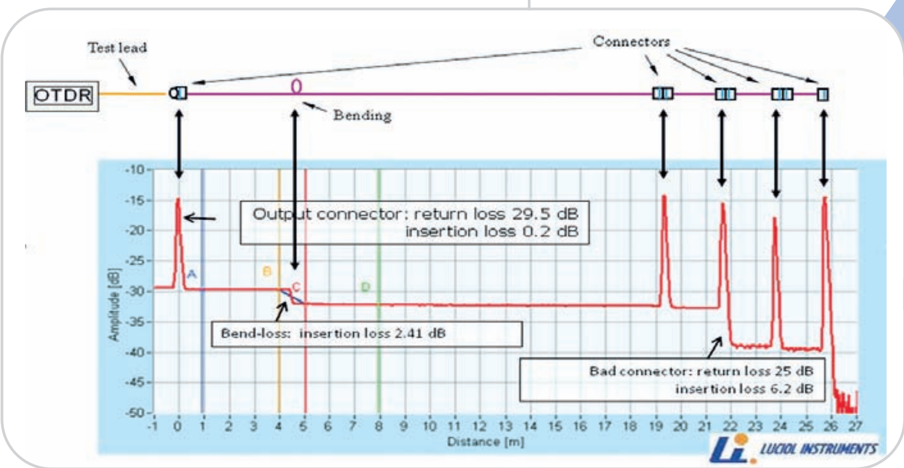


information

In physics, a photon is an elementary particle, the quantum of the electromagnetic interaction and the basic unit of light and all other forms of electromagnetic radiation.

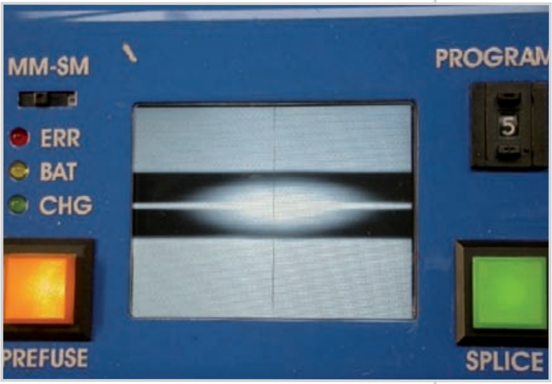
Optical Time Domain Reflectometer (OTDR) screenshot

Figure 13



Fusion Splice technology

Figure 14



This permanent repair restores the full integrity and characteristics of the optical cable (losses introduced by the 'Fusion Splice' are less than 0.1dB).

A complete kit P/N 1047320 (figure 15) was designed containing the Fusion Splice tools including the complete gear (pliers, scissors, light, support plate, etc.) and the material necessary to perform the repair on-wing.

You may find information concerning the repair of an optical cable in the ESPM 20-53-28, but also available in Airbus SIL 20-030.

On-wing repair kit

Figure 15

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Conclusion

In the recent past years, the optical fibre was introduced in the aeronautics. This has required to develop components and associated processes/methods to maintain them during the aircraft's life-cycle, like any other previous copper or aluminium electrical cables. In the coming years, no doubt that continuous improvements and further developments will come to light.

The principles of optical fibre installations are similar to other technologies, copper and aluminium, but require the optical faces to be scrupulously clean. The continuous development of the optical fibre's use in the aeronautics requires new skills and competences for an airline electrician, likely to work on the systems using optical fibre.

A specific training course (Optical Fibre Inter-System Code XMOF) dedicated to optical fibre troubleshooting and maintenance has been developed by Airbus and will be available beginning of 2011 in the Airbus Training e-Catalogue.

AIRBUS

A300/A310 Family optimized air-vent inlet NACA Duct

Continuous engineering solutions for fuel savings

Fuel economy has always been a concern for the operators, particularly with the increase in oil prices in recent years and global awareness for the environment. Airbus has been working with the operators to look for ways to improve fuel economy for all its aircraft programmes. For the A300/A310 Family programme, despite no longer being in production, Airbus has been looking into potential hardware improvements which would give a better fuel economy to its operators. Such improvements need to be attractive to operators and be capable for retrofit, with a quick return on investment. The improved NACA Duct described in this article reduces drag, thus improving the aircraft's fuel consumption.

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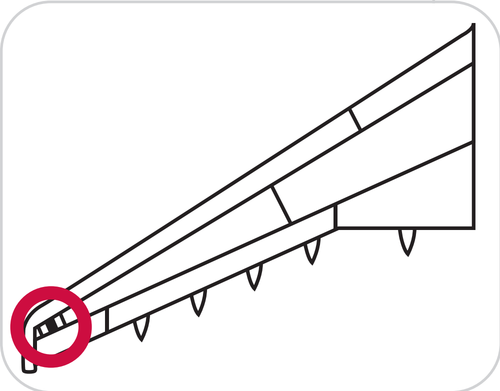
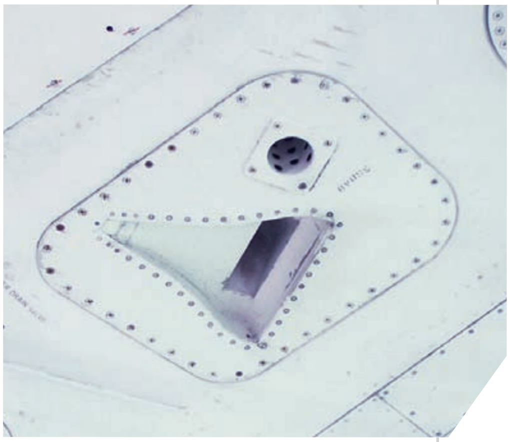
NACA Duct location on the wing

Figure 1



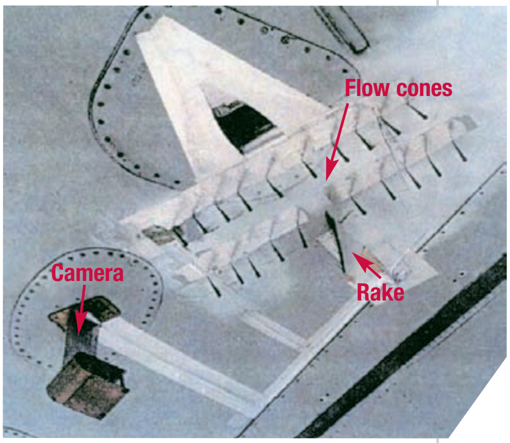
Current A310 NACA Duct, view from underneath the wing

Figure 2



Flight test set-up for A340 aerodynamic supplement

Figure 3



In-service experience

Based on the A320 and A330/A340 Family programmes, improvements have been studied to reduce aerodynamic drag through the introduction of a new NACA Duct. The A300/A310 Family programme team launched an activity to optimize its own, but with the constraint of a minimal impact to the structure and a minimal installation time.

Fuel system requirements

The NACA Duct is located near the wing tip, and counts one per wing (see figures 1 and 2). As an air inlet, the NACA Duct ensures that the differential pressure between the interior of the fuel tanks and the outside atmospheric pressure is kept to a minimum, particularly during climb and descent - the emergency descent being the most severe design case.
As a fuel vent system outlet, the NACA Duct is sized to permit fuel flow overboard in the event of an automatic refuel failure.

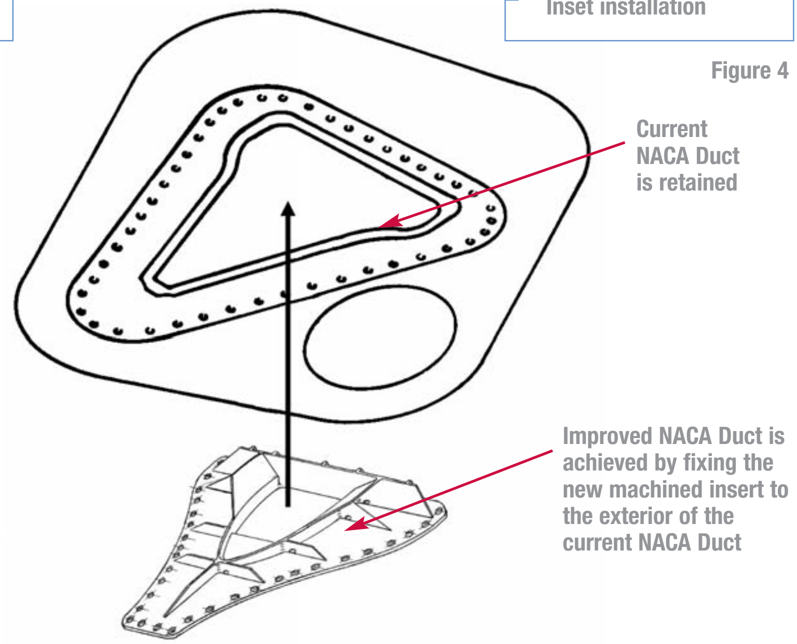
Meeting these design objectives ensures that the structural loads are kept to a minimum and therefore allow for a lighter wing. Maintaining the original design loads is essential to avoid any further modifications to the wing structure. For the A300/A310 Family programme modification, we have taken benefit from previous testings carried out on other Airbus programmes including on the fuel rig, the wind tunnel and flight tests (figure 3), thereby minimizing the cost of development and qualification.

Aerodynamic optimization of the air-vent inlet NACA Duct

Using knowledge gained from the optimization of other Airbus aircraft families, a new aerodynamic shape was created, which differs from the old shape particularly on the rear face of the insert see figures 4 and 5. This new insert still satisfies the fuel system requirements. The resulting drag reduction is 0.3% of the total aircraft drag, leading to an approximate fuel saving of 20-30kg per flight.

Inverted NACA Duct Inset installation

Figure 4



Industrialization

Several options were considered including a multi-part design. The chosen modification is a single one-piece machined insert which is attached externally with new fasteners to the existing NACA Duct. This means that the current NACA Duct does not need to be removed, minimizing the embodiment time for the retrofit solution. The complete retrofit can be achieved in eight hours elapsed time. This modification is fully inter-changeable and requires no additional parts to be modified.

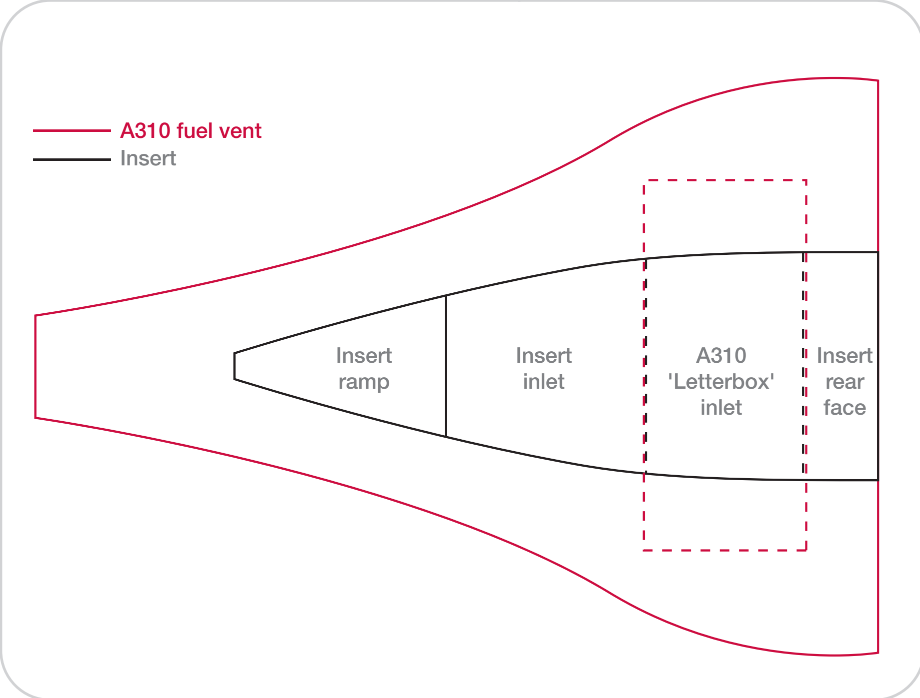
The original shape of the NACA Duct was analyzed and considered to be less than optimal, as put in evidence by flight tests performed on the A340.

The new shape of the NACA Duct was developed using analysis and testing to demonstrate the reduction in drag while maintaining a similar pressure differential. The benefit in the new shape results in the design changes brought to the rear face, from concave to convex of the inlet. This improves the flow aft of the inlet and therefore reduces the drag. In addition, the frontal area of the duct is reduced which also contributes to the reduction in drag.

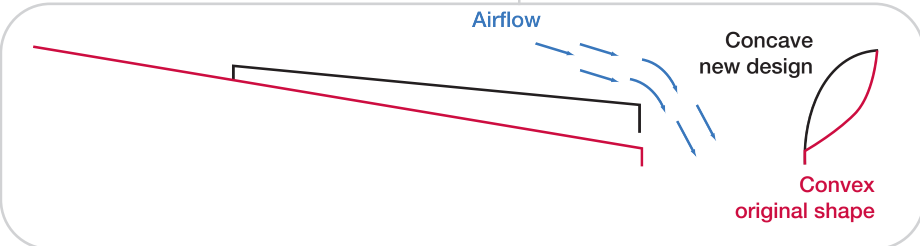
NACA Duct with insert top view and cross-sectional profile

Figure 5

Aerodynamic supplement



Line-of-flight section through the A310 fuel vent and geometry insert



information

A NACA Duct, also sometimes called a NACA Scoop or NACA Inlet, is a common form of low-drag air inlet design, originally developed by the U.S. National Advisory Committee for Aeronautics (NACA), the precursor to NASA, in 1945.

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Conclusion

The newly designed NACA Duct has taken advantage of the improvements made on other Airbus programmes and has been adapted to minimise the cost of parts and installation time for retrofit to the A300/A310 Family programme. The benefit to the operator is fuel savings with a short payback period (2 to 2,5 years).

AIRBUS

Radio Frequency Identification (RFID)

Airbus business radar

Radio Frequency Identification (RFID) is a form of Automatic Identification (Auto-ID) that uses a small wireless device that can be attached to objects or parts. It provides an accurate, automatic and a fast way to record and collect information about the object's or part's business activities. For example, you can automatically track the confirmation of deliveries into a warehouse, data can be written and stored onto the device in large quantities if required, and then can be read automatically from a distance with an RFID reader.

In the 1980's and 1990's, the use of RFID was often associated with building access control, automatic payments for road charges at toll booths and animal tracking. Today, as a result of massive advances in the technology's maturity, RFID is recognized as a fundamental enabler to streamline business processes, reduce inventory and increase the productivity and quality of business operations. Consequently, companies taking advantage of such capabilities can very quickly develop a competitive edge.

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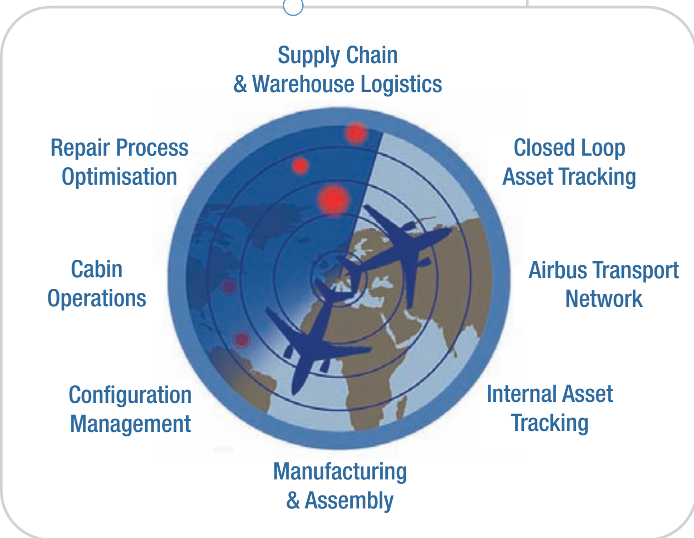
The history of RFID in Airbus

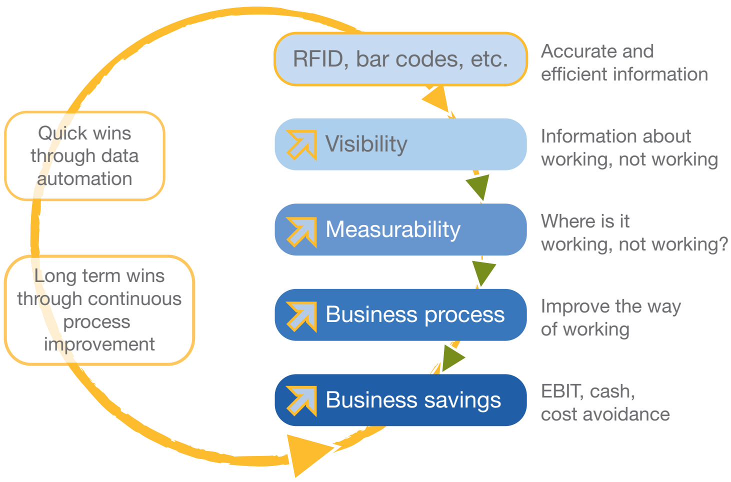
Airbus recognized this advantage early on and as part of its mantra for 'Non Stop Innovation', started piloting the technology as early as the year 2000, across its tool loans with airlines. By 2006, there were 15 projects across Airbus, each looking at promising new benefits enabled by RFID. However, it was clear that to maximize the benefits across the company, a coordinated approach was needed to avoid duplication of activities and to maximize synergies.

As a consequence, in 2007, a corporate decision was taken to launch a company-wide programme to increase visibility across the lifecycle of the aircraft, using a collection of automatic identification technologies (including RFID). This was called the Value Chain Visibility (VCV) programme. A dedicated transversal team was established to chart a company strategy, develop the optimum use of the technology and consolidate/prioritize activities across the company.

Airbus business radar: A digital Fly-By-Wire view of reality



Why increase visibility? Why RFID?



The Value Chain Visibility programme

The VCV programme is an Auto-ID inspired business transformation programme that is developing state-of-the-art streamlined business processes across the value chain through increased visibility and measurability. Its scope is the Airbus value chain, from suppliers to Airbus, between the global Airbus manufacturing sites onto airline customers and in-service partners.

The VCV programme is providing Airbus, its industrial partners and its customers with real-time automated visibility of processes, materials/asset movements and other key business events. By doing so, we move away from an analogue and paper-based value chain to what we call the "Digital Fly-By-Wire" value chain.

The business radar concept

This may seem like a radical concept at first glance, but the following comparison illustrates the potential benefits of the industrial Fly-By-Wire value chain and Airbus' business radar concept.

Airports use radar sensors (that use radio frequencies) to automatically track what is going on, in real-time. All the information from the radar sensors feed into the air traffic control system that informs the air traffic controllers what is happening, so they can make the right decisions faster. In other words, they have real-time visibility and measurability.

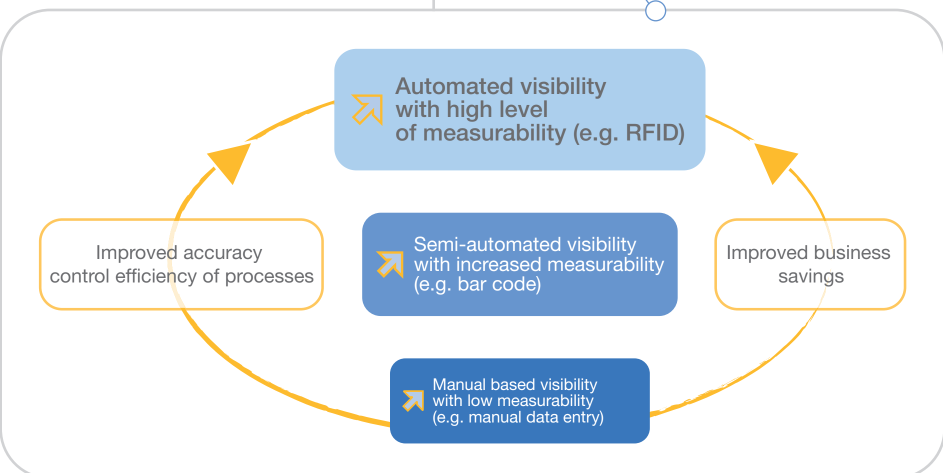
For airport and air traffic controllers, the benefits are extremely clear. Without that level of visibility, without real-time updates and without this automation, it would be extremely difficult to manage the skies efficiently and prevent incidents, given today's volume of air traffic.

The same is true for a global industrial company that has tens of thousands moving parts albeit the ground. The more visibility a company has into its operations, the more measurability and control it can have on its processes which in turn, help improve those processes which translate into savings and quality improvements.

Radio Frequency Identification (RFID) helps us adopt the same principle in the same way that radar sensors provide visibility to airports. It is our 'business radar' that lets us see what is going on digitally, automatically and in real time, so we can optimize the way we work and make the right decisions faster.

Tool tracking with RFID

Visibility, measurability and savings. They are all connected.



The Value Chain approach

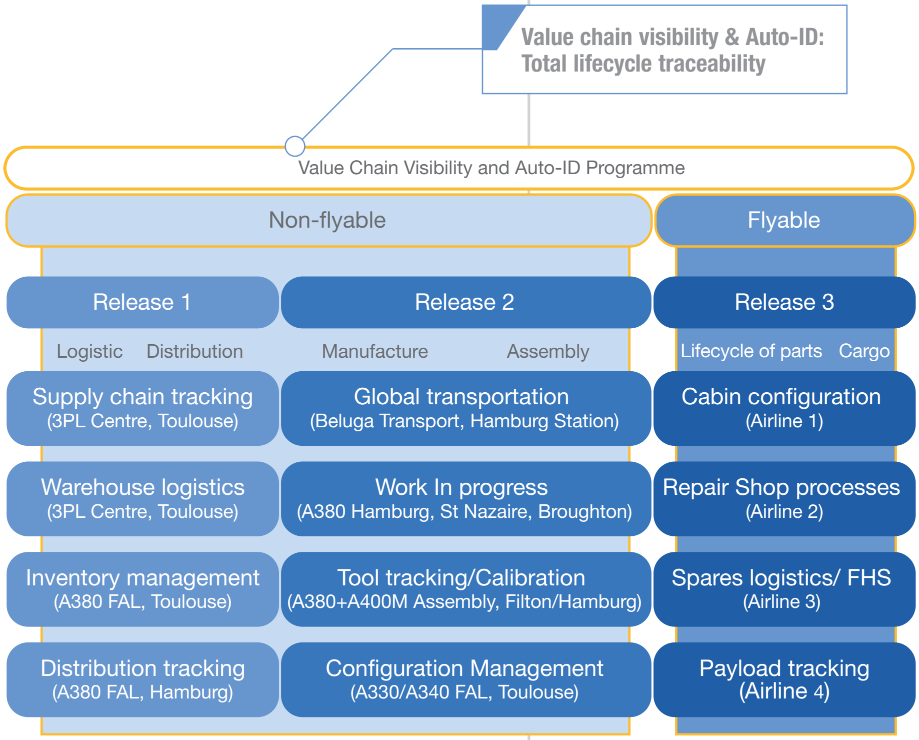
Airbus does not wish to limit the benefits of this improvement initiative to one specific function (e.g. logistics) or even itself. This is because Airbus considers its value chain to effectively be 'profits in motion'. These profits are not limited to any particular function but are spread all along it; the same being true for costs. Costs arise from waste that does not distinguish itself between functions, nor limits itself to company boundaries. So Airbus is focusing on the big lifecycle picture in order to make the big savings and develop an approach that maximizes the benefits to all actors across the value chain.

Due to the large scale of this lifecycle based approach, the VCV programme is split into two main categories which are the 'Non-Flyable' and 'Flyable'. The 'Non-Flyable' category refers to all the ground-based processes and includes the supply chain, transportation, logistics, manufacturing and assembly related applications. The 'Flyable' category refers to all in-service processes and includes operational, maintenance and payload tracking applications.

Within each category, there is a portfolio of new streamlined processes that span the lifecycle of the aircraft. These processes were first piloted in an individual Airbus business location and then once proven, are repeatedly deployed on a large scale across the company. In this way, we re-use and standardize both, the new process and solutions across the company. It is effectively process harmonization with a top down strategy, but executed in a bottom-up fashion.

- Non-Flyable:
  So far, Airbus has deployed almost 20 industrial projects in the 'Non Flyable' category that range from warehouse logistics to tooling management, to the work in progress tracking. All these projects, without exception, have shown very strong financial benefits in the order of millions of Euros per year, with pay back periods in most cases of less than one year. The tangible benefits induced by the higher level of automation include a reduction in inventory and capital assets, improved productivity and quality.
- Flyable:
  In March 2006, a two day RFID specific Customer Focus Group was held with 34 airlines and MRO (Maintenance, Repair & Overhaul) organisation participants. Airbus presented its ideas and the attendees provided feedback and their view of priorities. Their inputs have formed the cornerstone of the 'Flyable' project.

The results from an opportunity and pilot analysis across a range of in-service processes with key airlines and MRO partners were found to be better than expected. All the projects had a payback period of less than 12 months with medium to strong savings. But one of the critical enablers for these savings was the high memory UHF (Ultra-High Frequency) passive RFID tags on parts.



3PL: Third Party Logistics
FAL: Final Assembly Line

A350 XWB

As a result of this analysis, Airbus became the first aircraft manufacturer to request its suppliers to add permanent RFID tags to approximately 3,000 parts on each of its new A350 XWB aircraft. These RFID tags are designed to remain with the parts throughout their entire lifecycle, in order to enable process automation and enhance the process visibility for airlines, suppliers and MRO organisations.

For example, consider the line side maintenance domain. When a mechanic replaces a faulty unit with a replacement unit, he will be able to digitally scan the faulty and replacement units in order to complete his work order via a mobile RFID handheld reader. He will also be able to remotely upload this information into his Maintenance Information System (MIS) without the need to fill in any paperwork and later type it into his MIS. As a result, the overall process is much faster, the quality of data in the databases significantly improved and there is less administrative work.

RFID tracking process from 'A to Z'

notes

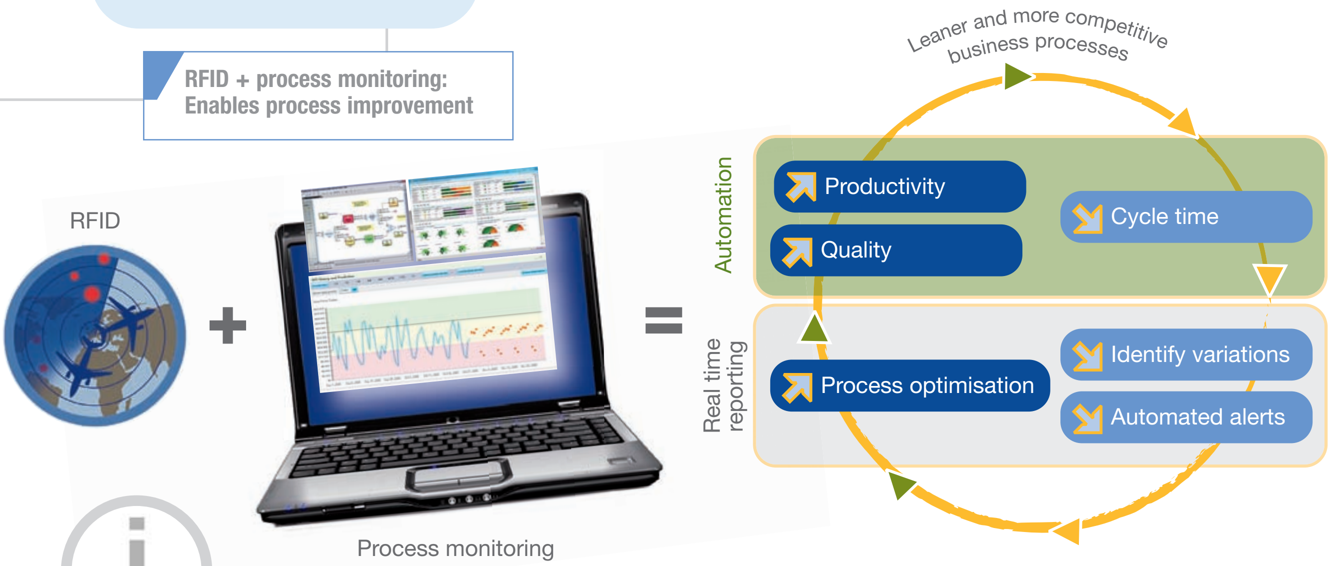
If you would like further details about what Airbus is doing and how RFID can benefit your company, please contact us. We would be more than happy to invite you to our Value Chain Visibility industrial showroom in Toulouse, France, where you can touch and see firsthand how Airbus is using the technology to deliver improvements and savings across its global manufacturing sites.

External services

Airbus has been approached by a number of companies, both in aerospace and outside, for support on RFID projects. Part of the added value is clearly to benefit from the first hand experience of the Airbus team and the proven portfolio of processes and solutions that have already been deployed within Airbus' industrial environment.

A successful example is the collaboration with Air Portugal's Maintenance and Engineering (TAP M&E) department in Lisbon, Portugal. TAP M&E and Airbus' team jointly studied and deployed a RFID solution for tracking parts in an engine repair shop. Work is now on-going to expand to two additional areas of TAP M&E's tracking operations (for tooling and life-vests).

RFID + process monitoring: Enables process improvement



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The theory behind the benefits

Visibility, measurability and business savings: They are all connected. All business savings come from process improvements. But we can't improve what we can't measure. And we can't measure what we can't see (i.e., visibility).
So visibility is a pre-requisite for all business savings. Furthermore, the level of visibility and in an organisation determines the maximum level of savings (i.e., if you can see so much, you can only measure so much, only improve so much and only save so much).
RFID helps us see more, measure more, improve more and save more. But while RFID is very important, it is not our end destination. The destination is fully automated and real-time visibility and monitoring of our business processes. RFID is one of the main vehicles that can help us reach this goal.

What are the benefits?
There are two categories of benefits short and long term.
In the short term, RFID helps us automate processes. Automation:
a) Improves productivity,
b) Makes processes faster which reduces cycle times and inventories,
c) Helps avoid manual errors which therefore improves quality. So overall faster processes, less inventory, less efforts and better quality.
In the long term, RFID can help identify areas where processes can be improved and is therefore an enabler for continuous improvement

How does RFID achieve this?
Firstly, RFID helps automate processes by removing the need to manually (via paper or bar code) track the progress of a business process. This helps accelerate the process, reduce the cycle times and makes it more lean. Secondly, RFID enables long term improvements by allowing us to automatically "see" in real-time how our processes are actually performing. If we then compare the actual performance against our target performance, we can see very quickly what is working and what is not. This helps us identify where we need to take corrective actions in order to focus our improvement processes.

Other EADS companies

The solid RFID successes within Airbus, together with the spirit of innovation across the EADS group (of which Airbus is one company), has resulted in companies within all the group are also interested in using RFID to enable savings. So, in order to capitalize on the experience and lessons learnt, the different companies within the EADS group are re-using and building on the past of Airbus' RFID work.

From left to right:
Clive HOHBERGER
Chairman Automatic Identification and Mobility (AIM)

Carlo K. NIZAM
Head of Value Chain Visibility & Auto-ID
Airbus

Dr. Patrick KING
Global Electronics Strategist
Michelin

Airbus employee receives the highest award for Radio Frequency Identification (RFID) activities

Carlo K. NIZAM received the distinguished Don Percival award in recognition of his outstanding contribution to the advancement of Automatic Identification (Auto-ID) solutions at the AIM conference in November 2010 in Chicago, U.S.A. The award was handed over by the Association for Automatic Identification and Mobility (AIM) which is the international global association for automatic identification and mobility technology. AIM was particularly impressed with Airbus' wide vision for RFID and how far and fast Airbus had pushed the boundaries for the application of the technology.
"To be recognised by your own company is one thing," Carlo says. "To be recognised by the Auto-ID industry as a whole as best-in-class takes it to another level".

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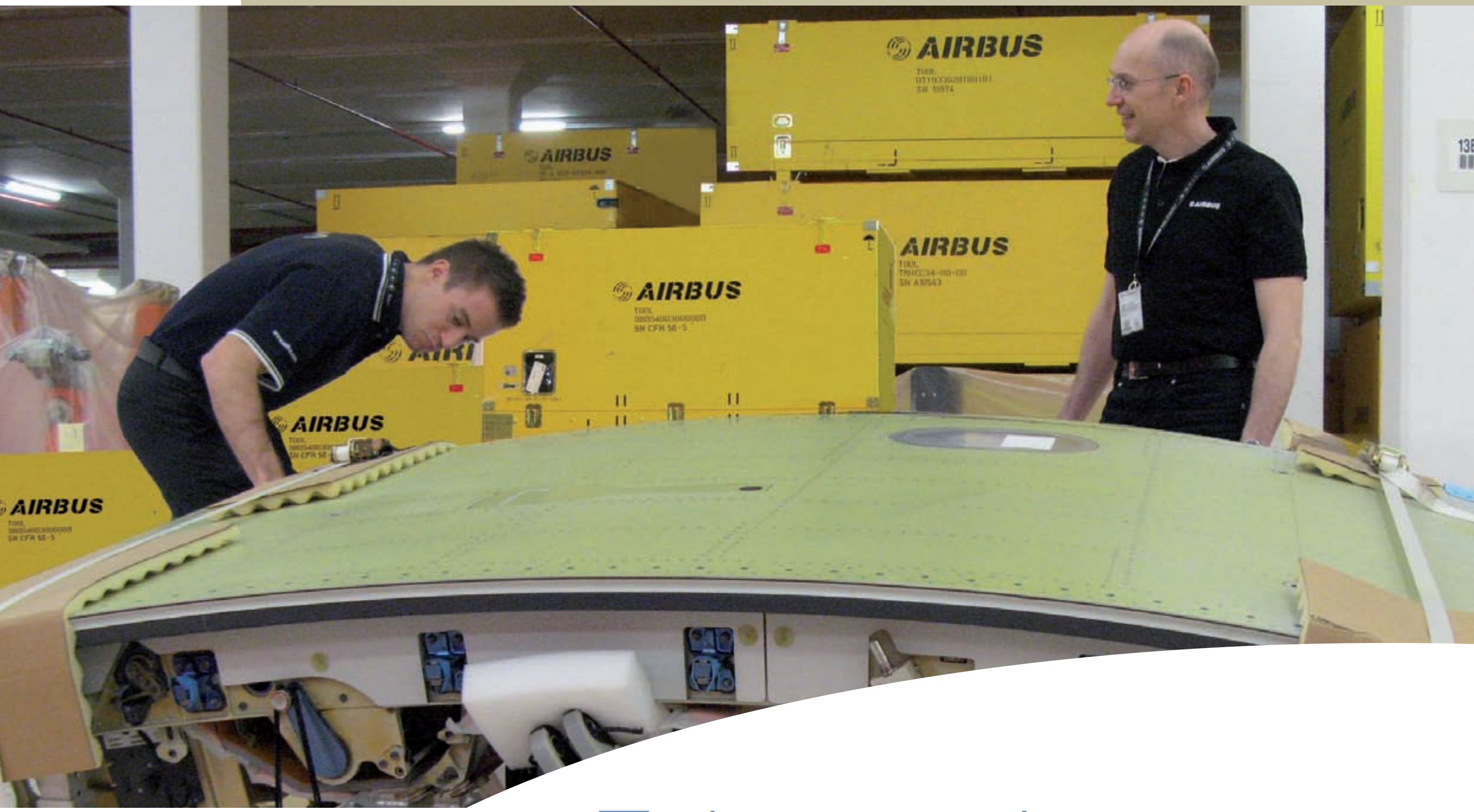
Conclusion

Airbus is using RFID as a 'business radar' to improve its business processes through better visibility and taking a lifecycle based approach through a single corporate programme, that aims to maximize benefits to all actors across the value chain. As part of this lifecycle based approach, Airbus has developed and deployed a full portfolio of RFID processes and solutions. The new A350 XWB aircraft will embed RFID capabilities from day one on 3000 of its parts and be able to take advantage of the portfolio of processes that have already been developed. Airbus is ready to support its airline customers and industrial partners to benefit from its proven industrial experiences.

AIRBUS



Enhanced spare part engineering support

Smart spare parts' design for a part standardisation

The Airbus Material and Logistics Engineering team has developed the capability to create efficient engineering solutions for the design of spare parts, maximizing their standardisation and harmonisation. Airbus defines innovative spare part solutions leading to improved part delivery lead times, based on the combination of engineering expertise with the material and logistics business experience.

Its approach to engineering solutions for material and logistics requirements and the services it provides to the customers includes the initiation and drive of standardisation and modular designs of spare parts, for the Airbus spares' aftermarket. The service also aims to provide new standardized part numbers and lead-time solutions based on customer requests. This article will explain the advantages and future of inter-changeability between spare parts.

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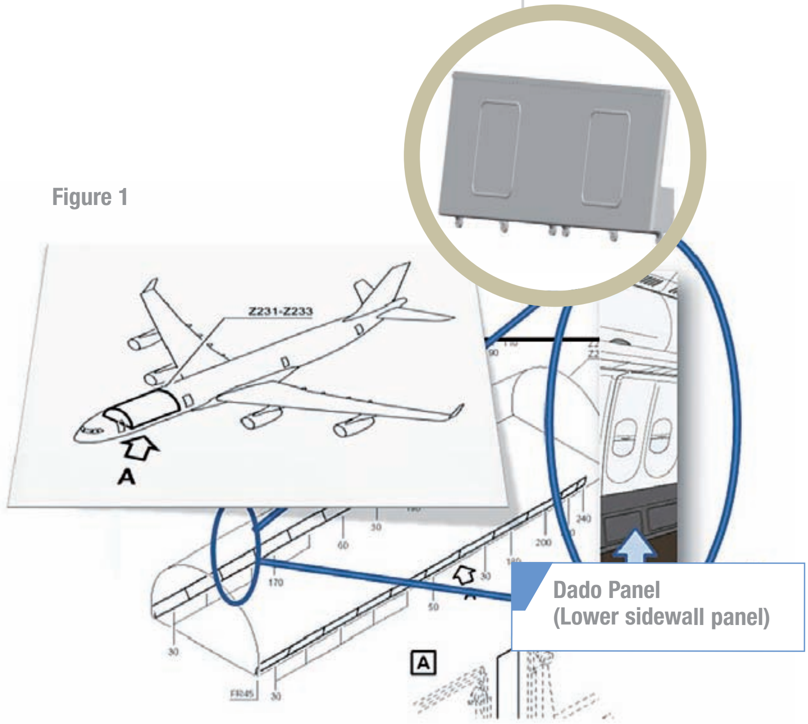
A typical case for the Material and Logistics Engineering support

When a component fails on an aircraft, the usual assumption is that this occurs due to fatigue, static loading, wear, corrosion or other influences which aircraft components are subject to. The immediate solution to allow the aircraft to continue its operations is always to replace the part, particularly when its essentiality code is '1' or 'No-Go', meaning the aircraft is not airworthy without the part. Airbus has experienced many cases where the root cause is not based solely on the part itself, but on various other external factors such as maintenance handling or on the installation and transportation. Once identified, the global issues can be solved faster and more cost-efficiently, compared to the time and cost of a part re-design.

A recent customer query regarding the lead-time for A340 aircraft cabin lower sidewall panels, commonly named 'Dado Panels', highlighted this point (figure 1).

Due to the fact that cabin lower sidewall panels are highly customized to the specific requirements of the customer's cabin design, the specific production lead times can be relatively high. Lower sidewall panels are finished by applying a film rendering the surface with the final colour and pattern for the cabin interior, specific to each customers' cabin specifications.

Figure 1



Some customers use a light grey colour, others a sand-colour, amongst the various other shades available. In this case, we looked into the various opportunities to reduce the replacement lead-time, whilst maintaining the integrity of the business, airworthiness and safety to fulfil the customers' requirements.

The only economically viable solution was to deliver semi-finished panels, requiring the customer to add the coating on-site but enabling him to operate his aircraft quickly. This bypassed the customisation issue and greatly improved the lead-time.

The following two prerequisites are required to be able to add the lower sidewall panel coatings on-site:

- An autoclave for the curing process,
- The qualification to perform the curing processes.

information

Inter-changeability:

Parts are inter-changeable (INC) when they are equal in form, fit and function. There are three main types:

- INC1 ➔ One way inter-changeable: New parts can replace old; old ones cannot replace new parts.
- INC2 ➔ Fully inter-changeable: Old parts can replace the new parts which can replace old parts
- INC3 ➔ Not inter-changeable.

Mixability:

Parts are mixable when different modification standards can be installed at the same time, in different locations, within a given system.

There are various maintenance facilities and external providers which fulfil these requirements and satisfy external aftermarket needs. These are able to apply such coatings to internal Airbus proprietary panels.

Once Airbus had followed up the 'Dado panel' case, an internal initiative was launched to create a new official Part Number (P/N) defining a standard procurable 'non-coated' version of the 'Dado panel'. This has been phased-in with the respective inter-changeability (ICY) links to the customised 'Dado panel' variants displayed in the customer's Illustrated Parts Catalogue (IPC). Airbus customers can now order a non-customised part, greatly reducing the lead-time, whilst giving the freedom to drive a cost/lead-time balance through a personal selection of a maintenance provider for the customisation work.

In this particular case, the solutions resulting from the analysis carried out highlighted the additional added value provided by the Airbus Material and Logistics Engineering team's inputs when tackling such in-service root cause analysis. There are many areas where combining experience of engineering processes and procedures within Airbus with the 'logistics and spares' expertise can lead to efficient trouble-shooting and the determination of the real root causes, particularly when only indirectly design-related. The Material and Logistics Engineering team has been established in 2007 in Airbus to address and solve such topics.

The Airbus Material and Logistics Engineering team way forward

Objectives

1. React in case of Aircraft-On-Ground (AOG) with more flexibility based on intelligent spares solutions.
2. Improve the part usability by ensuring specific market spare parts' inter-changeability (ICY),
   - Production ICY - Defining which systems are installed on the production aircraft.
   - Spares ICY - Connecting parts indirectly inter-changeable through chains of modifications.
   - Specific spares ICY - Allowing the customer to choose whether to use new systems installed in production.
3. Increase operational flexibility allowing increased regional parts' availability:
   - Reduce Part Number (P/N) variance in storage warehouses, whilst covering the fleet requirements.
   - Same P/Ns serve more customers.
   - Increased regional availability due to increased scope per Part Number.
4. Reduce lead times:
   - Standardized designs and parts.
   - Highly structured product lines and streamlined processes.

Approach

Existing parts

- Initiation of design changes to existing parts, creating spares which are far more flexible, covering multiple applications and complete P/N families.
- Reorientation of ICY codes to expand the usability of parts and to optimize the effectivity scope of P/Ns, as for spares a P/N can be effective through an ICY link.

New parts

- Ensure that design changes are carried out allowing the new parts to be inter-changeable where possible and initiating the creation of a separate, fully interchangeable spares' solution.

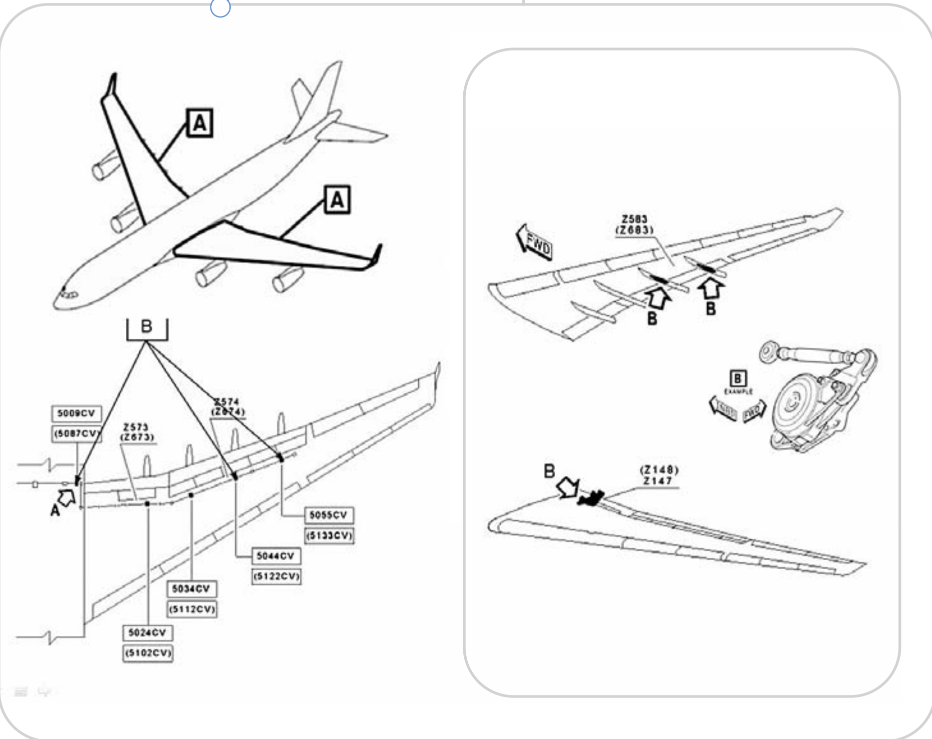
Current work and principles

The aircraft configuration in service today is the product of trade-offs between various specialists and innovative design solutions. To give an example, the aerodynamic design of the wing must be adapted to accommodate the structural requirements, and the structural design must be adapted to allow the required aerodynamic wing shape. Another important trade-off in aerospace design is the one between the in-service performance of particular aircraft parts and the spares logistics' requirements, such as mixability, inter-changeability and transportability. One standardized part performing the same task in two different locations is clearly more cost effective than designing two different parts to perform two only very slightly different tasks.
An efficient design must meet the operation's philosophy enabling the standardisation of parts, ensuring the highest degree of standardisation and its inter-changeability. The wing of an A340 aircraft, is already an existing example of standardisation to explain this principle. The Geared Rotary Actuator (shown as part 'B' in figure 2) can be used in two separate locations. The benefit of this is that one spare part covers both applications, allowing a greater flexibility and leaner warehouse stocks.

Airbus Material and Logistics Engineering team is working to identify all areas where different parts are similar in form, fit and function, to standardize parts and thus, to increase flexibility. The incorporation of service requirements throughout the life cycle, issues into the design process and the ongoing product development decisions for several parts in the A380 aircraft proves the validity of the concept.

The Geared Rotary Actuator inter-changeability on an A340 wing

Figure 2



Harmonisation and standardisation: Part 'B' harmonized the functions of 5055CV, 5044CV and 5009CV as the same part can be used in all three locations.

The design philosophy that Airbus is developing has been incorporated already for parts to other Airbus family aircraft. For the first time, it is also being incorporated into the A350XWB programme and will benefit all future programmes.

Initial and long term importance of inter-changeability

Design evolutions are important for continued airworthiness, safety and the technical advancement of Airbus aircraft programmes which keeps us at the forefront of technology. Whilst it is important to ensure the maturity of aircraft through continuous improvements, the inter-changeability is paramount, as for large expensive components it can have a huge positive impact on lead times.

information

Benefits for Airbus customers

- Flexibility for high priority demands:
  - Parts can be used for numerous applications
  - Reduced Part Number variance in warehouses whilst fully covering fleet requirements
- Shorter lead times and less complexity:
  - Modular design and spare part flexibility allows a lower inventory to cover the same fleet size, reducing complexity for Airbus operators' fleets and maintenance customers
  - The resulting budget savings allow re-investment in greater regional availability worldwide
- Inventory reduction due to reduced number of standards:
  - Focussing on full inter-changeability will allow Airbus to ensure the optimum progression of its product developments, whilst retaining simplicity and clarity of required spare parts thus driving operational efficiency and excellence.

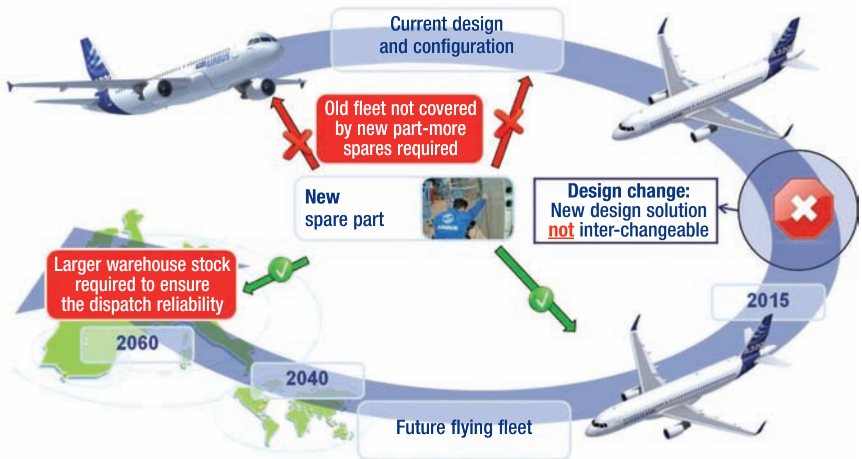
Airbus Material and Logistics Engineering team is not just looking at the technical performance of the part, but is applying a particular focus on the inter-changeability (ICY) and maintainability of the part. This is to secure lead times and the future AOG (Aircraft-On-Ground) performances and will allow Airbus to apply the lessons learnt from current projects to all future programmes. The long term impact of non inter-changeability (when design changes are carried out and the new solution is not interchangeable with the old solution) is that the pre-mod fleet cannot be provisioned with post-mod spares. This can lead to challenges throughout the aircraft lifecycle as the pre-mod spares must continue to be produced and stocked by customers, suppliers and Airbus (figure 3).

Material and Logistics Engineering solution

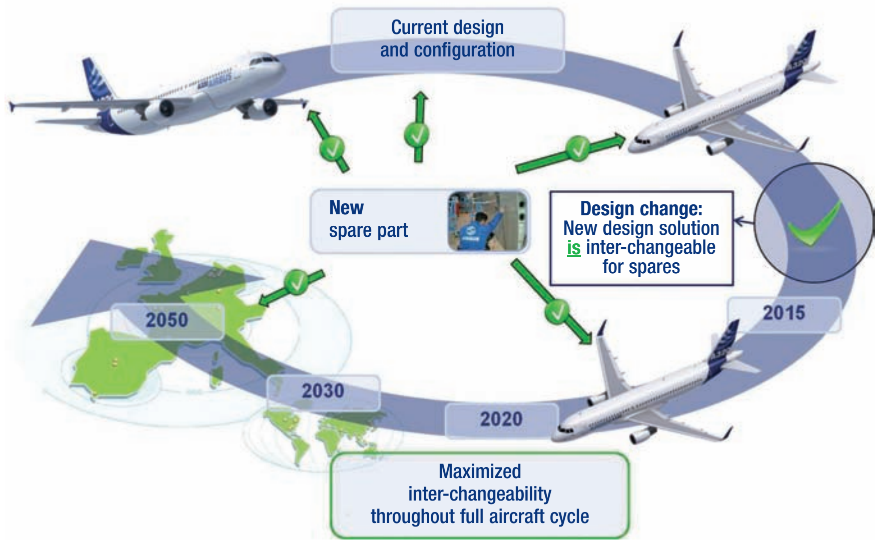
We initiate and facilitate the creation of new engineering solutions by working together with system specialists, allowing product developments to be inter-changeable, without compromising their technical excellence.

Spare parts engineering without inter-changeability

Figure 3



Spare parts engineering with inter-changeability



Future activities: Technical stock optimisation services

The processes Airbus is currently developing to optimize its warehouses, will show benefits in terms of tailoring service goals, enhanced regional availability and operational flexibility. Airbus intends to allow applications also to customers' spares warehouses. Looking towards the future, Airbus will be able to provide a technically orientated warehouse optimisation service, based on in-depth analysis with an initial focus on large, complex and high value parts. These are analysed based on consumption (essentiality), depreciation and risk, allowing a rigorous and firm decision process to identify candidates for elimination.

This will extend the scope of Airbus' current inventory consulting services, moving it to the next level of service excellence and will include the following:

- Inventory optimisation recommendations
- Special offers
- How to attract buyers
- When to scrap parts
- When does it make sense to modify/upgrade parts.

How to access the support?

Airbus Material and Logistics Engineering team's principle objective is to ensure that efforts are focussed on the parts which affect its customers the most, in terms of technical warehouse optimisation, inter-changeability and material planning. Airbus is available to cater to your material and logistics aftermarket requirements.

notes

In the frame of Airbus consulting services, Airbus offers two services addressing material and logistics' optimisation:

- Inventory review:
  - Optimisation of inventory levels,
  - Analysis of distribution of spares within the flight network
  - Support of preparation for fleet increase.
- Process efficiency review based on lean principles:
  - Increase of process efficiency and output
  - Identification and elimination of waste.

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Conclusion

The Material and Logistics Engineering team is building up knowledge and experience to support its customers in the resolution of material and logistics issues relating to the design of spare parts. Airbus is aiming to build closer links with its customers to focus on the parts which have the greatest cost impacts on its customers.

The Material and Logistics Engineering team is the focal point within Airbus for issues relating to the design of spare parts, specifically for logistics, aftermarket efficiency, mixability and inter-changeability which includes spare part definition and spare part design.

AIRBUS

Electric wire installations...

This picture - which can easily remind you that it's close to lunch time and that you're starving for a delicious plate of spaghetti after having read the FAST magazine - shows not less than the kilometres of electrical wire installed on aircraft.
This particular photo was taken during the Concorde's first electrical cables' dismantlement in April 1976.
No doubt that the use of the optical fibre technology (article page 14) will help reduce the amount of tangled cables on future aircraft.

... to fibre

Concorde is a turbojet-powered supersonic passenger airliner and first flown in 1969. It entered into service in 1976 and continued commercial flights for 27 years. Twenty aircraft have been built. Concorde was the first airliner to have a Fly-By-Wire Flight Control system. Its avionics were unique because it was the first commercial aircraft to employ hybrid circuits. Concorde's maximum cruising altitude was of 60,000 feet (18,000 m), subsonic airliners typically cruising below 40,000 feet (12,000 m).

Concorde is easily recognizable with its drooping nose which was a compromise between the need for a streamlined design to reduce drag and increase aerodynamic efficiency in flight, and the need for the pilot to see properly during taxi, take-off and landing operations.

This magnificent aircraft was manufactured by the former Aerospatiale and British Aircraft Corporation companies.
In French, the common noun 'concorde' means "agreement, harmony, or peace".

Photos courtesy of Airbus Flight Test Photo Lab

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Airbus operates 24 hours a day every day.

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RCSM location	Country
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Algiers	*Algeria*
Almaty	*Kazakhstan*
Amman	*Jordan*
Amsterdam	*Netherlands*
Astana	*Kazakhstan*
Athens	*Greece*
Atlanta	*United States of America*
Auckland	*New Zealand*
Bangkok	*Thailand*
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Kuala Lumpur	*Malaysia*
Kuwait City	*Kuwait*
Lagos	*Nigeria*
Lima	*Peru*
Lisbon	*Portugal*
London	*United Kingdom*

RCSM location	Country
Los Angeles	*United States of America*
Louisville	*United States of America*
Luton	*United Kingdom*
Luxembourg	*Luxembourg*
Madrid	*Spain*
Manama	*Bahrain*
Manchester	*United Kingdom*
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