DECEMBER 2006

FLIGHT

AIRWORTHINESS

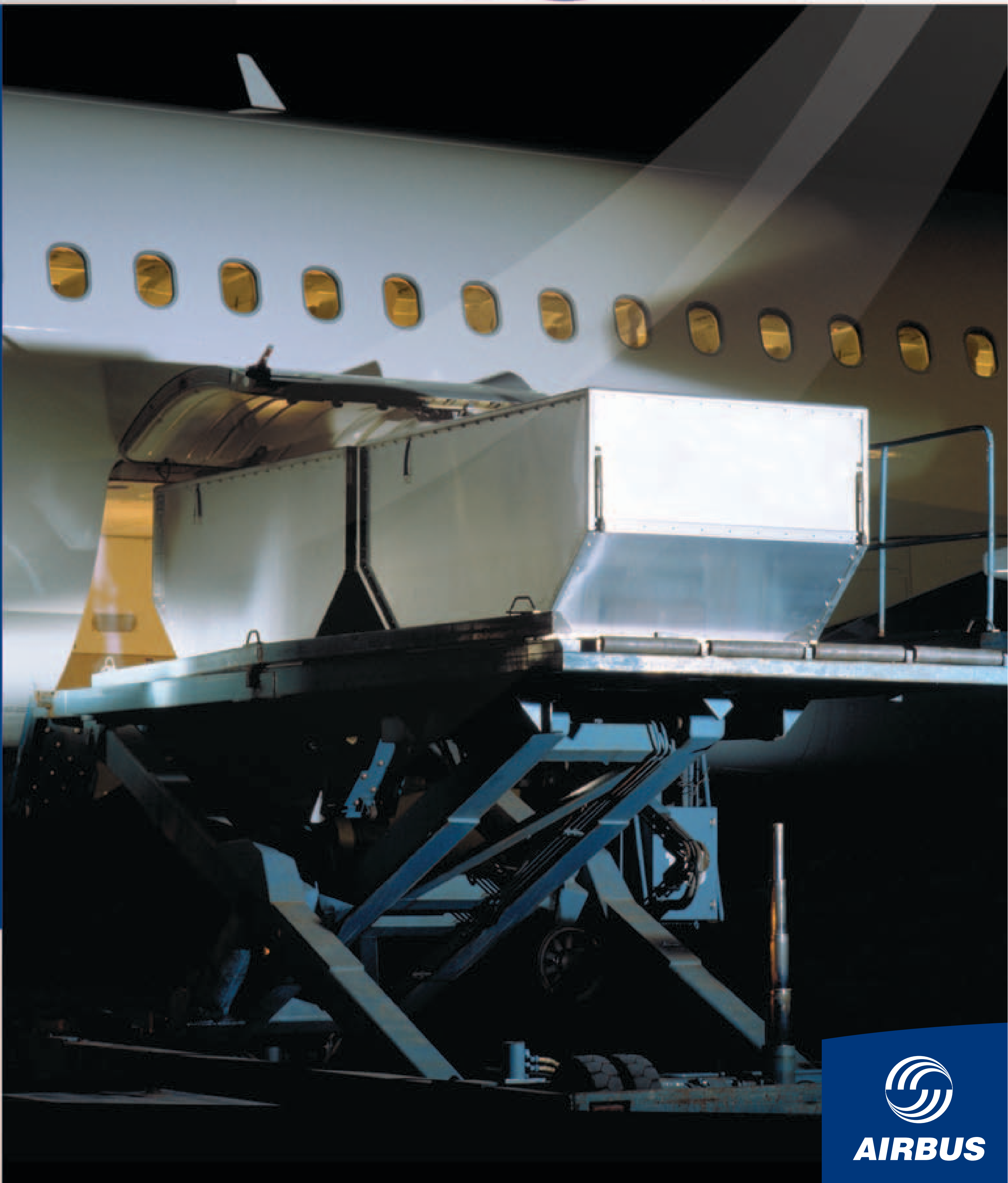
SUPPORT

TECHNOLOGY

# FAST 39

AIRBUS TECHNICAL MAGAZINE

FAST 39



AIRBUS

# Customer Services
## events

## Just happened

### HUMAN FACTORS SYMPOSIUM MOSCOW, RUSSIA 14-16 JUNE

The 22nd Human Factors Symposium took place with the theme of: 'Human Factors as a core value at Airbus'. The symposium encompassed HF strategy, HF training, operations and threat, error management in flight operations, ATC and maintenance. Particular importance was given to the Human Factors Toolkit Project, which is intended to reconcile Human Factors theory with operational guidance.
The event was sponsored by ICAO and IAC (Interstate Aviation Committee) of the CIS (Commonwealth of Independent States).

### TRAINING SYMPOSIUM SAN FRANCISCO, USA 2-5 OCTOBER 2006

The 8th Training Symposium was an arena not only to present continuing improvements in the training processes, but also to listen to the customers views on existing systems and thoughts on future solutions. Four separate conference streams covered pilot training, cabin crew training, maintenance training and simulation & training technologies. These complemented an exhibition featuring the latest developments in these fields. Inspired by the background of the Golden Gate, speakers introduced the theme of bridges to link the elements of the conference and strongly emphasized the necessity of building links between the three essential elements of the training model – good instructors, good programmes and good training media as well as the other critical bridge between the instructor and trainee.
The event brought together 81 airlines, 9 MROs, 5 authorities and suppliers from around the world.

## Coming soon

### SPARES, SUPPLIERS & WARRANTY SYMPOSIUM BANGKOK, THAILAND 12-14 MARCH 2007

This will be the 3rd regional Spares, Suppliers and Warranty Symposium. Following the success of the previous symposia in Hainan and Athens, this regional symposium for the Middle East, Asian and Pacific regions will present progress made from the previous symposia and provide the latest news concerning current initiatives in all three areas.
The symposium will be an opportunity for customers in these regions to exchange and express views concerning their daily practice and experiences, with the continual aim from Airbus and suppliers to assist in reducing operating costs. Speakers from Airbus and suppliers will both be present and available to discuss spares, supplier and warranty related topics.
On-line sessions and workshops are planned for an interactive and dynamic exchange of information at the end of the symposium.

### A320 FAMILY SYMPOSIUM BANGKOK, THAILAND 07-11 APRIL 2007

Airbus will propose a basic agenda that will be merged with customer suggestions, concentrating on major concerns that will likely be based on FAIR (Forum for Airline Issues Resolution) inputs. It is planned to cover all presentations in the main session. As usual, adequate facilities will be available for side meetings.
The formal invitation letters as well as the preliminary agenda will be sent no later than February 2007.

### 15TH PERFORMANCE & OPERATIONS CONFERENCE PUERTO-VALLARTA, MEXICO 23-27 APRIL 2007

As for every two years since 1980, the 15th Performance and Operations Conference will take place in Puerto-Vallarta. Flight crews, operations specialists, flight operations engineers, and performance specialists from all Airbus operators are invited to attend and actively participate in this event, which will offer numerous opportunities to constructively exchange views and information, and increase mutual cooperation and communication. The conference will address many operational topics covering all Airbus aircraft models in various sessions such as Looking Ahead, CNS/ATM (Communication, Navigation, Surveillance/Air Traffic Management), Flight Economics, e-Documentation, Operations, Performance, Electronic Flight Bag…
Invitations for the conference will be sent soon.

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PERFORMANCE MONITORING OF IFE SYSTEMS - AIRBUS VISION

# Performance monitoring of In-Flight Entertainment systems

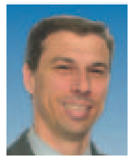
## Airbus vision

In the last issue of FAST Magazine 38, July 2006, Emirates made two valuable proposals aimed at improving In-Flight Entertainment (IFE) performance monitoring for the future.

One proposal is based on the use of the Aircraft Condition Monitoring System (ACMS) and the other is more based on an IFE built-in solution.

Both solutions would involve transmission of data to the ground.

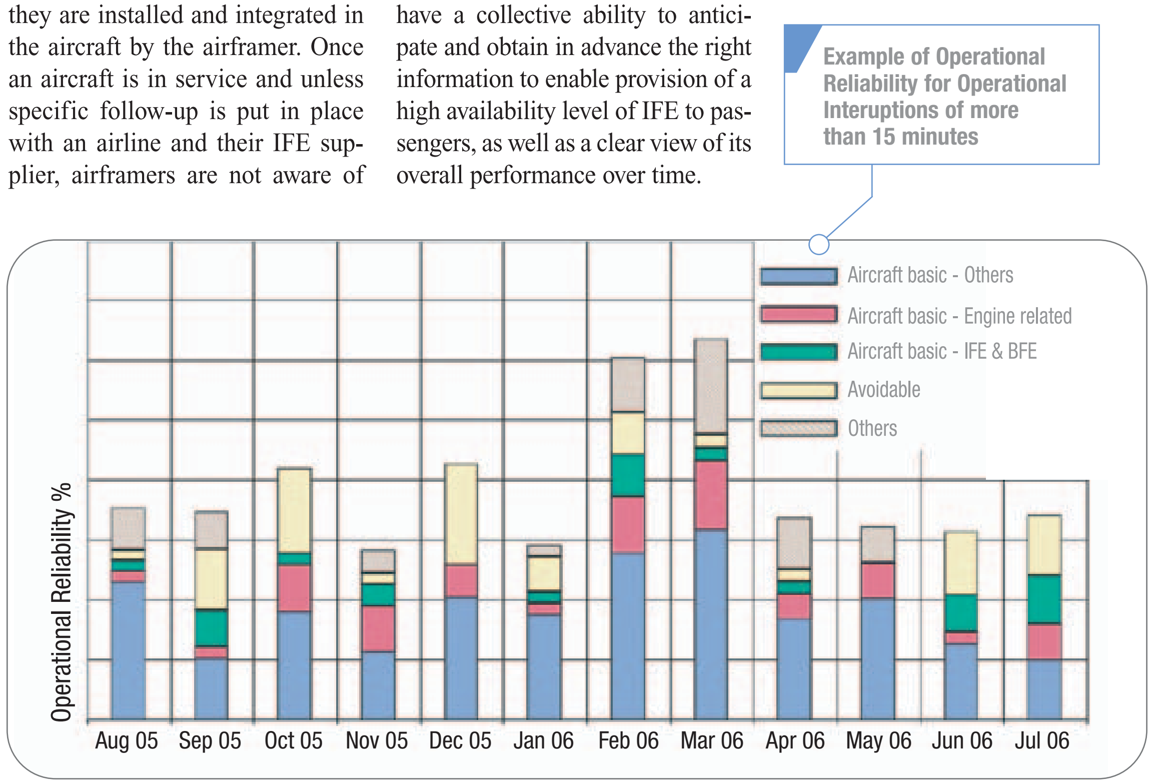
As promised in our last issue of FAST Magazine, we propose you to share with you in more detail Airbus vision for the future for IFE systems trend monitoring and enhanced maintenance processes.

**Marc Virilli**
Senior Director Cabin and Cargo Systems
Airbus Customer Services

**Joerg Reitmann**
Vice President and Executive
Expert Cabin Complete Systems
Head of GAHMM Architectures
Airbus Engineering


The rational behind Emirates proposal is the current difficulty to obtain easily and rapidly a clear and actual picture of how IFE performs during daily operation. The situation as perceived from an airframer standpoint, is quite similar. Although IFE systems are BFE (Buyer Furnished Equipment), they are installed and integrated in the aircraft by the airframer. Once an aircraft is in service and unless specific follow-up is put in place with an airline and their IFE supplier, airframers are not aware of who's job is to operate a complex system, the impact of a given failure at seat level has a more critical effect. Although IFE systems are not dispatch critical from an airline's MEL (Minimum Equipment List) standpoint, they are dispatch critical from a commercial point of view. For this reason it is essential to have a collective ability to anticipate and obtain in advance the right information to enable provision of a high availability level of IFE to passengers, as well as a clear view of its overall performance over time.




how IFE behaves until a customer complains, or until the level of Operational Interruption (OI) reaches a level where it impacts aircraft operational reliability (see illustration above). This also applies to other cabin BFE items such as seats and galleys.

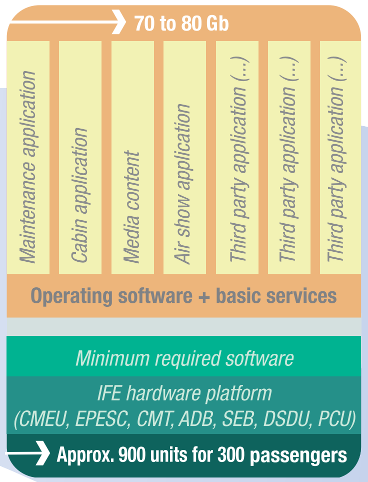
In most cases IFE system performance perception is based on a few high visibility events which are not representative of the overall level of performance of the system (but still need to be taken into account and addressed), or on seat availability figures produced by IFE suppliers which depend on each individual contract signed with each airline.

Because IFE systems are utilized by final users who have paid for a service and not only by people

## Monitoring IFE health today

As rightly mentioned by Emirates, monitoring the health of an IFE system today consists of providing accurate information in real time on what is going wrong between 2,000 interconnected LRUs (Line Replaceable Units) and several layers of software including data transportation, operating systems, Graphical User Interfaces (GUIs), third party applications, etc.

Several of these, both hardware and software, come from the consumer market and are off-the-shelf elements. In other words - not specifically adapted to the typical requirements of the aeronautical world, as you may see on the illustration on the right.



## WHAT IS AVAILABLE FOR IFE MONITORING TODAY?

*One of the tools existing today to monitor the health of the IFE system is Built-In Test Equipment (BITE) plus the use of a Central Maintenance System (CMS) or a Cabin Management Terminal (CMT).*


(*) AIRMAN™ (AIRcraft Maintenance ANalysis) developed by Airbus is a tool for data analysis. Its objective is to help airline maintenance departments to anticipate unscheduled maintenance events and to take decisions in the frame of troubleshooting. Refer to FAST Magazine 29, December 2001, for a description of an early version of AIRMAN™.

In recent years Airbus has started to adapt the monitoring techniques and algorithms used for the rest of the aircraft's electronics systems to the IFE. The concept is certainly right, indicating to an airline mechanic which LRU to remove, or which portion of wiring to trouble shoot is a praiseworthy objective, but very difficult to achieve for an IFE system.

BITE in general is a very good tool to monitor hardware failure - there is no doubt about this. However, as mentioned earlier, an IFE system is built partly from off-the-shelf parts (which are not designed to be necessarily deeply monitored as expected in the avionics world) and a very high amount of software developed by various different sources, before being integrated in an open platform.

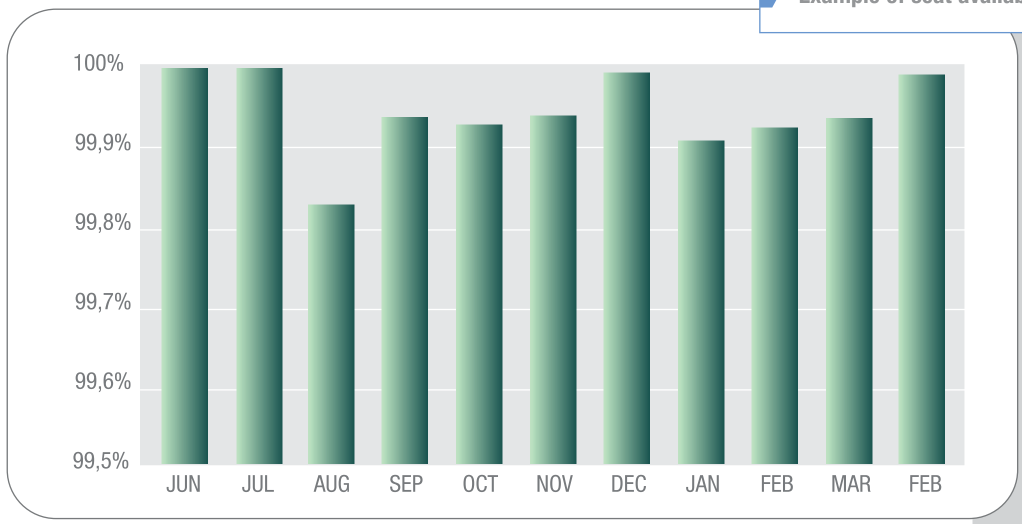
The result observed today is either incomplete and/or inaccurate BITE data given to mechanics, or obscure information that requires specific skills to be interpreted before it leads to the right action on the aircraft. Although not perfect, this is what is available today and a huge amount of work is done by the IFE suppliers and the airframer to improve as much as possible the reliability and accuracy of this data.

Once this information is available, the Aircraft Communication, Addressing and Reporting System (ACARS) network allows easy transmission to the ground where tools such as AIRMAN™ (*) can use it to enable preparation of maintenance actions to return faulty systems to normal operation in anticipation of the aircraft actually landing. AIRMAN™ fully applies to IFE, which from this perspective is an aircraft electronic system amongst others. The limits explained previously and the fact that BITE information will not be representative of the actual system behaviour as perceived by the passenger, makes it difficult to use as the right or sole source of data to determine the IFE system performance level.

*A second tool to monitor the health of an IFE system is the seat availability data produced by IFE suppliers.*

The limits here are the consistency of the raw data used from one customer to another, and that an IFE supplier is more interested in measuring system behaviour against a specification rather than against the satisfaction of the final user. Final user dissatisfaction could also come from issues like brightness, user friendliness, response time, temporary interruption of service, disturbance, noise, video quality, rest time, type of material used, number of resets done by cabin crew during a flight and so on, all of which are not captured by seat availability. As a matter of fact, seat availability figures are regularly quite high, but customer satisfaction at the end does not necessarily correspond with these figures.

Example of seat availability graph




Seat availability figures (see illustration above) must be balanced with the actual service to the passenger; typically a noisy audio channel will not necessarily be counted as a non-available seat, but will be reported as a nuisance by the customer. Similarly, slow response times can be noticed by passengers (reported or not to the crew), but the causes may not automatically be detected by the IFE system.

*Finally, a third tool at our disposal to monitor the health of an IFE system is reliability and DMC (Direct Maintenance Cost) data.*

The reliability of IFE LRUs is measured as for any other avionic system (Mean Time Between Unscheduled Removals, Mean Time Between Failures, No Fault Found percentage... figures), but this measurement is not available on a regular basis for all part numbers, making it difficult to consolidate an IFE reliability indicator for the system or sub-systems of it.

Furthermore, the specificity of IFE is the number of equipments of different nature, which are highly software driven and some of which interact directly with passengers. Reliability analysis as done for avionics is consequently less relevant, as it is more related to LRU hardware failure, rather than software anomaly or passenger misuse or misunderstanding.

As far as DMC is concerned, its computation considers only maintenance off-aircraft (shop activities: Repairs, test costs, spares prices, etc.). All work performed during line maintenance and all consumable usage is not measured. This also contributes to the poor pertinence of such an indicator for IFE systems.

# IFE health monitoring - One step forward

If an achievement needed is a real time view of the IFE system performance as perceived by its final users (cabin crew and passengers), as well as trend monitoring of this performance over time to be able to quantify the impact of system improvements and/or evolution, one solution is to use the cabin logbook as a prime source.

This type of exercise (paper cabin logbook analysis) is usually done in the scenario described by Emirates (case by case survey upon request). It has been done at Airbus for a few entries into service, but is a very time consuming exercise, requiring a lot of interpretation of write-ups (inaccurate write-ups or different wording for the same failure) and needing full cabin crew cooperation for entry of each event and proactive monitoring of passenger usage of the system.

Thanks to the latest developments of on-board open platforms and possible hosted applications, the cabin e-logbook products give the possibility to receive standardized logbook write-ups recorded in an electronic format. This provides opportunities to receive more accurate feedback from passengers and cabin crew (closer to their in-flight experience), even if it is probable that not all events experienced with IFE will be captured. This point could be addressed in the future by providing passengers a light logbook-like interface to directly input their perception of the system behaviour for a given flight on their personal screen (See illustrations on the previous page).

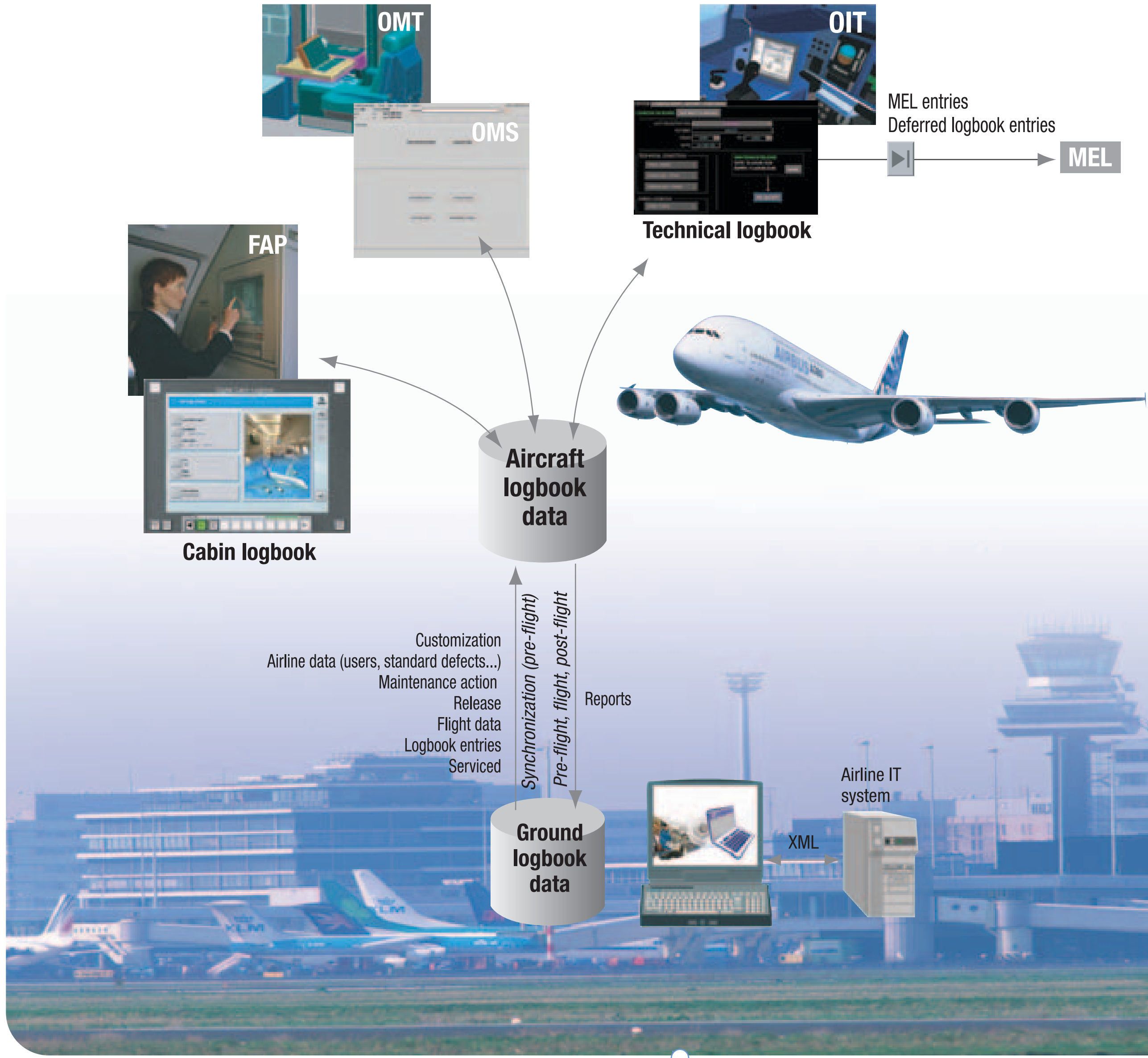
Thanks to the user friendliness of personal computer based applications, capturing a cabin event efficiently and consistently across all cabin crews becomes much easier than today. Consequently, analysis of a 'standard defect' is also much easier to model to produce indicators of how a given function/system behaves over time. This was prototyped as an IFE Maturity Tool (IMT) during A380 development.

As explained previously, IMT is based on use of the electronic cabin logbook using standard cabin defects to ease cabin crew entries and consequently encourage capture of every IFE related event in the cabin (this is already in place with the dedicated IFE paper logbook used by some Airbus customers). These cabin events can then be transmitted to the ground and compared with the exact aircraft cabin configuration and level of service proposed to all passengers to deduce the IFE performance perceived by passengers and cabin crew for a given flight.

Airbus e-logbook snapshots








Logical schematic of IFE tool

**OMT**: On-board Maintenance Terminal
**OMS**: On-board Maintenance System
**FAP**: Flight Attendant Panel
**OIT**: On-board Information Terminal
**MEL**: Minimum Equipment List

| IFE failure vs impact on services matrix | Music | Video | ... | Connectivity |
|---|---|---|---|---|
| IFE audio failure | 0 | 0 | ... | 1 |
| ... | ... | ... | ... | ... |
| IFE RJ45 audio failure | 1 | 1 | ... | 0 |
| ... | ... | ... | ... | ... |
| IFE seat reset | 0.5 | 0.5 | ... | 0 |
| ... | ... | ... | ... | ... |
| IFE failure Z | 0 | 0 | ... | 0 |

Example of IFE audio failure at seat 10B (B/C class)

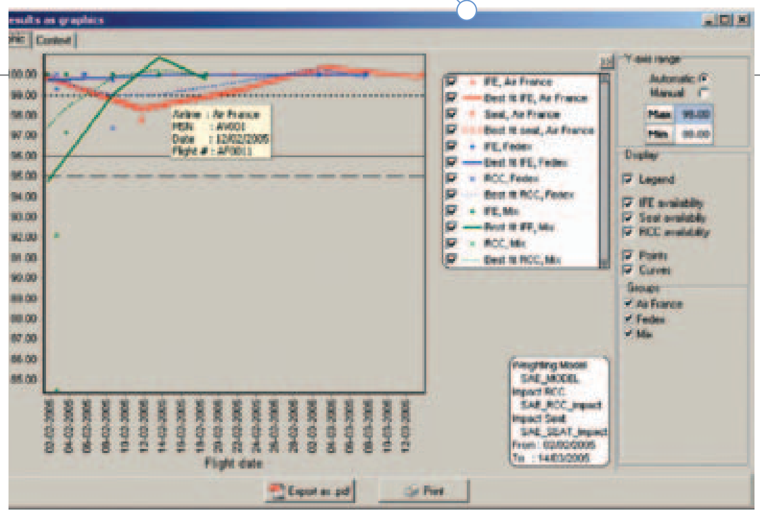
| Seat configuration matrix: Seat/Services | Music | Video | ... | Connectivity |
|---|---|---|---|---|
| Seat 1A | 1 | 1 | ... | 1 |
| ... | ... | ... | ... | ... |
| Seat 10B | 1 | 1 | ... | 1 |
| ... | ... | ... | ... | ... |
| Seat 80F | 1 | 1 | ... | 0 |

| Seat availability matrix: Seat/Services | Music | Video | ... | Connectivity |
|---|---|---|---|---|
| Seat 1A | 15 | 30 | ... | 3 |
| ... | ... | ... | ... | ... |
| Seat 10B | 0 | 0 | ... | 2 |
| ... | ... | ... | ... | ... |
| Seat 80F | 5 | 10 | ... | 0 |

Different types of weighting factors can also be applied depending on seat class, type of service, impact on service, etc. to balance the IFE availability calculation.

IMT also allows comparison of performance between two different IFE systems, two given aircraft serial numbers (MSNs), two given airlines, or two given aircraft types. This gives a powerful tool for IFE trend monitoring and quantification of benefits brought by system evolution. As a further step, future extension of the tool to seats, galleys, etc would provide cabin trend monitoring.

IFE trend monitoring graph



In addition to trend monitoring, which would be the only one valid for performance at a given airline and for a given system, IMT allows microanalysis of each event contributing to a given degradation thanks to the history of all logbook data or information in the database with associated detailed information (test results, removal/installation data, etc.).

## The future of IFE health monitoring and management

As described in the previous section of this article, IFE usage and performance data recording is necessary for the monitoring and management of complex network systems like IFE. Focusing only on LRU failures and corresponding indicators does not provide adequate performance results. To succeed, all the actors involved need to work together and share data available at airlines, Airbus and suppliers. One consolidated/harmonized database with different user access rights to different data subsets is an attractive solution.

This approach is part of a broader programme at Airbus that aims at enhancing aircraft availability with world-class solutions and reducing maintenance costs. This programme called GAHMM (Global Aircraft Health Monitoring & Management) is addressing the whole aircraft and includes the vision of four particular steps for the IFE.



### STEP 1
### CONSOLIDATION OF AIRCRAFT DATA

Building upon the work which has already started, the tools which are currently available or about to be available (see IMT page 7) and depending on the reliability of raw source data and actual usage of e-logbook, the next step is probably consolidating/complementing the e-logbook information with data gathered by the OMS (On-board Maintenance System), IFE BITE and/or IFE data collected through ACMS (Aircraft Condition Monitoring System) as suggested by Emirates.

### STEP 2
### CONSOLIDATION OF GROUND DATABASES

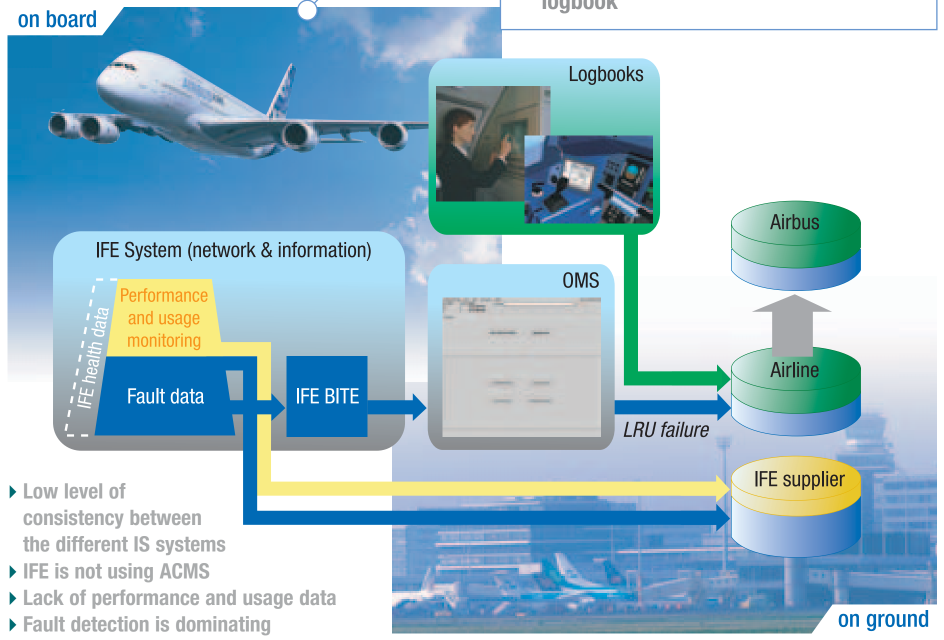
The IFE suppliers have developed databases in past years to gather performance indications for their systems to define areas for improvement and also to give a certain visibility to their customers about the in-service behaviour of their IFE (the limitations of this were highlighted previously).

The airlines have in-house a lot of information about parts removed, time spent on aircraft, recurrent actions conducted, logbook complaints and corresponding actions, commercial critical item list, etc. The airlines are also the first node of the network when data is retrieved from the aircraft (automatically or manually).

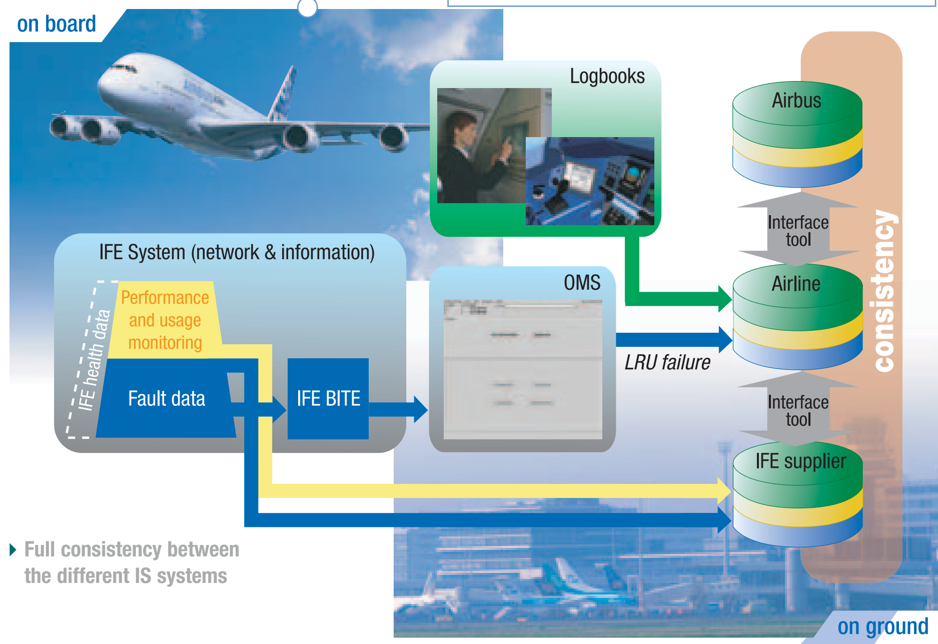
Finally, the airframer also gathers data for aircraft performance monitoring, for maintenance anticipation through AIRMAN™, e-logbook information will soon become available, etc.

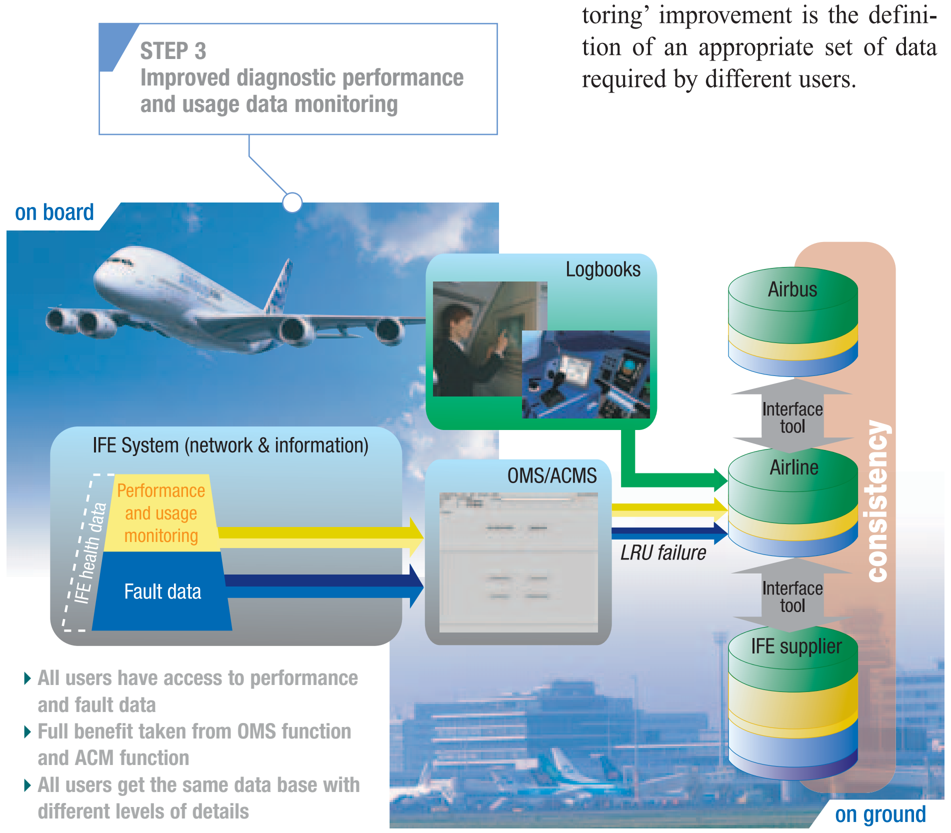
This current fragmented process leads to a situation where all this information is sometimes redundant and stored twice or more, sometimes not shared, sometimes not used, sometimes not useful,… There is a real need to converge towards a rationalized data distribution amongst the actors (complementary databases) with an interface tool that would allow each to extract the most benefit from the data available, whether it is stored within the airline, supplier or Airbus.

STEP 1
Consolidation of OMS BITE reports with logbook




STEP 2
Consolidation of various existing data bases






### STEP 3
### DETERMINING PERTINENT DATA

The corner stone of 'diagnostic performance and usage data monitoring' improvement is the definition of an appropriate set of data required by different users.

As described previously in this article and highlighted by Emirates, an IFE system is a network system which is highly software driven. Optimizing IFE performance demands that pertinent data, giving performance indications of hardware, network and software is available. The monitoring implemented must be adapted to the technology used, and the resulting information available to the appropriate population with the right level of detail.

The OMS and ACMS can be used complementarily to achieve this objective, as used for the engines, and as also suggested by Emirates.

These are the key requirements:

- To prepare the right maintenance action in anticipation of aircraft landing
- To minimize the time spent on aircraft to rectify a default
- To monitor IFE system performance over time
- To get a fast time-to-get-a-fix
- To define system improvements for the longer term



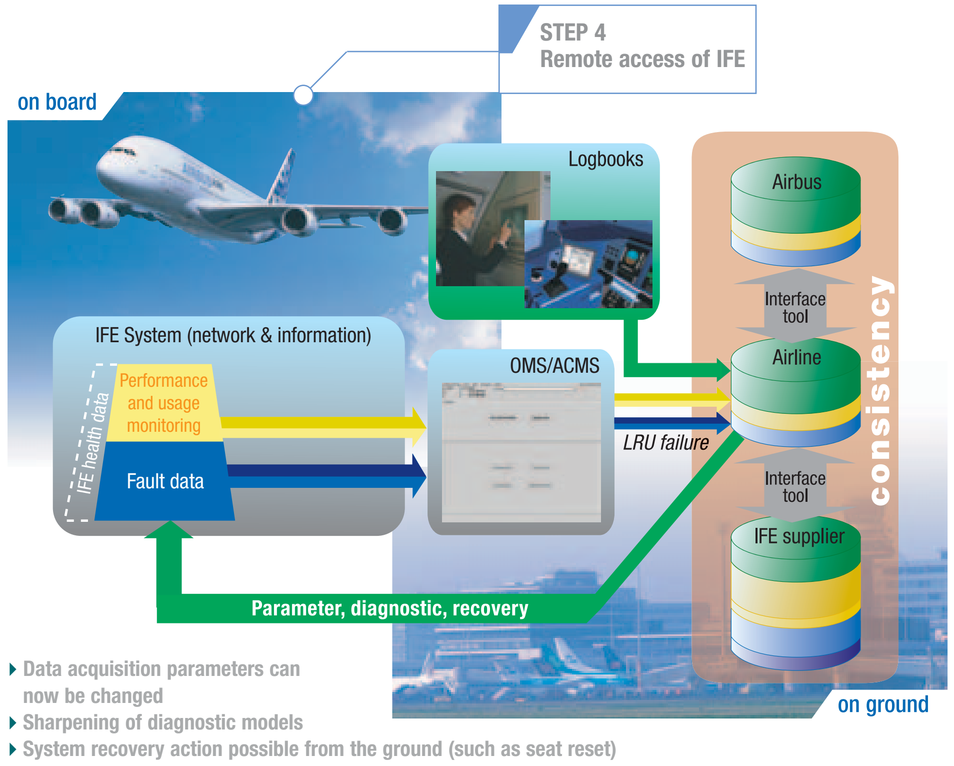


### STEP 4
### REMOTE IFE MAINTENANCE

The previous steps set the conditions necessary for good IFE heath monitoring in the future, but going further in this domain certainly means better usage of remote access techniques.

Preparing work in advance for an LRU change will save time. Better visibility can be offered to an airline, the IFE suppliers and the airframer by providing the right data through appropriate ground monitoring tools.

The same tools can gather information to steer new developments, but improvements can also be obtained by performing a number of tasks in a remote way, as done for the maintenance of desktop personal computers, for example adjustment monitoring parameters, remote seat reset, remote memory dump and remote software update.

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## Conclusion

Airbus shares the diagnostic made by Emirates - room for improvement exists in IFE performance monitoring. A first set of bricks exists today, such as BITE, AIRMAN™ and e-Logbook that can be used to automatically produce data to allow more precise monitoring of IFE performance, but in all cases the key point is completeness and reliability of the raw information.

Emirates have provided their view for a path to improvement that could be taken into account in current work.

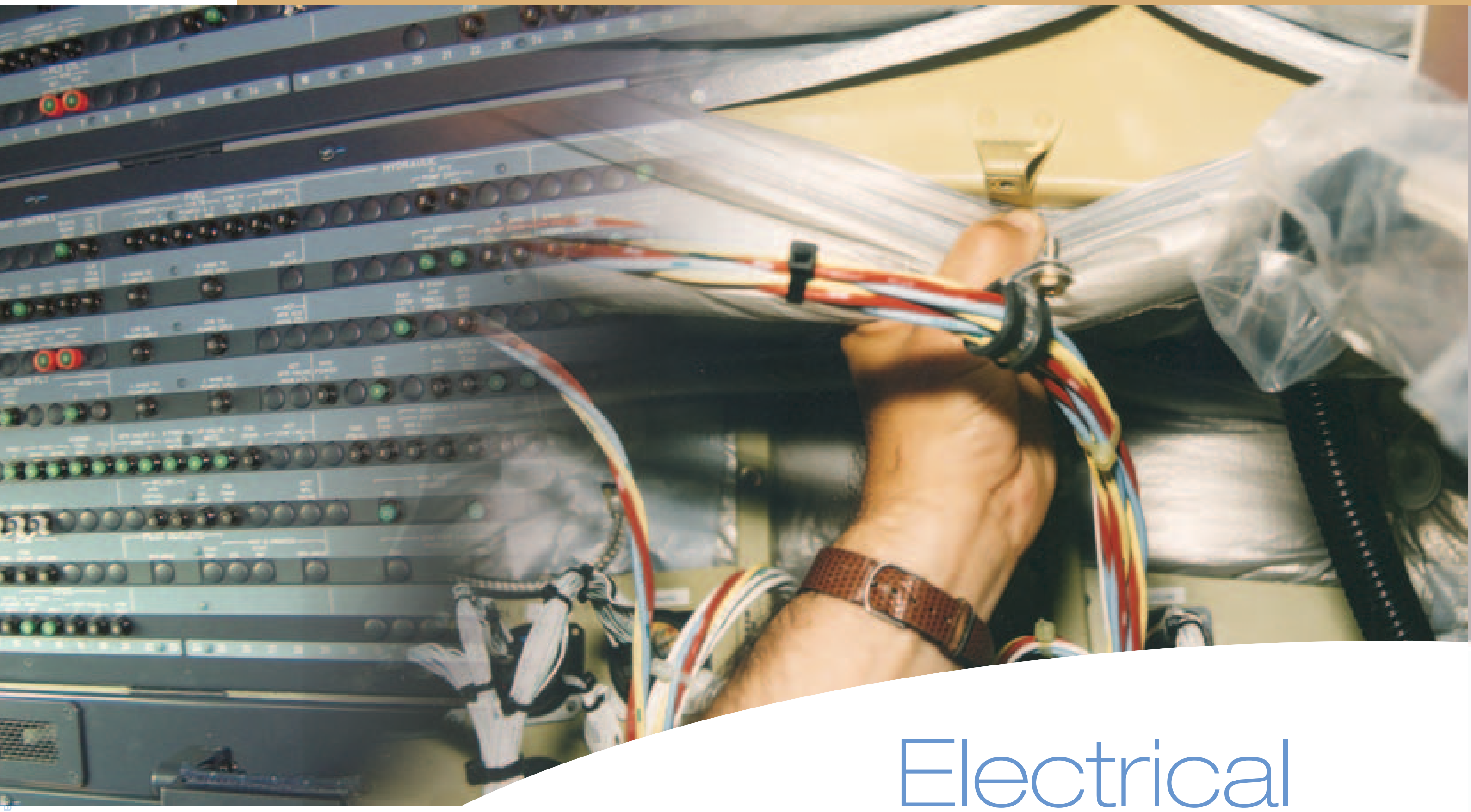
Activities are underway at Airbus to assess which data is required for IFE maintenance, which is required for engineering product improvement and which is required for trend monitoring. How can it be ensured this data is accurate and available, how can it be shared between IFE suppliers, airframers and airlines, who is responsible for this data and similar issues are being addressed.

A communication path to transmit this information to the ground and a ground tool to process it will easily be defined, but again pertinence of the raw data will be the key.

Airbus cannot unilaterally define requirements for the other actors on this subject, and therefore the GAHMM programme will be used as a vector for a collaborative approach with airlines and suppliers to specify joint requirements for future IFE system monitoring.

AIRBUS

ELECTRICAL LOAD ANALYSIS - MAINTAINING THE ELECTRICAL LOAD INTEGRITY OF YOUR AIRCRAFT



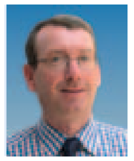
# Electrical Load Analysis

## Maintaining the electrical load integrity of your aircraft

The Electrical Load Analysis (ELA) reflects the electrical load data status at the time of aircraft delivery. It gives details of the electrical loads on each of the individual electrical busbars. For the aircraft delivered previously, it was only supplied as a paper manual with no post delivery revisions. This data formed the basis for operators to calculate and maintain a record of all changes to the aircraft electrical loads subsequent to any modification of the aircraft systems, throughout the operational life of the aircraft.

Airbus has now developed a new enhanced ELA that ensures operators can make full use of the electrical load data, while at the same time, maintain and record any changes to the electrical loads for each aircraft due to any post delivery modifications. An accurate ELA can then be produced and maintained for monitoring by the local airworthiness authorities.

An important additional evolution is that previously operators received an ELA that represented the first of each aircraft version delivered, but since March 2005, Airbus now supplies an ELA for each aircraft delivered. The ELA covers all Airbus aircraft types except the A300 B2/B4.

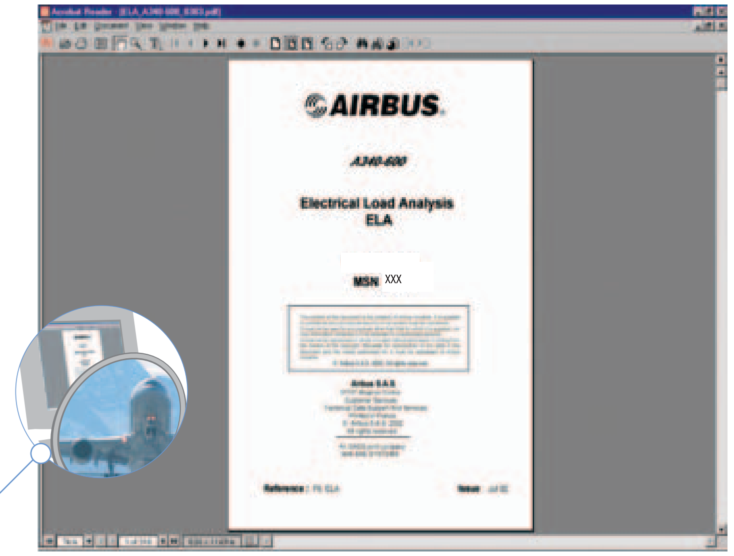


**Régis Barneron**
ELA Product Manager
Technical Data Support & Services
Airbus Customer Services


## Electrical load data in three different formats

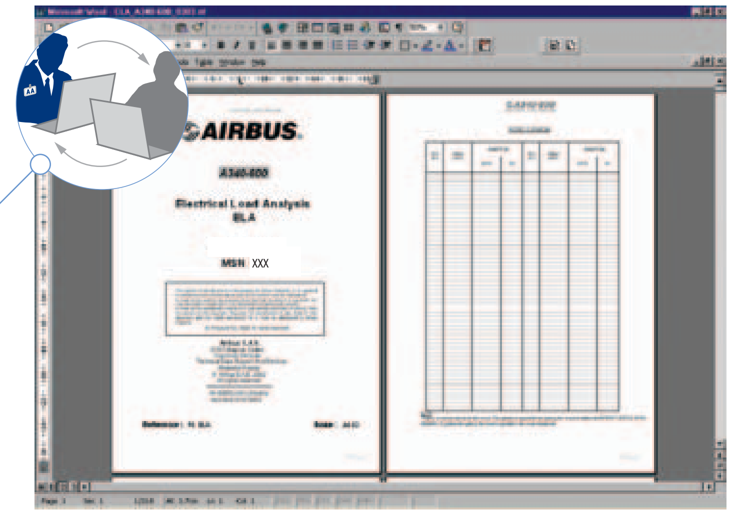
### Microsoft ExcelTM file

This file contains only the electrical load data (without the table of contents, introduction, or total loads). *Using Excel™ standard functions, operators can use this file to compute the electrical load data within the worksheet table.* Additionally, using the Excel™ filter tool eases the data selection and retrieval process.




### PDFTM file format

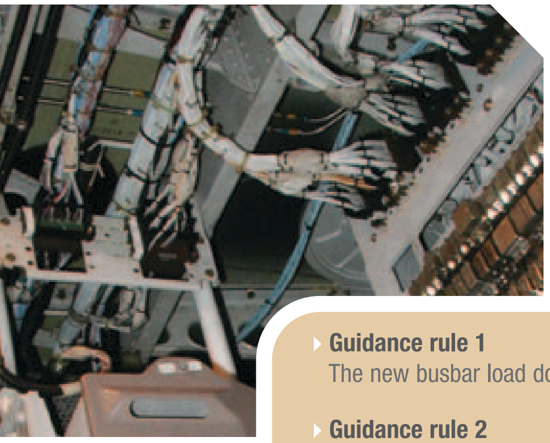
This file represents the master record of the aircraft electrical loads status at aircraft delivery. *This file is non-modifiable.*




### The complete ELA in a Rich Text Format (RTF)

*This file can be modified by operators.* This gives operators the opportunity to update and maintain a current version of the ELA. This version of the ELA can be made available to local authorities if required.

ELECTRICAL LOAD ANALYSIS - MAINTAINING THE ELECTRICAL LOAD INTEGRITY OF YOUR AIRCRAFT

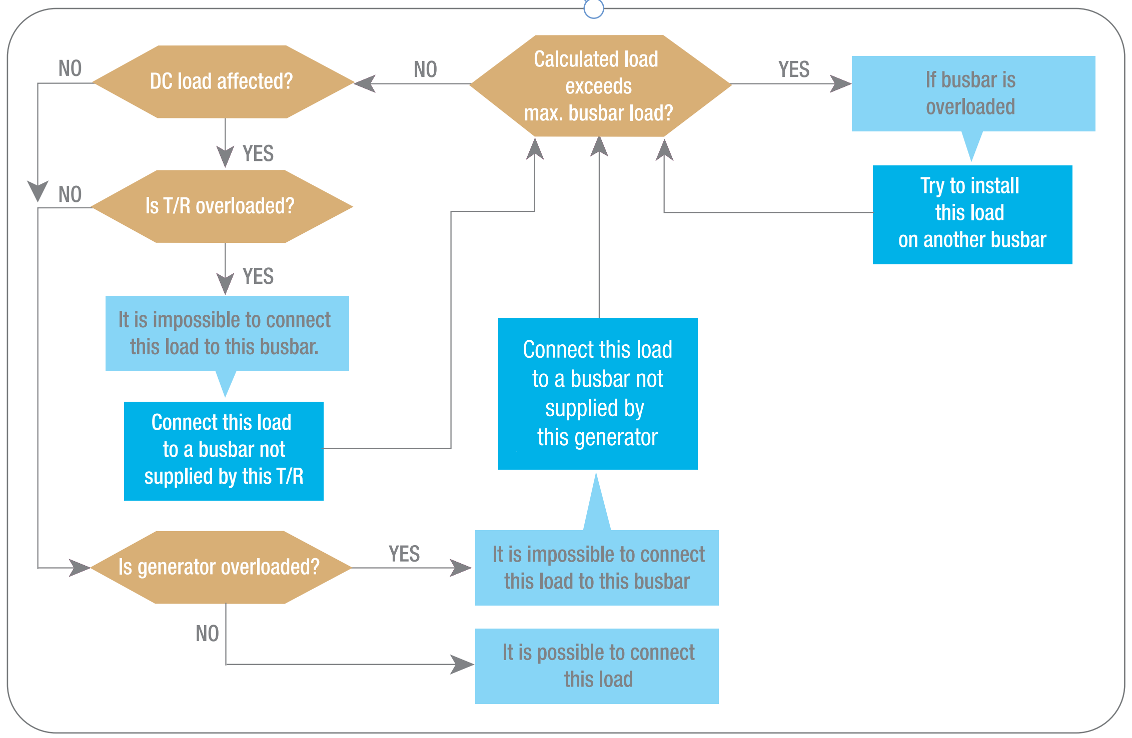


## Electrical load changes following an aircraft modification

Using the design assumptions shown in paragraph 7 of the ELA introduction to compute the electrical load changes due to aircraft modification, an operator can modify an aircraft by means of an Engineering Order. To do this the ***nominal power***, the ***maximum value*** and the ***operational value*** for each flight phase must be determined (if the actual operational values cannot be determined then the maximum load values should be used). These changes to the electrical loads must be analysed to ensure and maintain the electrical load integrity of the aircraft electrical distribution system in accordance with the following four guidance rules:

- **Guidance rule 1**
  The new busbar load does not exceed the maximum authorized load
- **Guidance rule 2**
  The new total busbar load (permanent + intermittent) must not exceed the busbar Circuit Breaker (C/B) trip time. (The C/B trip times are compatible with the modified electrical circuit)
- **Guidance rule 3**
  The new total loads do not exceed the Transformer Rectifier (T/R) nominal value (e.g. for the A340 this is 5,600 watts)
- **Guidance rule 4**
  The generator loads do not exceed the generator nominal power (for the A340 this is 75KVA)

Decision tree
Checks to be made before installing a load

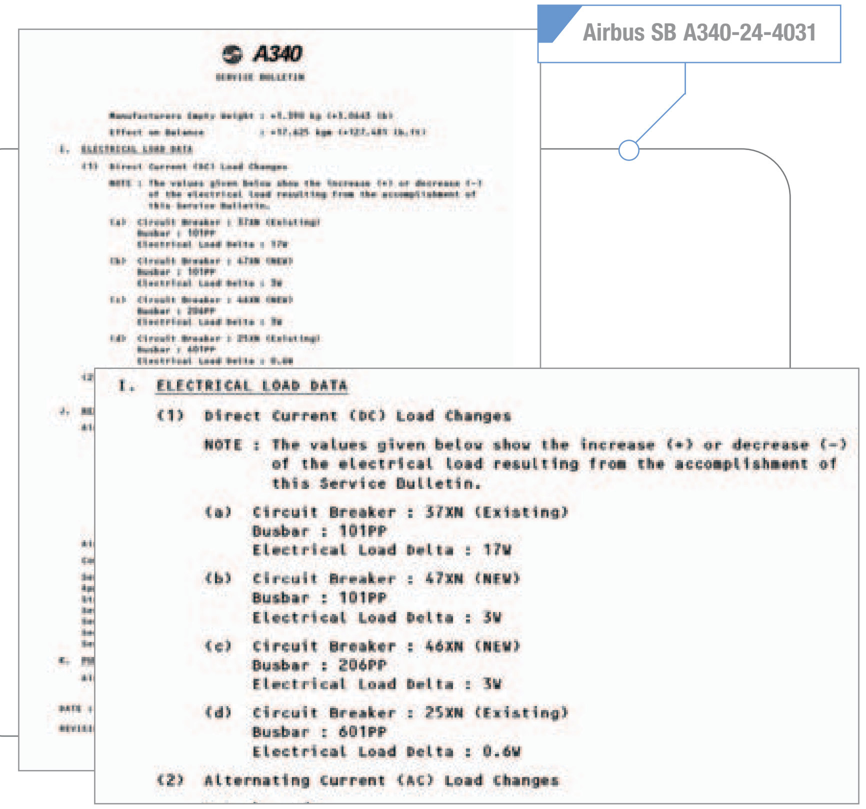



The decision tree can be used as an aid to assess the compatibility of the aircraft electrical system to ensure the proposed aircraft modification complies with the above rules in the various electrical configurations.

Similarly, when an Airbus Service Bulletin (SB) affects the aircraft electrical loads, the changes, including any changes to the affected C/Bs, are indicated in a dedicated paragraph of the SB. The values given will indicate any increase or decrease in the electrical loads following the accomplishment of the SB.

The figure on the right shows the Airbus SB A340-24-4031 covering the installation of a new Electrical Contactor Management Unit (ECMU) standard on an A340 aircraft. It indicates that the affected C/Bs 37XN and 25XN exist on the aircraft and C/Bs 46XN and 47XN will be added during accomplishment of the SB. Operators should use this information to update their ELA for the post SB aircraft.

Airbus SB A340-24-4031



A340
SERVICE BULLETIN

I. ELECTRICAL LOAD DATA

(1) Direct Current (DC) Load Changes

NOTE : The values given below show the increase (+) or decrease (-) of the electrical load resulting from the accomplishment of this Service Bulletin.

(a) Circuit Breaker : 37XN (Existing)
Busbar : 101PP
Electrical Load Delta : 17W

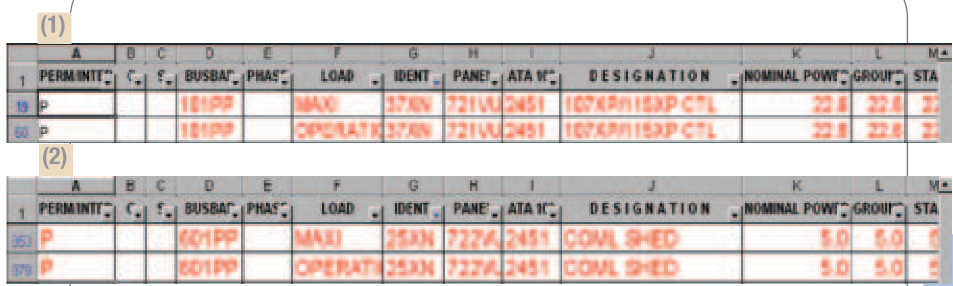
(b) Circuit Breaker : 47XN (NEW)
Busbar : 101PP
Electrical Load Delta : 3W

(c) Circuit Breaker : 46XN (NEW)
Busbar : 206PP
Electrical Load Delta : 3W

(d) Circuit Breaker : 25XN (Existing)
Busbar : 601PP
Electrical Load Delta : 0.6W

(2) Alternating Current (AC) Load Changes

Original (1) and revised (2) ELA existing C/B data



(1)

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PERMINTE | C | S | BUSBAR | PHASE | LOAD | IDENT | PANEL | ATA | DESIGNATION | NOMINAL POWER | GROUND | STA |
| 19 | P | | | 101PP | | MAXI | 37XN | 721VU | 2451 | 107XP/115XP CTL | 22.8 | 22.8 | 22 |
| 50 | P | | | 101PP | | OPERATI | 37XN | 721VU | 2451 | 107XP/115XP CTL | 22.8 | 22.8 | 22 |

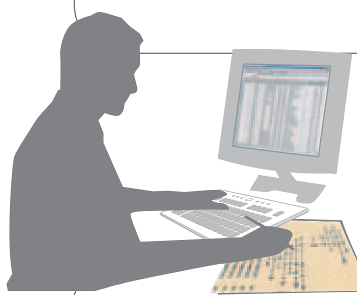
(2)

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PERMINTE | C | S | BUSBAR | PHASE | LOAD | IDENT | PANEL | ATA | DESIGNATION | NOMINAL POWER | GROUND | STA |
| 353 | P | | | 601PP | | MAXI | 25XN | 722VU | 2451 | COML SHED | 5.0 | 5.0 | 5 |
| 379 | P | | | 601PP | | OPERATI | 25XN | 722VU | 2451 | COML SHED | 5.0 | 5.0 | 5 |

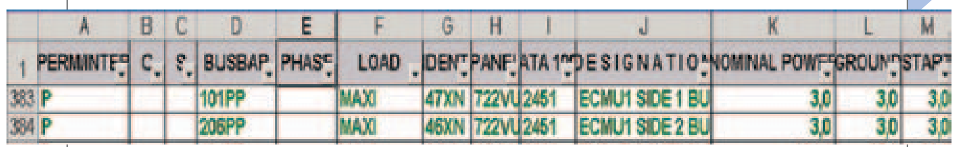
## How to update and maintain the supplied Excel™ file

To revise the data for an existing C/B using the ELA Excel™ file, select the C/B concerned and add the maximum and the operational electrical loads listed in the SB or airline Engineering Order to the existing electrical loads (as illustrated in the figure on the right).

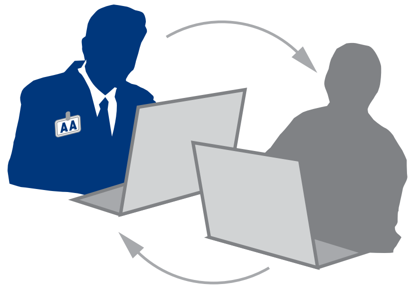
For all new additional C/Bs, rows to cover relevant new maximum and operational loads are inserted in the file and completed with the electrical load data as given in the SB or airline Engineering Order. Using the Excel™ autosum function insert the revised totals of both the maximum and operational loads for all flight phases (as illustrated in the figure on the right).



Add new additional C/B data



| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PERMINTE | C | S | BUSBAR | PHASE | LOAD | IDENT | PANEL | ATA 1 | DESIGNATION | NOMINAL POWER | GROUND | STAR |
| 383 | P | | | 101PP | | MAXI | 47XN | 722VU | 2451 | ECMU1 SIDE 1 BU | 3,0 | 3,0 | 3,0 |
| 384 | P | | | 206PP | | MAXI | 46XN | 722VU | 2451 | ECMU1 SIDE 2 BU | 3,0 | 3,0 | 3,0 |



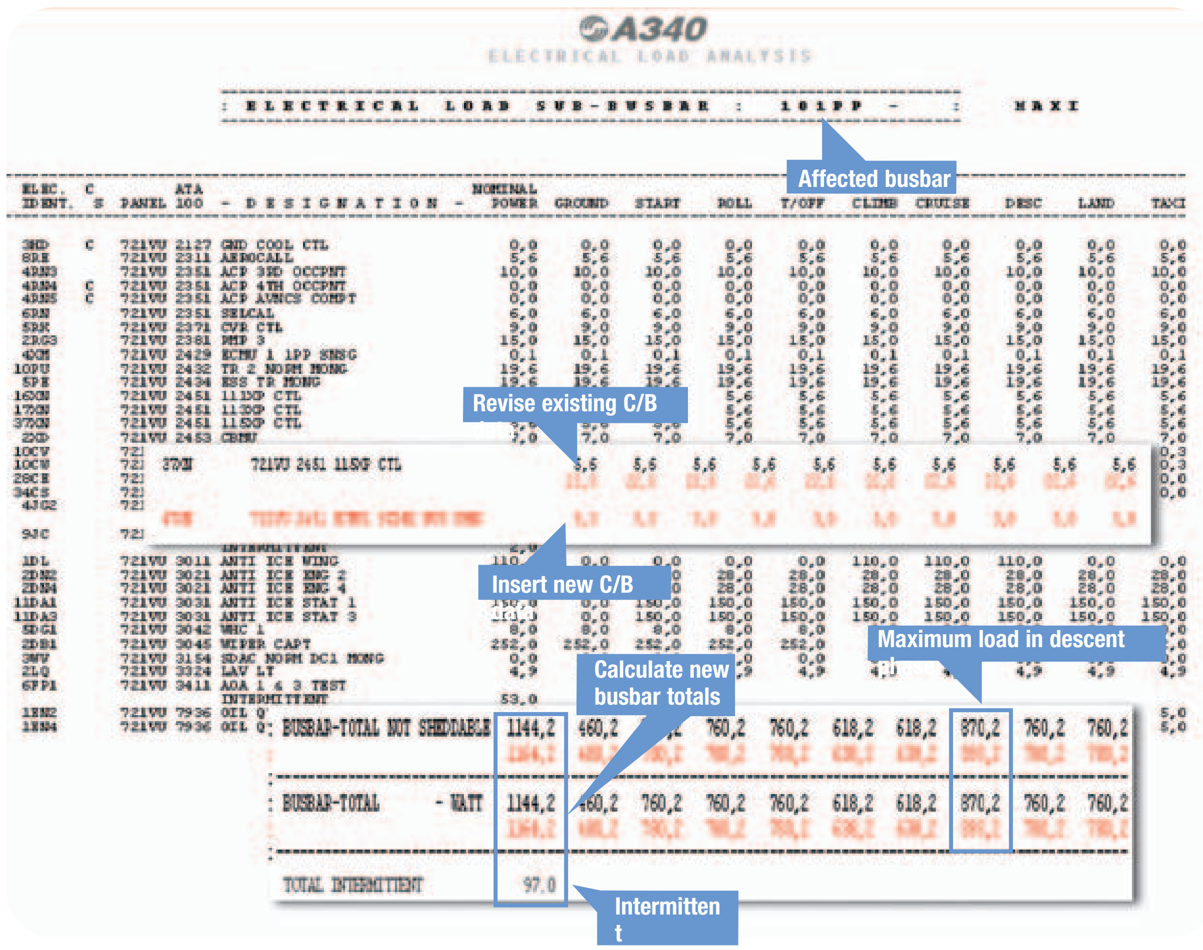
## How to update the RTF file

Using the revised electrical load data for each of the affected busbars as specified in the Airbus SB, or airline Engineering Order, update the RTF file.

In the example illustrated below, the busbar affected is 101PP. The existing C/B 37XN has an existing load of 5,6 watts during each flight phase; therefore insert the revised load, which is 22.6 watts for all flight phases. Then insert the electrical loads for all new C/Bs, in this case C/B 47XN, which has a load of 3.0 watts for each flight phase given by the SB or Engineering Order.

Note in this example that a maximum load of 890.2 watts occurs during the descent flight phase.

Updating the 'RTF' file




| ELEC. IDENT. | C S | PANEL | ATA 100 | - DESIGNATION - | NOMINAL POWER | GROUND | START | ROLL | T/OFF | CLIMB | CRUISE | DESC | LAND | TAXI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3HD | C | 721VU | 2127 | GND COOL CTL | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 8RE | | 721VU | 2311 | ARMOCALL | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 |
| 4RN3 | | 721VU | 2351 | ACP 3RD OCCPNT | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 |
| 4RN4 | C | 721VU | 2351 | ACP 4TH OCCPNT | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 4RN5 | C | 721VU | 2351 | ACP AVNCS COMPT | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 6RN | | 721VU | 2351 | SELCAL | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 |
| 5RK | | 721VU | 2371 | CVR CTL | 9,0 | 9,0 | 9,0 | 9,0 | 9,0 | 9,0 | 9,0 | 9,0 | 9,0 | 9,0 |
| 2RG3 | | 721VU | 2381 | MMP 3 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 |
| 4QM | | 721VU | 2429 | ECMU 1 1PP SNSG | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 |
| 10PU | | 721VU | 2432 | TR 2 NORM MONG | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 |
| 5PE | | 721VU | 2434 | ESS TR MONG | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 | 19,6 |
| 16XN | | 721VU | 2451 | 11XP CTL | [illegible] | [illegible] | [illegible] | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 |
| 17XN | | 721VU | 2451 | 11XP CTL | [illegible] | [illegible] | [illegible] | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 |
| 37XN | | 721VU | 2451 | 11XP CTL | [illegible] | [illegible] | [illegible] | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 |
| 2XD | | 721VU | 2453 | CBMU | 7,0 | 7,0 | 7,0 | 7,0 | 7,0 | 7,0 | 7,0 | 7,0 | 7,0 | 7,0 |
| 10CV | | 721 | | | | | | | | | | | | 0,3 |
| 10CW | | 721 | | | | | | | | | | | | 0,3 |
| 28CE | | 721 | | | | | | | | | | | | 0,0 |
| 34CS | | 721 | | | | | | | | | | | | 0,0 |
| 4JG2 | | 721 | | | | | | | | | | | | |
| 9JC | | 721 | | | | | | | | | | | | |
| 37XN | | 721VU | 2451 | 11XP CTL | | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 5,6 | 
| 1DL | | 721VU | 3011 | ANTI ICE WING | 110,0 | 0,0 | 0,0 | 0,0 | 0,0 | 110,0 | 110,0 | 110,0 | 0,0 | 0,0 |
| 2DN2 | | 721VU | 3021 | ANTI ICE ENG 2 | [illegible] | [illegible] | [illegible] | 28,0 | 28,0 | 28,0 | 28,0 | 28,0 | 28,0 | 28,0 |
| 2DN4 | | 721VU | 3021 | ANTI ICE ENG 4 | [illegible] | [illegible] | [illegible] | 28,0 | 28,0 | 28,0 | 28,0 | 28,0 | 28,0 | 28,0 |
| 11DA1 | | 721VU | 3031 | ANTI ICE STAT 1 | 150,0 | 0,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 |
| 11DA3 | | 721VU | 3031 | ANTI ICE STAT 3 | [illegible] | 0,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 | 150,0 |
| 5DG1 | | 721VU | 3042 | WHC 1 | 8,0 | 8,0 | 8,0 | 8,0 | 8,0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2DB1 | | 721VU | 3045 | WIPER CAPT | 252,0 | 252,0 | 252,0 | 252,0 | 252,0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 3WV | | 721VU | 3154 | SDAC NORM DC1 MONG | 0,0 | [illegible] | [illegible] | [illegible] | 0,0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 2LQ | | 721VU | 3324 | LAV LT | 4,9 | [illegible] | [illegible] | [illegible] | 4,9 | [illegible] | [illegible] | 4,9 | 4,9 | 4,9 |
| 6FP1 | | 721VU | 3411 | AOA 1 & 3 TEST INTERMITTENT | 53,0 | | | | | | | | | |
| 1RN2 | | 721VU | 7936 | OIL Q | | | | | | | | | | 5,0 |
| 1RN4 | | 721VU | 7936 | OIL Q | | | | | | | | | | 5,0 |
| | | | | BUSBAR-TOTAL NOT SHEDDABLE | 1144,2 | 460,2 | [illegible] | 760,2 | 760,2 | 618,2 | 618,2 | 870,2 | 760,2 | 760,2 |
| | | | | BUSBAR-TOTAL - WATT | 1144,2 | 460,2 | 760,2 | 760,2 | 760,2 | 618,2 | 618,2 | 870,2 | 760,2 | 760,2 |
| | | | | TOTAL INTERMITTENT | 97.0 | | | | | | | | | |





### HOW TO CHECK THAT THE MAXIMUM BUSBAR LOADS ARE NOT EXCEEDED

Referring to the wiring manuals, Identify the C/Bs and the generator associated with the busbar and also identify their current rating as shown in the example on the right. In this example, the new and existing C/Bs, 37XN and 47XN are connected to the 28VDC busbar 101PP. This busbar is protected by the existing C/B 2PN1. The nominal current rating (IN) for this C/B is 50 amps.

To ensure the busbar 101PP is not overloaded, calculate the maximum permitted busbar load:

*Maximum permitted load = 50 amps x 28 volts = 1,400 watts*

Ensure that maximum load in each flight phase does not exceed 1,400 watts. In this case (refer to figure on the preceding page), 890.2 watts is the maximum load, and this occurs during the descent phase.

Because this is less than the maximum permitted load of 1,400 watts, it is confirmed that busbar 101PP will not be overloaded following the modification.

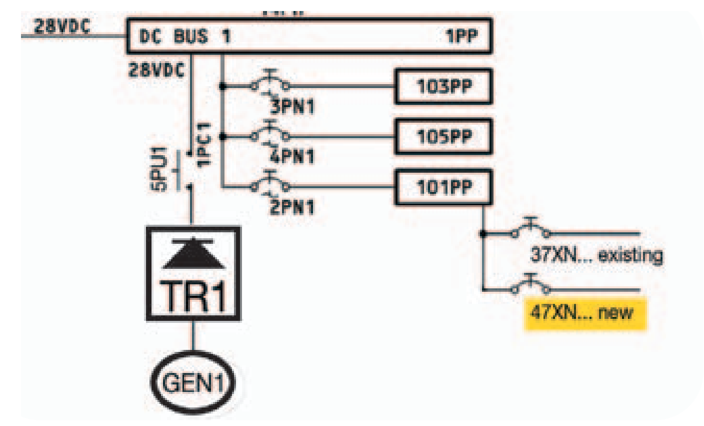
It is recommended that the busbar permanent load is lower than 85% of maximum busbar load (refer to Advisory Circular N°25-16 available at the FAA Website) (*http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/MainFrame?OpenFrameSet*). The revised maximum load in the descent phase of 890.2 watts will be the new maximum load for C/B 2PN1.

*Maximum 101PP bus-bar load (permanent) = 890.2 watts*

*890.2 watts < (0,85% x 1,400 watts) = 1,190 watts*

Therefore the new 101PP busbar load does comply with the recommendations of Advisory Circular N°25-16.

Modified wiring schematic




### HOW TO CHECK THAT THE MAXIMUM AUTHORIZED CURRENT VALUES FOR C/B 2PN1 DO NOT EXCEED THE C/B RATING

Check the current rating of the circuit breakers connected to the busbar and make sure that new loads do not exceed their nominal rating. The circuit breaker ratings are given in ASM/AWM (Aircraft Schematic Manual/Aircraft Wiring Manual) 24-5X. Make sure that generators and Transformer Rectifier Units (TRUs) will not be overloaded in all electrical configurations and flight phases.

The max permanent current for C/B 2PN1 will be:

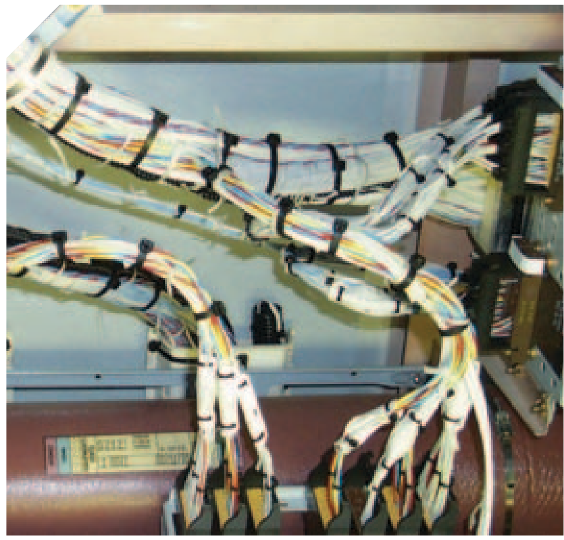
*890.2 watts /28 volts = 31.8 amps which is less than the C/B nominal current of 50 amps*

The max permanent + intermittent current for C/B 2PN1 will be:

*890.2 + 97 = 987.2 watts/28 volts = 35.2 amps which is less than the 2PN1 C/B trip time*

### AMEND THE ELA RECORD OF REVISIONS IN THE 'RTF' DOCUMENT

To maintain the current status of the ELA, complete the ELA 'Record of Revisions' with the references and dates of the incorporation of the airline engineering modification or Airbus SB.




## 'How to use' instructions

In March 2005, Airbus inserted in the ELA Introduction a comprehensive 'How to Use' the ELA, which provides guidance on how to maintain and keep the ELA updated. It provides several examples that cover the embodiment of airline modifications and Airbus SBs. For additional information, please refer to SIL (Service Information Letter) 00-080.

This information is also available for download from the Technical Data Support and Services site on AirbusIWorld.

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## Conclusion

With the introduction of the enhanced ELA, operators can use the Excel™ file and its standard functions to compute the electrical load data within the modifiable worksheet table. The availability of the Excel™ filter tool eases the data selection and retrieval process and also gives operators the possibility to simulate electrical load values.

Then using the RTF version of the ELA, the actual and current electrical load data status can be reflected and maintained by the operator, and can be shown to the Airworthiness Authorities when required.

AIRBUS





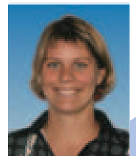

# Cargo configurations

## Flexible upgrades for A320 Family aircraft

A320 Family aircraft offer a number of different configurations in the lower deck cargo compartments, answering the operational needs and constraints of their operators.

With a wider base and higher compartment height than equivalent aircraft, the A320 Family cargo compartments provide an easier and more practical working environment. Vertical main sidewalls allow cargo items to be stacked more easily and IATA (International Air Transport Association) contour Unit Load Devices (ULDs) can be loaded if the optional cargo loading system is installed. Large outward opening doors allow easy access to the cargo compartments and protection from bad weather conditions during loading.

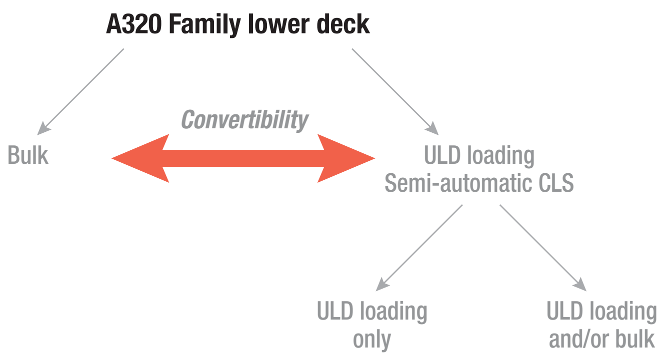
All these features allow faster turnarounds, increased revenue potential and a reduction in manpower cost. This article explains the options available for upgrading the cargo configuration by retrofit and their advantages.



**Sonia Bouchardie**
Design Manager
Upgrade Operations - Systems
Airbus Customer Services

The aircraft can be converted to three main configurations:
- ***Basic bulk***, which allows freight to be loaded
- ***Semi-automatic cargo loading system***, which allows pallets and containers loading
- ***Semi-automatic cargo loading system with full bulk capability***, which allows freight, pallets and containers loading

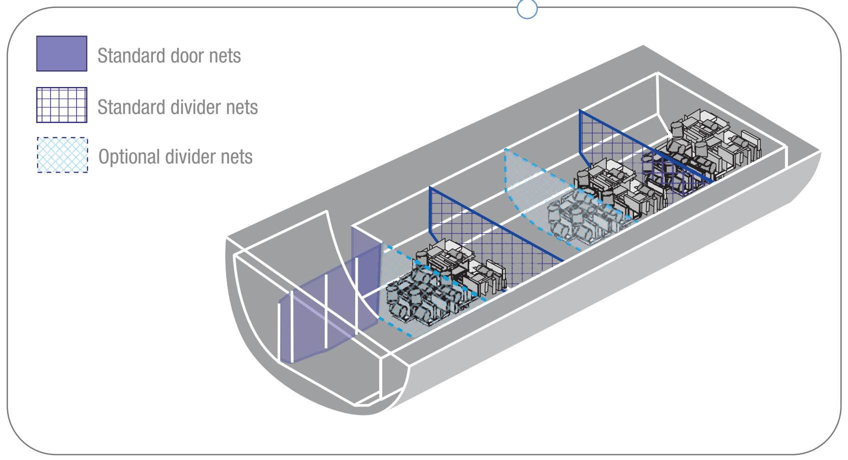
These configurations can be further upgraded with various options.




**Requirements for conversion to full bulk configuration system**

- Basic cargo compartment lining on ceiling, side and partition walls and basic cargo compartment floor panels, capable of bulk loading up to a maximum average load density of 15 lb/ft3
- Centerline T-beam reinforcement
- Standard door and divider nets as required for full bulk transport
- Protection devices for rapid decompression panels at frame 24A
- Net attachment points on the cargo hold floor and ceiling area
- Tie-down points on the cargo compartment floor
- Load and net arrangement placards

**Example of arrangement in A321 forward cargo compartment**




Adaptation of the configuration is required when one or two ACTs (Additional Centre Tanks) are provisioned in the aircraft due to ACT restraint/support components (see article on ACTs in FAST Magazine 35, December 2004).

The original cargo conversion philosophy offered:
- A semi-automatic Cargo Loading System (CLS), to handle pallets and/or containers, with some provisions for occasional bulk as a further option

or,
- Convertibility provisions which allowed opting for either a full bulk (previously known as kit 1) or a semi-automatic CLS with full bulk capability (previously known as kit 2).

The current cargo conversion philosophy superseded this in 1999 (for A320 MSN - Manufacturer Serial Number - 1050 onwards, A321 MSN 1080 onwards and A319 MSN 1096 onwards) and for today's upgrades. It now offers a simplified principle:
- Semi-automatic CLS, to handle pallets and/or containers, with some provisions for occasional bulk as a further option

Or
- Semi-automatic CLS with full bulk capability

## Cargo configuration upgrades advantages

### CONVERSION TO FULL BULK CONFIGURATION SYSTEM

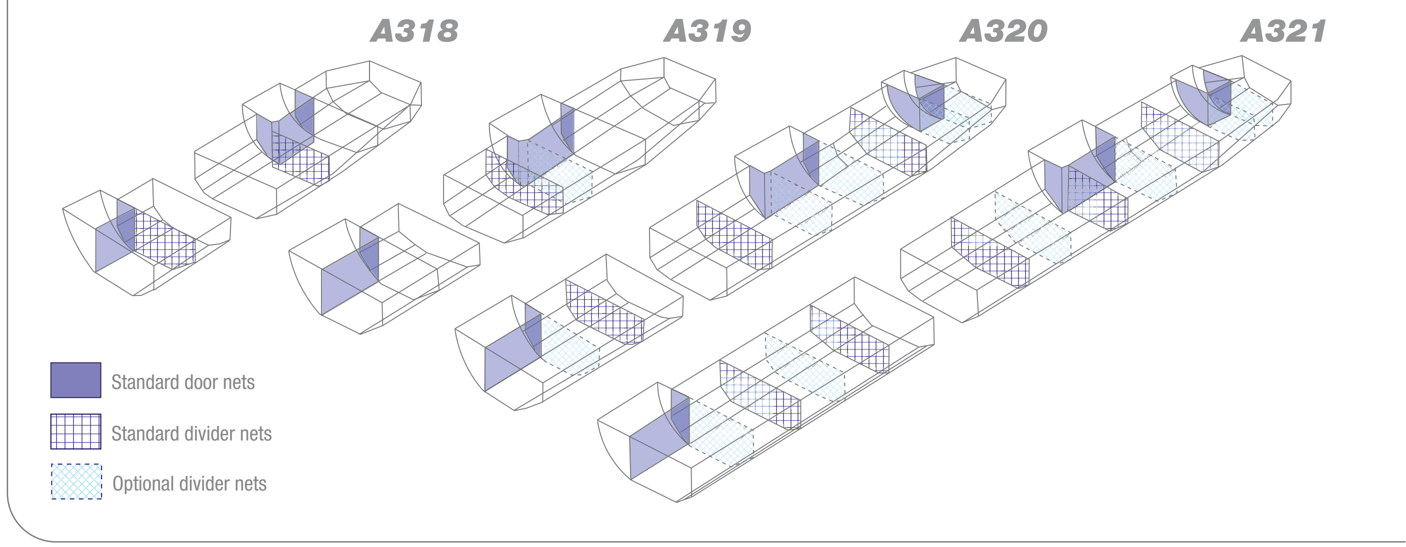
A full bulk configuration is installed, and structural provision is made for attaching optional divider nets.

*Depending on aircraft type, further optional divider nets can be installed in the cargo compartments if a more precise balance calculation is requested by customers to separate special cargo.*





**Basic full bulk configuration in forward and aft cargo compartments for all A320 Family aircraft**

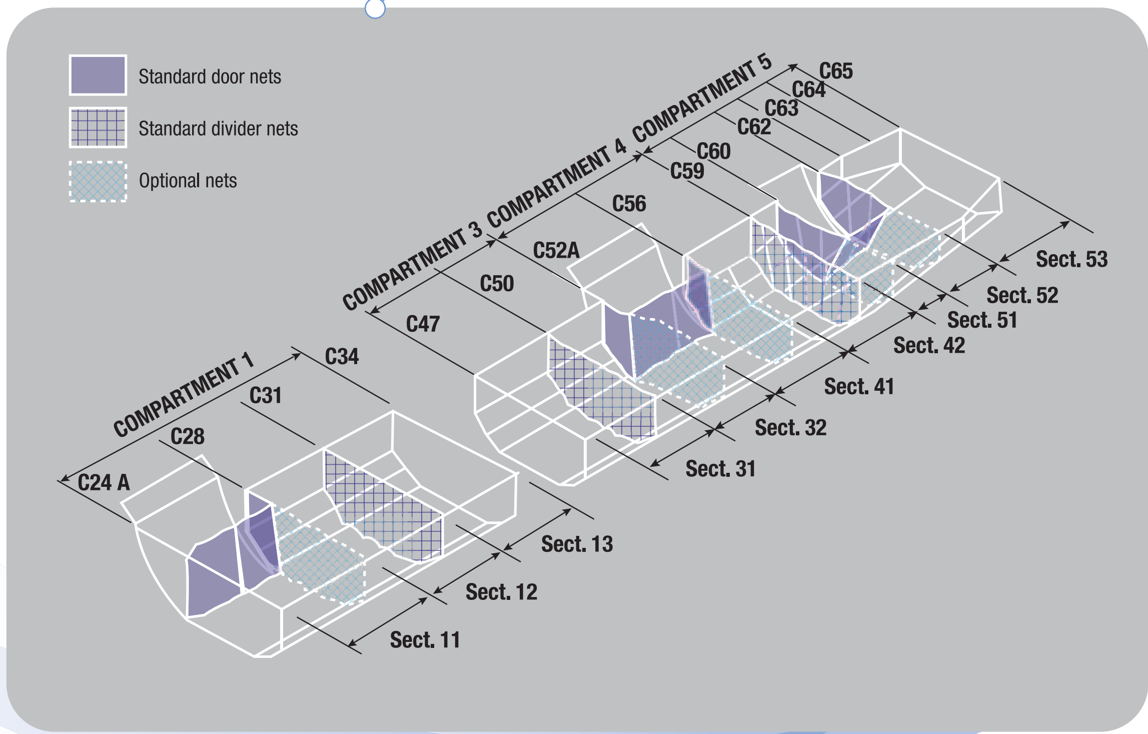



It is possible to install reinforced floor panels, limited to the flat floor to minimize the weight increase, for heavy bulk usage in the forward and aft cargo compartments.

*This increases the durability and impact resistance of the cargo compartment floor panels if required by operational experience of a customer.*

When the panels are reinforced, the local loads are increased. The reinforcement can be applied to any existing floor panels from the previous technology E-type to the current technology S-Glass and features a modified build-up with two additional layers of prepeg with increased impact resistance.

**Example of A320 standard/optional nets locations**



CARGO CONFIGURATIONS - FLEXIBLE UPGRADES FOR A320 FAMILY AIRCRAFT

### Volume and Maximum Gross Weight (MGW) valid for each cargo configuration for A320

| Compartment N° | Bulk configuration: Usable volume m³ | ft³ | Max load lb | kg | CLS configuration: Usable volume m³ | ft³ | Max load lb | kg |
|---|---|---|---|---|---|---|---|---|
| 1 | 13.28 | 469 | 7500 | 3402 | Depends on ULD type and contour | | 7500 | 3402 |
| 3 | 9.76 | 345 | 5349 | 2426 | | | 5000 | 2268 |
| 4 | 8.5 | 300 | 4651 | 2110 | | | 5000 | 2268 |
| 5 Bulk only | 5.88 | 208 | 3300 | 1497 | 5.88 | 208 | 3300 | 1497 |
| **Compartment N°** | **CLS* + Full bulk configuration: Usable volume m³** | **ft³** | **Max load lb** | **kg** | **CLS* + Occasional bulk configuration: Usable volume m³** | **ft³** | **Max load lb** | **kg** |
| 1 | 13.11 | 463 | 7500 | 3402 | 13.11 | 463 | 4630 | 2100 |
| 3 | 9.71 | 343 | 5349 | 2426 | 9.71 | 343 | 3430 | 1556 |
| 4 | 8.36 | 295 | 4651 | 2110 | 8.36 | 295 | 2950 | 1338 |
| 5 Bulk only | 5.88 | 208 | 3300 | 1497 | 5.88 | 208 | 3300 | 1497 |

* refer to CLS configuration for ULD loading

The floor structure can support, via the floor panels in the flat and sloping floor areas, a maximum distributed load of 732kg/m² (150lb/ft²), while it is capable of supporting, via ball mats or roller tracks, a maximum distributed load of 488kg/m² (100lb/ft²).

## CONVERSION TO SEMI-AUTOMATIC CARGO LOADING SYSTEM

An electrically powered, semi-automatic CLS is installed in the forward and aft cargo compartments allowing the transport of ULDs (pallets/containers).

*The semi-automatic cargo loading system improves turnaround efficiency by reducing cargo loading and unloading time (with a single loader), minimizes risk of injuries to bulk loading staff and improves customer service (protection of cargo from wet weather and theft, improved baggage tracking, operational flexibility, improved cargo security, heavy cargo capability).*

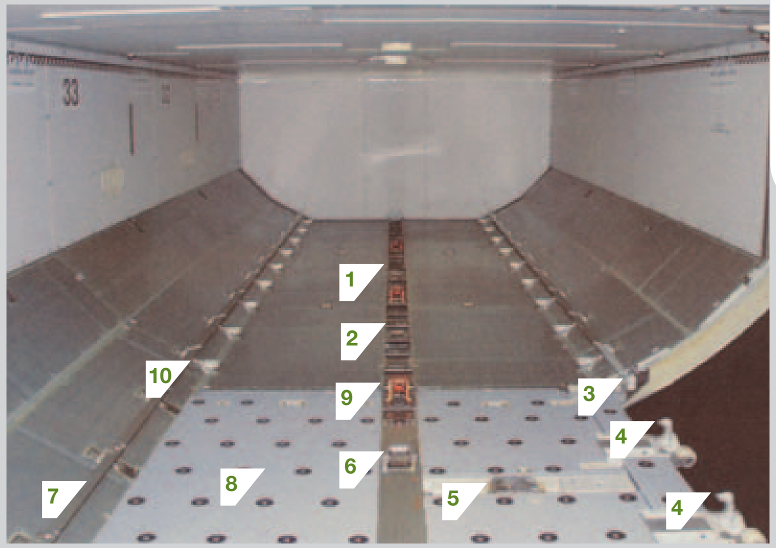
This option is only available for the A319, A320 and A321.

The Max Gross Weight (MGW) of each ULD is limited for the A320 Family CLS to 2500lbs (1134kg).

System provisions are made for a CLS in the forward and aft cargo compartments plus minimum electrical provision for a mechanized bulk loading system in the forward and aft cargo compartments (aft cargo compartments only for A318 and A319).

### Semi-automatic cargo loading system

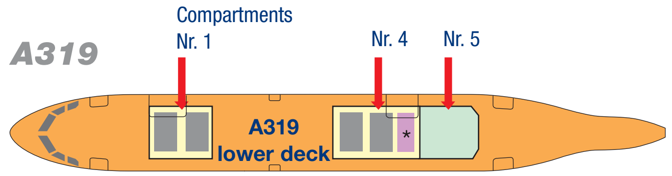
1. Center roller track
2. Transport rollers
3. Entrance guides
4. Retractable YZ-latches
5. Lateral PDU
6. Longitudinal PDU
7. Continuous side guides (optional)
8. Ball mat area
9. XZ-latches
10. Fixed YZ-guides (with integrated rollers)




### Containers or pallets distribution

* Optional specific container: LD3/40 - IATA Contour H

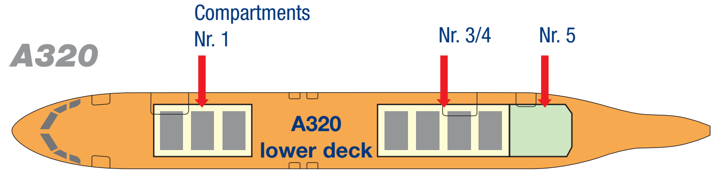
**A319**




4 (+2/3) ULDs

- 2 containers or pallets in forward cargo compartment
- 2 containers or pallets in aft cargo compartment.

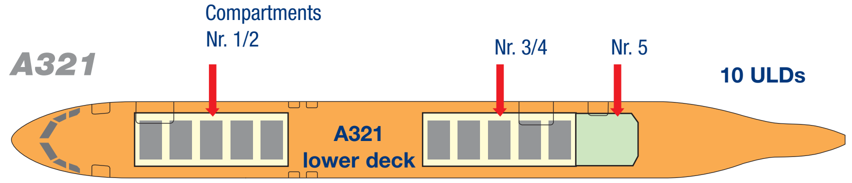
**A320**




7 ULDs

- 3 containers or pallets in forward cargo compartment
- 4 containers or pallets in aft cargo compartment.

**A321**



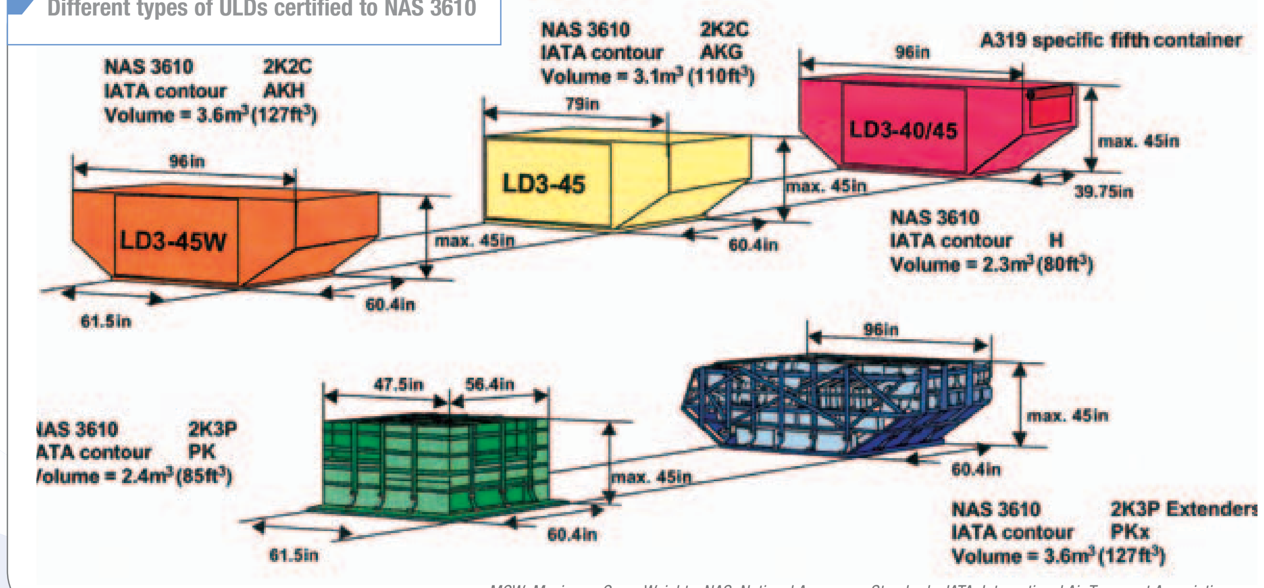

10 ULDs

- 5 containers or pallets in forward cargo compartment
- 5 containers or pallets in aft cargo compartment.

### Requirements for conversion to semi-automatic cargo loading system

- Replacement of the standard bulk floor panels, sidewall and ceiling panels by lightweight panels
- Removal of protection devices for rapid decompression panels at frame 24A
- Installation of a drainage system with the CLS
- Structural modifications allowing CLS installation and system operation
- Installation of modified placards for the new cargo compartment configuration
- Installation of the CLS and the following associated system components:
  1/ Restraint, guidance: Guides, latches and end stops
  2/ Transport: Roller tracks, ball mats
  3/ Conveyance: Power drive units, control panels, proximity switches

### Different types of ULDs certified to NAS 3610




*MGW: Maximum Gross Weight - NAS: National Aerospace Standard - IATA: International Air Transport Association*

CARGO CONFIGURATIONS - FLEXIBLE UPGRADES FOR A320 FAMILY AIRCRAFT

The semi-automatic CLS has an option allowing occasional loading of bulk cargo in addition to the CLS. This option is only available for the A319, A320 and A321.

Fixed provisions for occasional bulk loading are provided in addition to the CLS (with some limitations).

*Occasional bulk loading applies on routes/destinations where no ground service equipment is available and/or no ULDs are available and/or baggage requirements call for maximum volume utilization of the cargo compartments.*

The following limitations apply:

- Segregation of the cargo compartments into sections by divider nets and installation of door nets
- Each net section must be filled to at least 80% of its volume
- The cargo compartments are capable of transporting bulk up to a maximum average density of 10lbs/ft³ (160kg/m³)
- Occasional transport of bulk load shall not exceed 60 flights per year. More frequent use of the cargo compartments for occasional transport of bulk loads increases the possibility of damage to the lining and floor panels. When occasional transport of bulk load is done more regularly than once per calendar week, the operator is recommended to visually inspect the floor panels, linings and decompression panels at weekly intervals

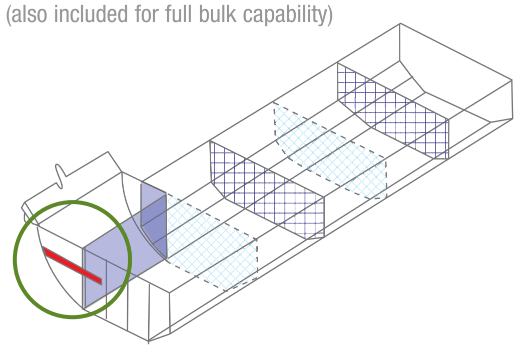
The fixed provision conversion consists mainly of:

- Protection devices for the rapid decompression panels and a fender at frame 24
- Load placarding and markings for the new cargo compartment configuration

The required divider nets/door nets are not part of this provision, but should be ordered directly from the net manufacturer.

Another option is the continuous side guide *to ease the guidance of netted pallets or slightly dished pallets.*

Additional protection for CLS with occasional bulk at frame 24 (A321)



Fender
(also included for full bulk capability)

## CONVERSION TO SEMI-AUTOMATIC CARGO LOADING SYSTEM WITH FULL BULK CAPABILITY

This option provides operational capability to transport either ULDs and/or bulk freight up to a maximum average density of 15lbs/ft³. *This is the most flexible solution for customers who often change modes of ground handling operations.*

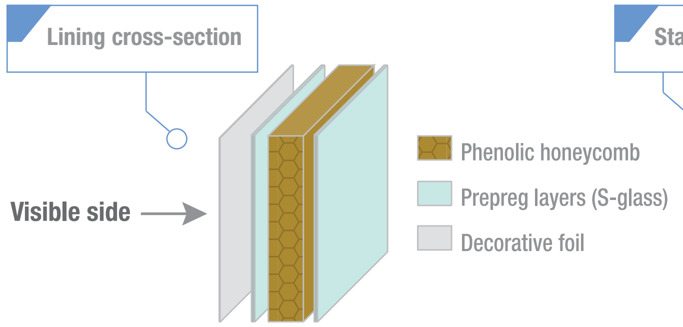
It is possible to install protection panels on the CLS and a full bulk cargo configuration. *This allows operation with bulk cargo while maintaining and protecting the CLS components.*

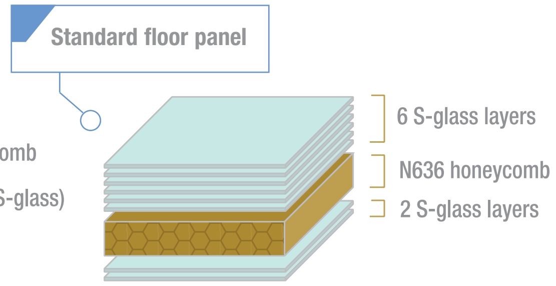
**Requirements for conversion to semi-automatic cargo loading system with full bulk capability**

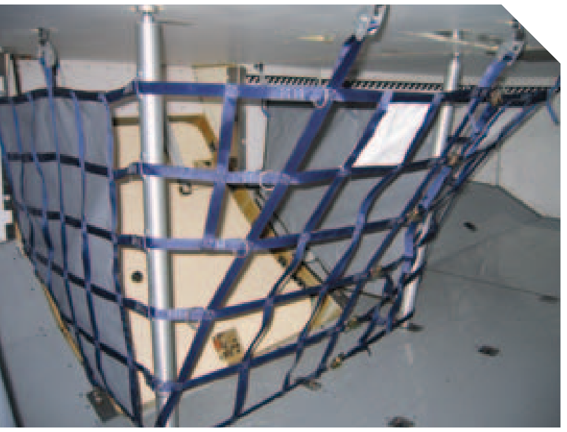
- Electrically powered semi-automatic CLS
- Additional tie-down fittings
- Door nets with stanchions and divider nets for the forward and aft cargo compartments
- Reinforced cargo floor panels for heavy bulk usage for the forward and aft cargo compartments, flat floor part only
- Drainage system
- Side wall/ceiling panels for bulk loading in the forward and aft cargo compartments
- Fender for protection devices for the rapid decompression panels at frame 24A

Semi-automatic cargo loading system with full bulk capability

1 Ceiling and
2 sidewall panels for bulk usage (15lb/ft³)
3 Divider nets
4 Door nets
5 Reinforced floor panels



## S-glass linings and floor panels

For all three configurations, the new enhanced cargo compartment lining and floor panels are of S-glass type since September 2004 (from A318 MSN 2276, A319 MSN 2287, A320 MSN 2301 and A321 MSN 2305) and are sandwich panels with the following build up:

- Honeycomb core
- S-glass layers

*This S-glass enhanced floor panel design has greater impact resistance, is lighter in weight than former E-glass panels and is more robust for cargo handling. Also no aluminium top sheet is incorporated in the design.*

It meets all Federal Aviation Requirements and European Aviation Safety Agency Requirements for:

- Flammability
- Low smoke/toxicity
- Leak proof with respect to Class C (compartment classification for fire extinguishing system)
- Rapid decompression
- Lining panels are secured with quick release attachments, giving good accessibility to systems located behind the lining

When a cargo compartment is converted on an in-service aircraft, S-glass new technology panels replace the existing panels.

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## Conclusion

Airline operations can often demand different cargo handling on sectors of the route network. This can result in bulk cargo only on one sector and pallets or containers on another sector, sometimes with a small amount of bulk cargo included.

The variation in these requirements demands flexible solutions for airlines to enable them to maximize their efficiency and revenue from cargo handling. The A320 Family cargo configurations described in this article provide the flexible solutions to enable airlines to meet these demands and can be retrofitted whatever the current configuration of an aircraft is.

Cargo compartment configuration change offers can be obtained via a Retrofit Modification Offer by request to Airbus Upgrade Services at *upgrade.services@airbus.com*

These cargo compartment configuration change options are also planned to be added to the Airbus Customer Services Upgrade Services e-Catalogue so customers can review and request their preferred options on-line.

AIRBUS



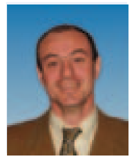


# Maintenance cost and reliability control

## Services to better serve airlines worldwide

The commercial aviation industry has become more and more challenging and maintenance costs and reliability control are key factors for airline success. Recognizing this, Airbus has identified various activities, products and services, which will support airlines in their efforts to reduce costs and increase their efficiency in the maintenance economics area. These Airbus activities have resulted in a number of products and services such as IDOLS, DMC benchmarking and other projects targeting specific issues to address the challenges.

This article describes the services offered by Airbus to airlines to support their maintenance economics activities and explains their goals, benefits and prerequisites. It also explains projects that will further support airlines in the future.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MAINTENANCE COST AND RELIABILITY CONTROL - SERVICES TO BETTER SERVE AIRLINES WORLDWIDE

**IDOLS Blue Circle** | **IDOLS Gold Circle** | **IDOLS Silver Circle**

Air+ *by Airbus*

Each customer has specific needs that require specific solutions and 'Air+ *by Airbus*' provides customized support packages to meet these needs. Tailor-made solutions can cover all technical operations because 'Air+ *by Airbus*' is a flexible portfolio ranging from traditional product support to very innovative services, thus offering the

## IDOLS

To support airline needs for measuring performance and comparing with other Airbus operators, Airbus has built a set of on-line services called IDOLS, which stands for 'In-service Data On Line Services'.

The first step of IDOLS is to provide tools to benchmark reliability performance against competitors, or give a clear status of the situation of the global Airbus fleet. Then, a system of navigation (cockpit view) allows analysis via a drill down function.

IDOLS is an evolutionary tool developed to support airline business needs and workshops are organized regularly to propose new solutions and obtain airline feedback.

IDOLS is also one of the modules of 'Air+ *by Airbus*' (see note on the left), the comprehensive portfolio of support and services created by Airbus to support customers in meeting their business objectives.

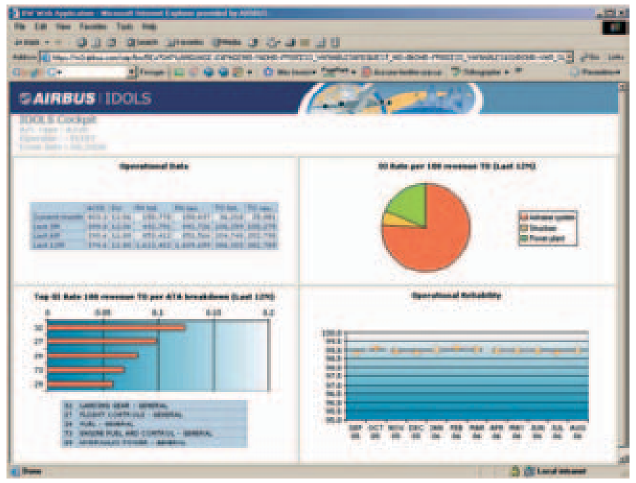
IDOLS offers airlines a choice of membership of three circles:

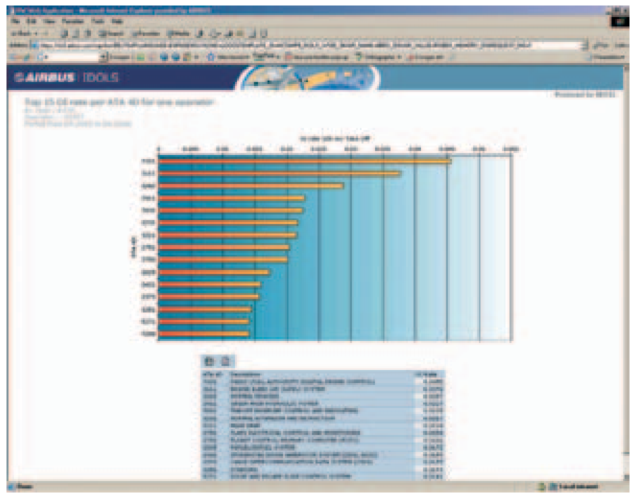
- All airlines are by default *Blue Circle* members with access to all general IDOLS reports as well as to detailed reports on their own fleet compared to the global fleet
- *Gold Circle* members have in addition to their Blue Circle access rights all the detailed data of the other Gold Circle members. Membership of the Gold Circle is obtained by signing a Data Sharing Agreement with Airbus
- The *Silver Circle*, also called the Alliance Circle, is designed for specific airlines willing to share their reliability data only between themselves
  The global Airbus fleet value is also included. Access to this circle is obtained by a specific Data Sharing Agreement signed by all members of the alliance together with Airbus.

**IDOLS screens**

▸ IDOLS cockpit

▸▸ Top OR-Rate by ATA Chapter

▸ 

▸▸ 

## Airbus annual maintenance cost benchmarking report

Nowadays, airlines are becoming more and more concerned with their Direct Maintenance Costs (DMC), since this can be an area for significant cost saving opportunities. Therefore, it is important that airlines have visibility of their maintenance cost performance versus other operators of the same aircraft type. To help monitor their DMCs, Airbus launched the annual maintenance cost benchmarking report in 2003. The IATA MCTF (International Air Transport Association Maintenance Cost Task Force) has adopted this toolset as their basic tool for DMC collection, allowing a single reporting format for both IATA and Airbus annual maintenance cost benchmarking reports.

### THE REPORT

Airbus issues an annual maintenance cost benchmarking report every year, which provides a full range of benchmarking material from a global to a detailed level. The benchmark graphically presents collected data, including an analysis to better understand the figures presented.

There are different benchmarks, with a maturing fleet age approach, on:

- Airframe DMC (base, medium and heavy maintenance)
- Component DMC
- Engine DMC
- Powerplant accessories DMC
- Total DMC cost
- Maintenance check man hours

The benchmark presents the reported data as well as the adjusted data (adjustment rules being applied for a common sector length and labour rate) to compare fairly airline results in total confidentiality. Airlines are provided individually with their own identification code to help read the Airbus benchmark report.

### WHY PARTICIPATE IN THIS PROGRAMME?

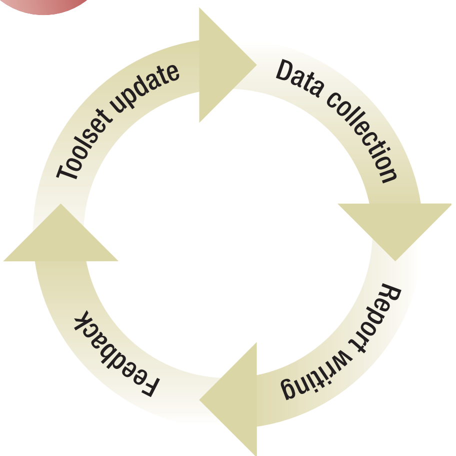
The annual maintenance cost benchmarking report is designed to be an airline's preferred means for maintenance cost optimization and gives a unique opportunity to:

- Benchmark maintenance performance against other airlines
- Forecast DMC expenditures
- Identify the main areas of cost improvements

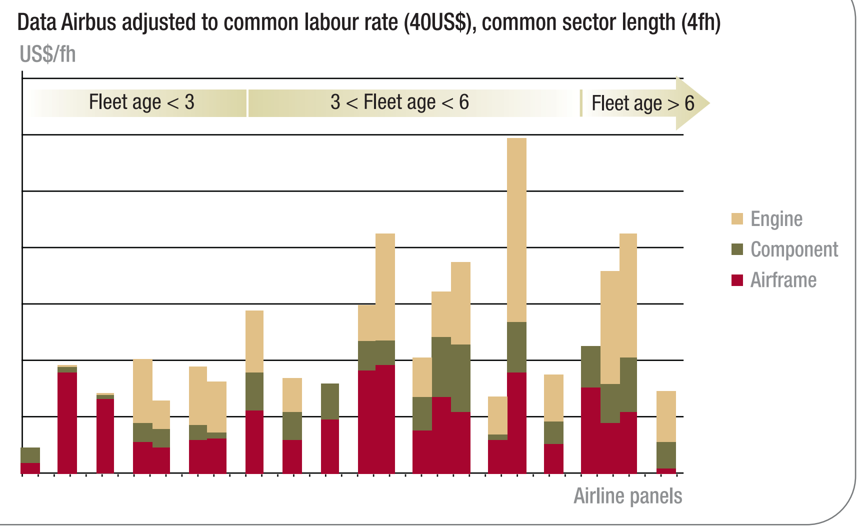
Airbus provides a downloadable on-line intuitive tool known as the 'maintenance cost benchmarking toolset' designed for data reporting, which has a comprehensive and user-friendly interface and enables reporting levels to be chosen to allow reporting of:

- Aircraft level (airframe, components and engines)
- Check events level (from transit to heavy checks)
- Component level (review of top cost drivers)
- Engine level (engine shop visit costs)

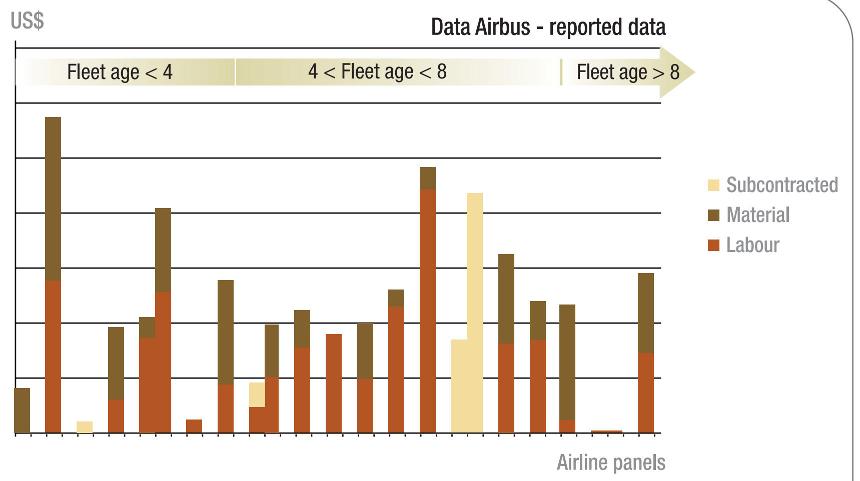
The quality of the annual report provided to airlines depends on the amount and the quality of data provided by participants via the maintenance cost benchmarking toolset. Airline data confidentiality is preserved via a confidentiality agreement signed between each airline and Airbus.




A330
Example of global maintenance costs




A330/A340 C Check
Example of global check costs




### THE MAINTENANCE COST BENCHMARKING TOOLSET

This has been developed to be as close as possible to an airline's daily business. The main menu is very comprehensive enabling easy navigation through the different topics, such as:

- General information (finance, accounting, fleet information…)
- Global DMC (airframe, components, powerplant)
- Cost Per Event (from transit to heavy checks, rotables, consumables and engine shop)

Once an airline starts to fill in topics in the toolset, they can select and print preliminary graphs of their costs. Graphs can be displayed for global DMC (total costs and costs per flight hour) and cost per event (line, base and heavy maintenance total costs). When the toolset topics are completed, it gives access to the summary of costs for airframe, components and engines for material, labour and subcontracted work. Access is also given to a questionnaire, which enables airlines to provide suggestions and feedback on the toolset to Airbus. When the toolset and questionnaire are filled in, they should be sent back to Airbus via mail or e-mail to: *dmc.report@airbus.com.*

## Airline Services activities

The Airline Services section dealing with Maintenance & Engineering performance, accomplishes Best Industry Practices (BIP) audits covering the following elements:

- Regulatory approval support
- Maintenance programme: Development, implementation, and optimization
- Maintenance means definition and optimization
- Maintenance check performance
- Support package definition and contract review
- Outsourcing preparation and support
- Maintenance information system: Evaluation and specification support

This group also deals with economic aspects of airline operations via Entry Into Service (EIS) assistance on-site.

Another aspect of Airline Services covers aircraft performance optimization through reliability and maintenance cost reviews, covering:

- Aircraft configuration optimization, including Service Bulletin (SB) cost/benefit analysis
- Top-down maintenance cost optimization
- Long-term budget build up
- Cost management process improvement





These services are provided by Airbus on airline request.

## Training seminars and programmes

### MAINTENANCE ECONOMICS SEMINAR

This five-day seminar was created to satisfy requests from airlines to enhance their knowledge of global management and control of maintenance costs, including other aspects of operational costs, and discuss the latest industry standards definitions.

Only a well-structured DMC process with performance targets, data collection and analysis, benchmarking and decision findings enables cost reduction and budget control. Performance measurement must address internal airline requirements, but should also be according to international standards to ease contractual negotiations and data sharing with other industry members.

The seminar agenda is compiled to respond to these specific needs and covers:

- Industry definitions used to measure and exchange DMC
- Supplier support standards to better negotiate initial provisioning, repair time, No Fault Found (NFF) policy, etc
- Build-up of maintenance reserves and budget
- Methods to control costs of component maintenance
- Methods to analyse DMC
- Use of Airbus maintenance and engineering tools such as: AIRMAN™, SB cost benefit model
- Spares management: Definitions and Airbus services to optimize processes
- Make or buy decisions of airline maintenance activities
- Maintenance contract negotiations with airline service providers


- Maintenance programme variations and adaptation to airline needs
- Engine fleet management

The seminar speakers have a background in airline, supplier, MRO (Maintenance, Repair and Overhaul) and maintenance activities and are in similar positions in Airbus. They are active members in various IATA, ATA (Air Transport Association) Specification 2000 groups and are pleased to share with airlines the latest developments in these domains.

The scope of the seminar is particularly tailored for airline middle management of the following services: Technical support, system engineering, logistics, maintenance programme planning, production planning and control, line maintenance, hangar maintenance, component and engine maintenance, reliability, cost control and maintenance information analysis.

This seminar is organized three times per year at the Airbus Training Centre Toulouse.

### RELIABILITY CONTROL PROGRAMME TRAINING

The objective of this three-day training is to explain how to implement streamlined RCP processes within a maintenance


and engineering organization and covers: Data collection, analysis and corrective actions, performance measurement and display, component reliability, etc. It aims at explaining the role of the RCP in the context of overall aircraft operations such as:

- Increasing aircraft availability and improving dispatch reliability
- Minimising maintenance costs
- Optimizing spares inventory costs

It also deals with Best Industry Practices processes and specific examples of RCP outputs.

This training is run three times per year in Toulouse and can be provided on-site at airline request.

## Additional projects and initiatives

### A320 FAMILY NACELLES - CUSTOMIZING DMC IMPROVEMENTS FOR AIRLINES

During the last A320 Family Technical symposium in Rhodes (23-27 May 2005) airlines raised specific concerns about nacelle maintenance costs, so Airbus launched an investigation with Goodrich Aerostructures and IAE (International Aero Engines) to better understand nacelle maintenance costs and develop ways to optimize them for both A320 Family engine types. A detailed cost analysis study was performed using data from Goodrich's MRO facilities for component overhaul and annual parts sales over several years. This enabled the most common cost drivers to be identified for the worldwide fleet and gave an initial prioritization for investigation. The study also showed that cost drivers could vary significantly between airlines. Therefore, to have a fair assessment of real maintenance cost for an individual airline and ensure improvement actions are cost effective for them a customized analysis is needed.

The first step was a general improvement plan to address the common cost drivers identified at worldwide fleet level, which was done by reviewing 'countermeasures' to these cost drivers, such as new and existing:

- SBs
- Repairs and repair limits
- Inspection and serviceable limits

Each countermeasure was evaluated for its cost effectiveness in mitigating the top cost drivers - the cost saving after implementation of each countermeasure was compared to the cost of continuing to operate 'as is' today over a period of several years. In the case of SBs and repairs the cost of incorporation was also considered.

In addition, Goodrich developed Maintenance Management Guidelines for both engine programmes. These assist airlines to develop and optimize their own nacelle maintenance plan by providing all maintenance requirements and recommendations in a single document.

Detailed results were presented during operator meetings such as



MAINTENANCE COST AND RELIABILITY CONTROL - SERVICES TO BETTER SERVE AIRLINES WORLDWIDE

the CFM CFG (Customer Focus Group) in Denver (May 2006) and the IAE PMAG (Powerplant Maintenance Advi-sory Group) in San Diego (January 2006). Goodrich also published an article in their 'Field service technical status – April 2006' for CFM nacelles.

As mentioned previously, nacelle maintenance costs and their specific cost drivers vary from one airline to another depending on operation, maintenance policy, commercial policy etc. Therefore, a customized study per airline is essential. To maximize effectiveness, each study is performed using methods similar to those of the general improvement plan, allowing identification and prioritization of cost drivers specific to the airline. Thus, each general countermeasure is re-evaluated for its real benefit to the airline. Furthermore, this may identify additional countermeasures to be developed.

A customized study is currently underway at one airline and Goodrich and IAE encourage other airlines to contact them directly if they are interested in this service, or if they would like to know more about nacelle maintenance cost reduction.

### COMP@RE

Airbus is developing a component performance control project called *Comp@re* (COMponent Performance Assessment on Reliability and Economics). The scope of *Comp@re* is to measure reliability and maintenance cost performance of components (LRUs – Line Replaceable Units) defined as rotables or repairables that are repaired off-wing (removed from the aircraft and repaired in shop).

*Comp@re* will allow airlines to:

- Have a clearer view on LRU cost drivers
- Benefit from Airbus and other airlines experience
- Proactively address arising issues before they become major problems: Visibility over a wider fleet allows detecting potential issues earlier
- Prioritize modification embodiment
- Build-up LRU references
- Negotiate and control flight hour agreements
- Propose corrective actions in collaboration with the OEM (Original Equipment Manufacturer)
- Exchange information with airframers and the OEM
- Evaluate the effectiveness of chosen solutions

Comp@re is in a pilot phase with several Airbus business partners and availability to airlines will be announced in the future.

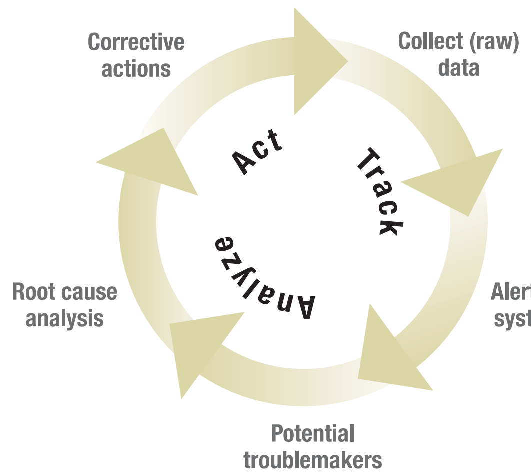
## Airbus participation in aviation industry working groups

### IATA MAINTENANCE COST TASK FORCE (IATA MCTF)

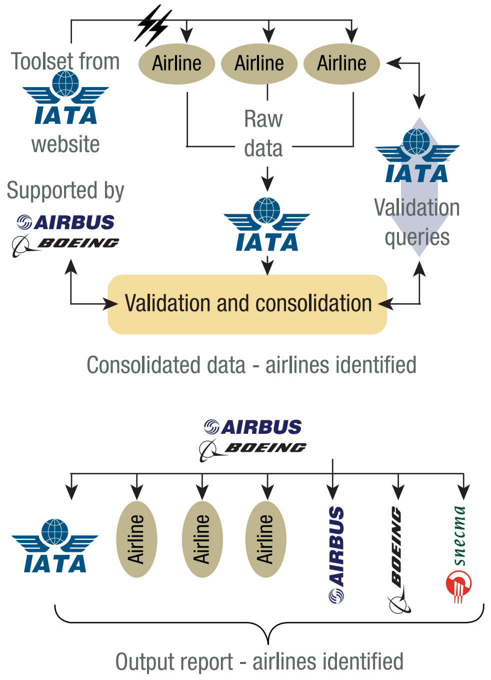
The IATA MCTF aims at Engineering and Maintenance (E&M) cost reduction with a focus on maintenance cost reporting, benchmarking and cost reductions. Its objectives are:

- Benchmark with an airline's own historical data, or compare with leading industry practices
- Define and standardize reporting of commercial airline maintenance costs
- Identify high cost drivers and target areas for maintenance cost reduction individually or as a group
- Provide a forum for aircraft maintenance trends

The MCTF has developed unique data collection, analysis and reporting toolsets. The definitions and toolsets have been approved by representatives of the airline industry.




IATA/MCTF - 2006 data flow process




### SPEC 2000

SPEC2000
e-business standards

Aircraft manufacturers receive data from airlines mostly through Excel™ files or by fax, but rarely via a standardized format file transfer. Data received by Airbus in various formats requires a lot of manual work to transpose, which can generate unavoidable typing errors. Aircraft manufacturers would like to collect more data more efficiently, plus enlarge the scope of data and from this improve feedback to airlines and suppliers. From this point of view, Airbus has become part of the standardization initiatives with airlines, MROs and suppliers, with the objective to help initiate standardized reporting of data for the benefit of the whole industry.

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## Conclusion

To support airline needs for measuring reliability, maintenance cost performance and comparisons with competition, Airbus offers a set of products and services:

IDOLS, a module of Air+ *by Airbus*, is an on-line reliability performance benchmarking tool, enabling airlines to compare their reliability performance.

The annual maintenance cost benchmarking report provides airlines a toolset to monitor DMCs, which is used by IATA MCTF to allow a single reporting format for both IATA and Airbus annual maintenance cost benchmark reports.

Maintenance Economics Seminars cover a wide range of maintenance economics related topics and case studies.

Reliability Control Programme Seminars deal with data collection, analysis & corrective actions, performance measurement & display, component reliability, etc.

Airline Services deals with maintenance & engineering performance and accomplishes BIP audits at airline sites. It also provides EIS assistance on-site and fleet performance optimization through reliability and maintenance cost reviews.

Additional projects and initiatives cover various aspects of maintenance economics. Nacelle maintenance costs and optimization for both A320 Family engine types were recently addressed.

Comp@re is currently being developed to measure the reliability and maintenance cost performance of LRUs defined as rotables or repairables.

Airbus also participates in various aviation industry working groups such as IATA MCTF and SPEC 2000, which aim to enhance and rationalize current and future ways of dealing with maintenance economics.

These services enable airlines to compare, measure and minimize their maintenance costs. Airbus is continually working on maintenance cost initiatives and as further initiatives and services are developed, Airbus will provide information on these.

AIRBUS

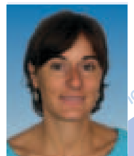




# Phoning in flight
## Voice and data communications with the GSM on-board system

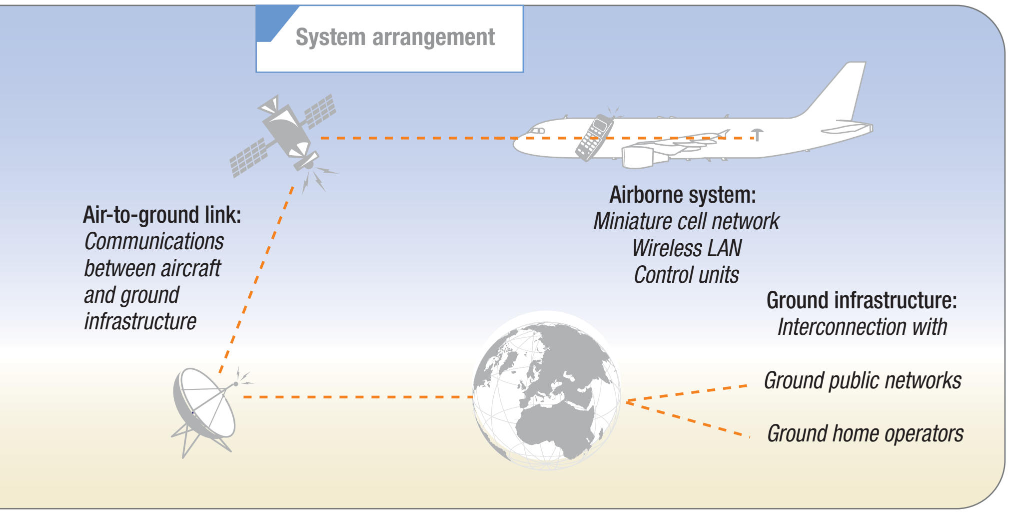
To fulfil the personal and business communication expectations of aircraft travellers, the GSM (Global System for Mobile communications) on-board system developed by Airbus will allow passengers with just an ordinary GSM cell phone or Smartphone to use GSM voice and data services in-flight on-board Airbus A320 Family aircraft (A318, A319, A320 and A321) and non-Airbus aircraft.

Thanks to satellite broadband links and advanced lightweight technology and in total compliance with aviation and telecommunication regulatory requirements, passengers will be able to exchange calls and Short Message Service (SMS) messages. On-board communications will be charged directly by each mobile operator to the passenger's account at rates mirroring international roaming charges.



**Emeline Baur**
Manager Marketing Services
Upgrade Services
Airbus Customer Services

System arrangement




## System architecture

The system architecture consists of an ***airborne segment*** and ***a ground segment***, plus a ***satellite transport domain*** overlapping both segments as shown in the picture below.

The system, designed to operate during the cruise phase of flights at least 3,000m (10,000ft) above the ground, offers passengers the following services:

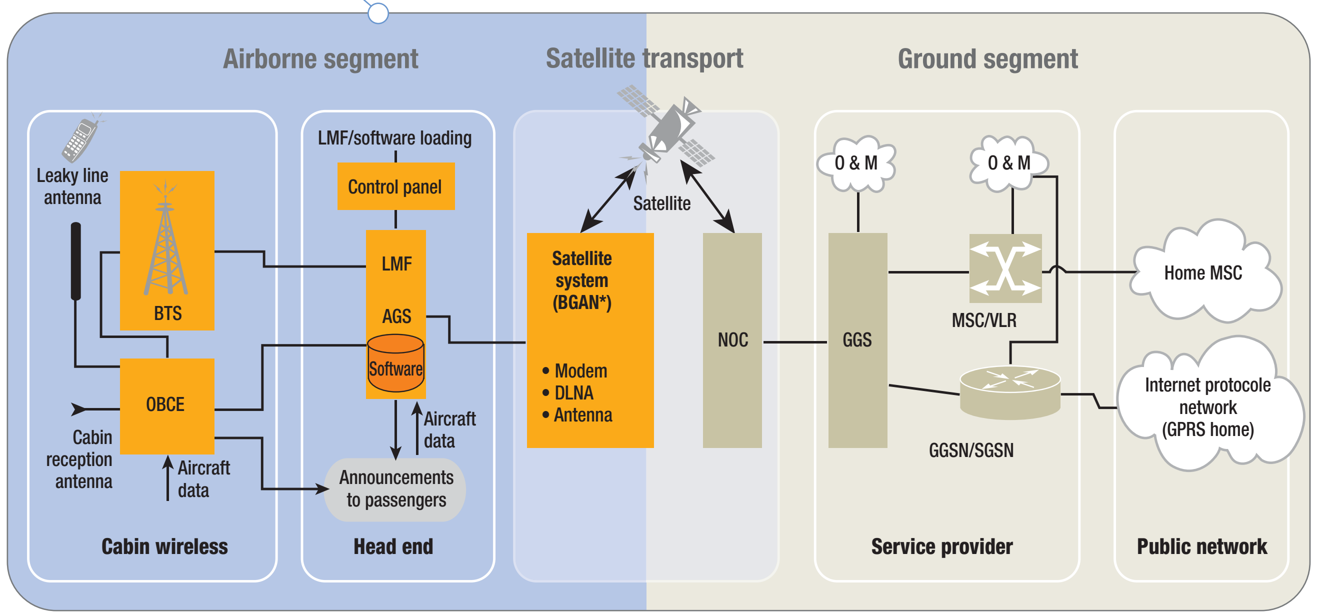
- Voice
- Short Message Service (SMS)
- General Packet Radio Service (GPRS) data services supporting Multimedia Message Service (MMS) and Wireless Application Protocol (WAP)
- Call forwarding, barring and calling line identification

The Inmarsat™ Swift Broadband satellite communication system (satellite modem + antenna mounted on the fuselage exterior) connects the GSM on-board system with the ground telephony network via the Inmarsat4 satellites. Communication services will be provided over European countries that have adopted the regional framework for on-board mobile networks and provided operating rights are obtained from the country where the aircraft is registered.

GSM on-board system features:

- System monitoring and selection of data or voice and data service mode from the cabin
- System switch-off from cockpit
- 14 simultaneous incoming/outgoing calls
- 28 channels can be supported with a second optional Base Transceiver Station (BTS)

System architecture




**BGAN**: Satellite system (next generation Inmarsat™ BGAN in service in 2006)



## The airborne segment

The airborne segment consists of the following:

### BASE TRANSCEIVER STATION (BTS)

The BTS has 14 channels for accessing passengers' mobile phones. The BTS (also known as a picocell) establishes the communication pipe to the mobile phones and supports all necessary system features like radio access, power level control, handovers and frequency configuration and manages the radio frequency resources to allow the mobile stations to access to the GSM on-board system. A second optional BTS can be installed to increase the available channels to 28.

### ON-BOARD CONTROL EQUIPMENT (OBCE)

OBCE controls all cell phones in the cabin. The purpose of the OBCE, in conjunction with the BTS, is to control the radio frequency emissions of all mobile phones and to prevent them from trying to connect to radio networks outside the aircraft. The OBCE ensures that mobile phones in the aircraft cabin cannot access terrestrial networks and do not transmit any signal without control of the GSM on-board system. The OBCE is able to control mobile stations in all frequency bands in areas overflown, e.g.: GSM 900, GSM 1800 and Universal Mobile Telecommunication System (UMTS), by transmitting a suitable noise floor. The power level of this noise floor will depend upon the aircraft altitude and is calculated by the OBCE. An independent RF (Radio Frequency) detector, integrated in the OBCE permanently proves availability of the noise floor control emission at the output of the OBCE. A connection between the RF detector and AGS (Airborne GSM Server) reports availability of the power levels to the AGS. The same detector also activates signs ('Switch off Mobiles') to passengers for any system failure. The OBCE also integrates a filter/combiner for the RF signals of the BTS and the OBCE noise generators to the leaky line antenna.

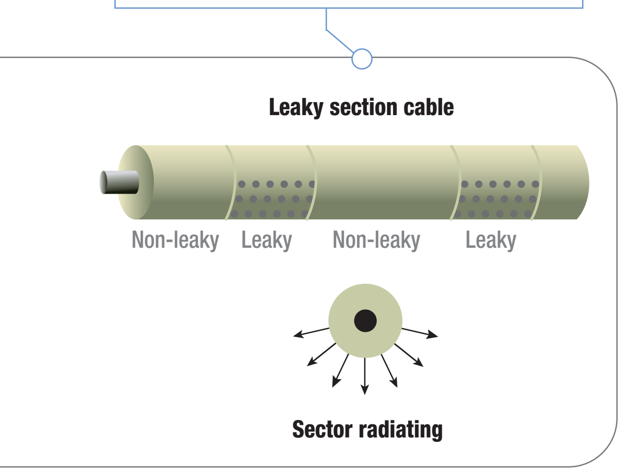
### AIRBORNE GSM SERVER (AGS)

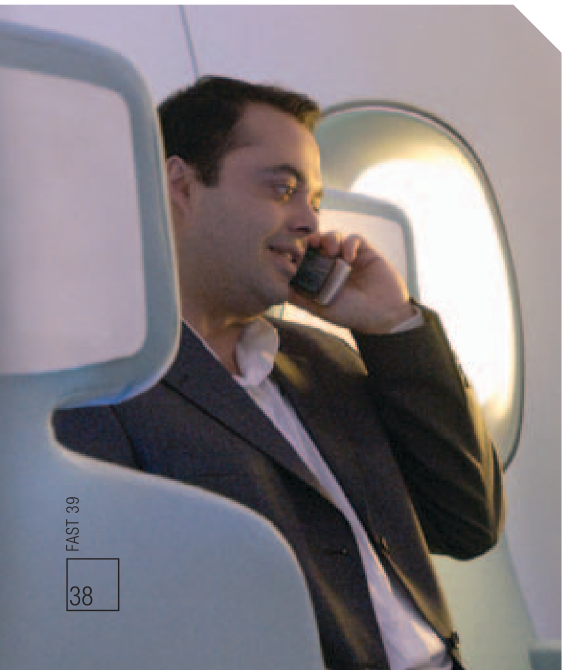
The AGS integrates the GSM software on-board and interconnects the mobile phone system with a satellite modem. The AGS controls the data streams between the BTS and the satellite modem and has a communication management function for management of bandwidth capacity, resources and prioritization to the satellite modem for the satellite link. It also controls the BTS and the OBCE (for maintenance only) and manages parts of the operations and maintenance functions.

The AGS also hosts the system's local maintenance function (LMF). Part of the AGS is also a software (SW) loading function. LMF and SW loading functions are manageable from a standard laptop computer connected to the control panel. The satellite modem used utilizes the Inmarsat™ Swift-Broadband service and modulates the data into signals for the external satellite link, which are sent and received by the external aircraft antenna. The Swift-Broadband system provides one satellite channel at a minimum.

On-board control equipment (OBCE)

Working principle of the leaky line antenna



### CONTROL PANEL

The control panel is the system interface for the crew and is installed in the aircraft cabin. It monitors and controls the system with push buttons (with integrated indications) and system indication lights.

Three system indication lights show:

- The 'system ready' LED (Light Emitting Diode), green illuminated when the system has started or is in idle mode
- The 'system failure' LED, yellow illuminated in case of failure
- The 'service available' LED, green illuminated when it is possible to use GSM on-board services

### LEAKY LINE ANTENNA

A leaky line antenna for signal coverage of the aircraft cabin is installed in the ceiling along the whole cabin length and distributes RF signals from the OBCE and BTS. The frequency range of the antenna is 400MHz to 3GHz and due to the close proximity of mobile phones and BTS electro-magnetic radiation to crew, passengers and aircraft equipment is low and far below the levels recommended by the World Health Organization (WHO).

### RECEPTION ANTENNA

A reception antenna connected to the OBCE via coaxial cable above the cabin ceiling, is a standard dipole to receive signals from passengers phones.

### ADDITIONAL CONTROLS

Additional controls provide system control, functions and indication:

- System ON/OFF switch
- 'Voice (Calls) Off' switch (voice calls disabled, data calls (SMS/GPRS) enabled)
- Passengers sign ON/OFF (no mobile phone signs). The signs are switched automatically by the system. Cabin crew can also switch them on for service reasons (asking passengers to power off their telephones)
- Maintenance button
- Maintenance interface via an external equipment
- Cockpit button giving pilots final control over the system in the cabin
- Modification of the passenger service unit channel to replace the NO SMOKING sign by a NO GSM pictogram. A NO SMOKING placard will be added on each PSU unit for passenger visibility

## The satellite transport domain

Connects the airborne and the ground segments with a satellite link providing transportation and interconnection to terrestrial service providers and backbone networks. It comprises the following components:

- The satellite antenna that transmits and receives signals to and from the Inmarsat™ satellite
- Diplexer/Low Noise Amplifier (DLNA) located near the satellite antenna for diplexing, filtering and amplifying signals
- A satellite modem that opens a communication pipe to the Inmarsat™ satellite and modulates the data stream into RF signals (and vice versa).

The Network Operations Centre (NOC) is in charge of the dynamic channel assignment to achieve the quality of service required taking into account the traffic load.

## The ground segment

The ground segment is based on a 2.5-generation ground infrastructure, which provides the elements for circuit (GSM) and packet (GPRS/General Packet Radio Service) switching. This infrastructure includes all the standard elements used in any GSM mobile operators' infrastructure such as:

- The Mobile Switching Centre (MSC) managing the switching of the incoming and outgoing calls
- The Visitor Location Register (VLR) completing the authorization process with the home mobile operators of the subscribers roaming on the network
- The Serving GPRS Service Node (SGSN), Gateway GPRS Service Node (GGSN) and border gateway supporting the GPRS core network.
- The Ground GSM Server (GGS), which is the equivalent of the AGS on-board the aircraft, reformats the traffic coming from the aircraft to the standard A-Bis interface and vice-versa.
- The home location register, which in the OnAir™ network, will only be used for the testing of the roaming relations.

The ground segment also includes the elements interfacing with the air-to-ground link provider's gateway. These elements regrouped under the diverse routing function ensure the conversion and optimization of the GSM A-Bis interface into a protocol enabling the efficient transmission over the air-to-ground link.

All UMTS (Universal Mobile Telecommunication System) devices are backwards compatible with GSM and GPRS, so passengers with UMTS phones can use them to access these services.

Overlaying the ground segment, the Operational & Management (O&M) elements ensure the management, monitoring and operation of the network (including the external components such as the air-to-ground link and the airborne system).

Similar to the O&M elements, the billing element ensures the generation of the information necessary for billing purpose (e.g. Call Detailed Records or CDR). This information is mainly provided by the MSC and SGSN elements.

## Conclusion

The system's availability is a long awaited solution for existing and future aircraft and the communication services will become available in early 2007, firstly for the Western-European market. The system is applicable for the whole A320 Family and guarantees that passengers' cell phones will operate in a mode compliant with aviation and telecommunication regulatory requirements during the cruise phase of flights.

The architecture of the GSM on-board system consists firstly of the airborne segment, the satellite transport domain, and finally the ground segment. The Inmarsat™ Swift Broadband satellite communication system connects the GSM on-board system with the ground telephony network via the Inmarsat4 satellites.

OnAir™, Airbus' preferred service provider for voice and data communication services on-board, is a joint venture between Airbus and SITA™ and provides GSM and GPRS services for mobile phones, portable digital assistants (e.g. Blackberry™) and data (Internet).

To enable smooth and flexible embodiment of the GSM on-board system on in-service aircraft with a minimum aircraft grounding time, Airbus has developed a stepwise installation of four Service Bulletins and associated kits (three for provisions installation and one for system installation and activation).

GSM on-board equipment will be delivered as Buyer Furnished Equipment to customers by Airbus KID-Systeme.

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Photo Senneck

# In flight entertainment

## How in flight entertainment has changed!

Today we have the multiple video and audio outputs available mentioned in the IFE articles in this FAST Magazine 39 and the previous FAST Magazine 38. Compare this against a big event that took place almost exactly eighty years ago.

On a sunny 7 November 1926 at 10:30 am, a three engined Junkers G24 (a large aircraft in those days) named 'Wotan', manufacturers serial number 841, registration D915 and built in 1925, took off from Berlin Tempelhof airport in Germany. The flight took the aircraft from Berlin to Hannover, Münster and Frankfurt and its objective was to present for the first time to a wide public the technical equipment of the Telefunken and Ultraphon AG companies during a long haul flight in co-operation with Lufthansa and the free press.

From the aircraft in flight music and spoken presentations were transmitted and also sent to ground stations at Hannover, Münster (also connected to Dortmund and Elberfeld) and Frankfurt am Main.

The transmissions were made up to a distance of 400km and were a recorded concert presented by Director Gaertner of Ultraphon AG, a speech to listeners by Professor Weitz (wearing a cap in the photo above) and a recitation by the actor and lecturer Alfred Beierle who read a chapter from a high altitude flight novel.

During the flight the wireless operator had the brilliant idea to order lunch, which he did at 12:18 am and was promptly answered by the ground station at 12:19 am... Lunch ordered!

The unique value of the flight was not only the aeronautical and radio technological performance, but also that every broadcast was to a precise time as it had to fit into the continuing programmes of the different ground stations.

The flight successfully finished at Frankfurt airport with a speech by the airport director, including an appreciation of the flight and the consequences for air traffic safety for which this Lufthansa flight set a milestone in development.

*Text by courtesy of Lufthansa*

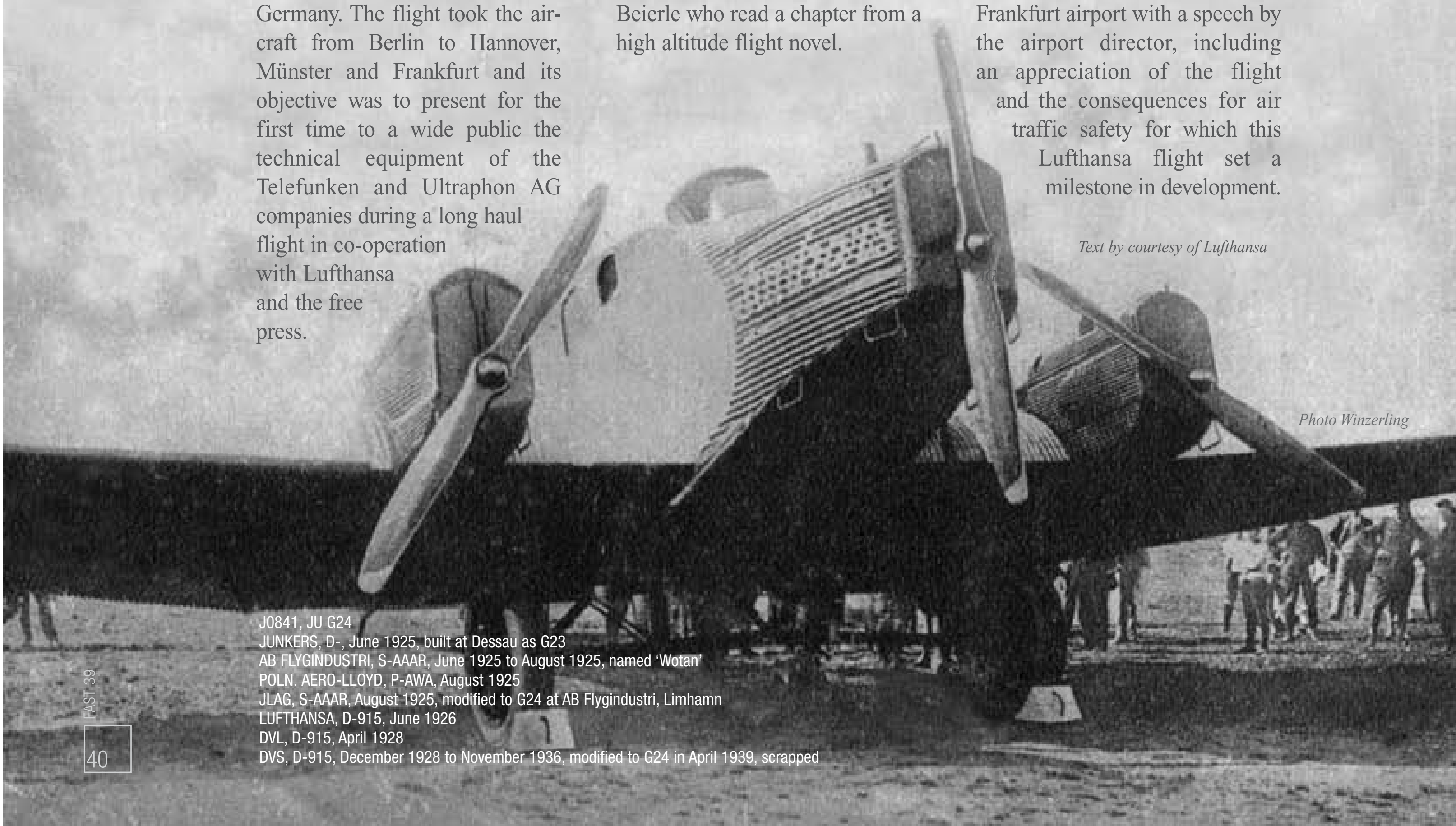
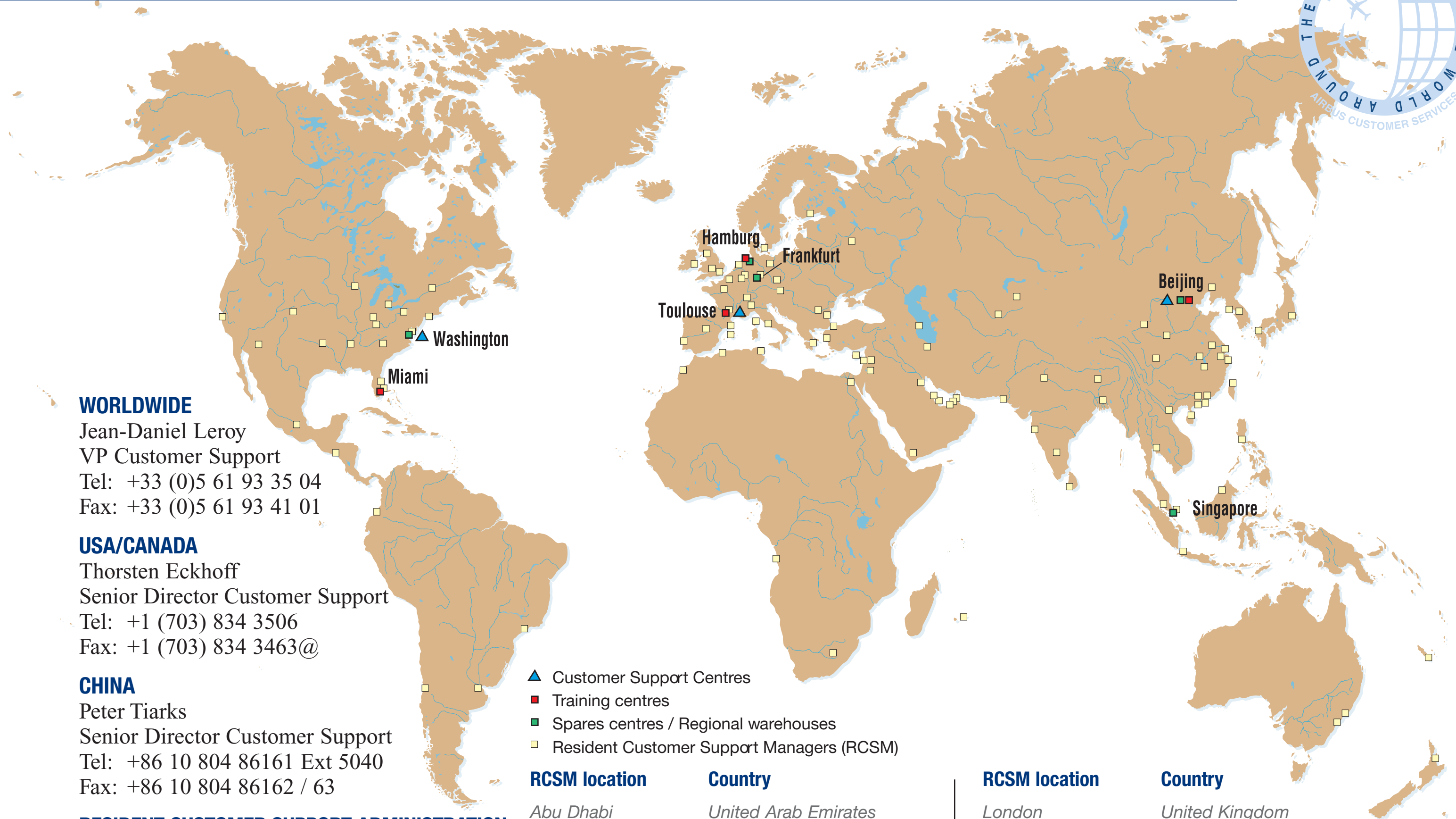


Photo Winzerling

J0841, JU G24
JUNKERS, D-, June 1925, built at Dessau as G23
AB FLYGINDUSTRI, S-AAAR, June 1925 to August 1925, named 'Wotan'
POLN. AERO-LLOYD, P-AWA, August 1925
JLAG, S-AAAR, August 1925, modified to G24 at AB Flygindustri, Limhamn
LUFTHANSA, D-915, June 1926
DVL, D-915, April 1928
DVS, D-915, December 1928 to November 1936, modified to G24 in April 1939, scrapped

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| RCSM location | Country |
|---|---|
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| Ajaccio | France |
| Algiers | Algeria |
| Almaty | Kazakhstan |
| Al-Manamah | Bahrain |
| Amman | Jordan |
| Amsterdam | Netherlands |
| Athens | Greece |
| Auckland | New Zealand |
| Baku | Azerbaijan |
| Bandar Seri Begawan | Brunei |
| Bangalore | India |
| Bangkok | Thailand |
| Barcelona | Spain |
| Beijing | China |
| Beirut | Lebanon |
| Berlin | Germany |
| Brussels | Belgium |
| Bucuresti | Romania |
| Buenos Aires | Argentina |
| Cairo | Egypt |
| Casablanca | Morocco |
| Charlotte | United States of America |
| Chengdu | China |
| Cologne | Germany |
| Colombo | Sri Lanka |
| Copenhagen | Denmark |
| Dalian | China |
| Damascus | Syria |
| Delhi | India |
| Denver | United States of America |
| Detroit | United States of America |
| Dhaka | Bangladesh |
| Doha | Qatar |
| Dubai | United Arab Emirates |
| Dublin | Ireland |
| Dusseldorf | Germany |
| Fort Lauderdale | United States of America |
| Frankfurt | Germany |
| Guangzhou | China |
| Haikou | China |
| Hangzhou | China |
| Hanoi | Vietnam |
| Helsinki | Finland |
| Hong Kong | S.A.R. China |
| Indianapolis | United States of America |
| Istanbul | Turkey |
| Izmir | Turkey |
| Jakarta | Indonesia |
| Johannesburg | South Africa |
| Karachi | Pakistan |
| Kita-Kyushu | Japan |
| Kuala Lumpur | Malaysia |
| Kuwait city | Kuwait |
| Lanzhou | China |
| Larnaca | Cyprus |
| Lisbon | Portugal |

| RCSM location | Country |
|---|---|
| London | United Kingdom |
| Louisville | United States of America |
| Luanda | Angola |
| Luton | United Kingdom |
| Macau | S.A.R. China |
| Madrid | Spain |
| Manchester | United Kingdom |
| Manila | Philippines |
| Mauritius | Mauritius |
| Memphis | United States of America |
| Mexico City | Mexico |
| Miami | United States of America |
| Milan | Italy |
| Minneapolis | United States of America |
| Montreal | Canada |
| Moscow | Russia |
| Mumbai | India |
| Nanchang | China |
| Nanjing | China |
| New York | United States of America |
| Newcastle | Australia |
| Ningbo | China |
| Noumea | New Caledonia |
| Palma de Mallorca | Spain |
| Paris | France |
| Paro | Bhutan |
| Phoenix | United States of America |
| Pittsburgh | United States of America |
| Prague | Czech Republic |
| Quito | Ecuador |
| Rome | Italy |
| Sana'a | Yemen |
| San Francisco | United States of America |
| San Salvador | El Salvador |
| Santiago | Chile |
| Sao Paulo | Brazil |
| Seoul | South Korea |
| Shanghai | China |
| Sharjah | United Arab Emirates |
| Shenyang | China |
| Shenzhen | China |
| Singapore | Singapore |
| Sydney | Australia |
| Taipei | Taiwan |
| Tashkent | Uzbekistan |
| Tehran | Iran |
| Tokyo | Japan |
| Toulouse | France |
| Tulsa | United States of America |
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