Structuring a M&E IT system to achieve a range of functionalities and meet long-term requirements is a complex process. One requirement is to configure a system to coordinate all defect reporting, diagnosis, rectification planning & routine line maintenance tasks into a streamlined process.

Structuring a M&E system for line maintenance & defect functionality

The traditional system of coordinating and monitoring aircraft schedules and operations with on-going maintenance control and line maintenance involves several departments and individual staff members. These can be based in several locations, using different information sources and communication systems.

This inevitably means that staff and departments work with old, inaccurate and differing information. The overall system for managing and coordinating flight operations and line maintenance is largely manual; albeit with some IT systems used to autonomously manage individual processes. The technology is now available to transform and streamline this process by using a fully electronic and coordinated system.

Such a system is intended to make the flight operations, maintenance control and line maintenance process more efficient by using fewer staff, making fewer mistakes, having lower costs and fewer aircraft delays, improving aircraft utilisation, and providing staff and departments with a clearer and more up-to-date view of aircraft maintenance status and operations.

Flight operations

The first step of the flight operations and line maintenance process starts with communicating the planned flight schedule prior to operation, and the actual flight operations data as aircraft operate.

"As well as allowing for coordinated maintenance plans to be made, the flight schedule plan provides information on the location of each aircraft. This is used by the airline's maintenance control centre (MCC), which also uses a maintenance & engineering (M&E) system for monitoring the aircraft's maintenance status during operations and planning line maintenance actions," says Chris Reed, managing director at TRAX.

The flight operations department also has to communicate flight operations data, as flights occur, to the flight operations and M&E systems. "This includes out, off, on and in (OOOI) times and aircraft defect and technical fault data. This is sent by the aircraft to a ground server, and then fed into the MCC, and the flight operations and M&E systems," says Reed.

Air-to ground communication

Airlines have four systems to choose from for effecting automatic air-to-ground communication.

The first of these is the original form of the aircraft crew and reporting system (ACARS). The original ACARS, sometimes referred to as ACARS (POA), has the lowest cost and is used by the most aircraft. It uses very high frequency (VHF) radio signals, so it only works on a line-of-sight basis. This gives it an effective range of up to 200nm.

This has been followed by VHF data link mode 2 (VDL Mode 2), which is ACARS with a higher bandwidth. "This will be required on increasing numbers of aircraft," says Gary Anderson, business development director at ARINC Aviation Solutions. "VDL Mode 2 is required to support data link communications. Controller pilot data link communications (CPDLC) will be used from January 2015 by air traffic control in the Maastricht zone of upper European airspace. All aircraft flying in this airspace will be required to have CPDLC capability, and so will have to be retrofitted with VDL Mode 2 equipment. The US will start operating its free flight system about two years later, so aircraft operating in US airspace will also have to be retrofitted with this equipment.

"The VHF radio set on the aircraft used for ACARS transmissions changes frequency automatically depending in which part of the world it is flying," continues Anderson. "The system has a frequency look-up table, and changes frequency several times during flight when flying over remote areas."

Some long-range aircraft are already equipped with future air navigation system (FANS) equipment. This is a satellite communication system for data or voice. It is used to send navigation position reports using data to replace a pilot's radio transmissions. FANS-equipped aircraft already comply with the Eurocontrol mandate to handle CPDLC, and so do not need VDL Mode 2. This includes most long-haul aircraft in all parts of the world.

The second option for air-to-ground communications is high frequency (HF) radio transmissions. These bounce off the earth's ionosphere, and so travel further. "ACARS can also be used with HF, and it uses a HF radio that is data-link compliant. This is referred to as HFDL," says Anderson. "More younger generation aircraft have HF data radios. These are automatically switched on when the aircraft loses VHF data communications. ARINC uses 15 ground stations for receiving ACARS transmissions from aircraft, and these are relayed to airline systems. ARINC is the only provider of HF ACARS. While some consider HF data radios to be old technology, aircraft manufacturers are still equipping aircraft with them,

The use of ETLs is the first stage to streamlining the fault reporting, defect diagnosis and rectification process. There are several additional stages to go through before an airline can have a coordinated flight operations, MCC and line maintenance system.

including the A350."

The third and fourth options are two forms of satellite communication.

Inmarsat uses three geostationary satellites that provide a wide bandwidth for data and voice communications, and the internet. It covers most areas of the world, but not the polar regions.

Iridium does provide global coverage via 66 small satellites in different orbits. It was originally developed for telephones and shipping, and has a narrower bandwidth than Inmarsat.

ARINC communication, for ACARS, can also be used with Inmarsat and Iridium. This is useful if the aircraft is not equipped with HF radio.

It is important to consider the advantages and disadvantages of these four communications systems with respect to fault reporting, flight operations, MCC and line maintenance.

Once flight operations, and defect and fault information has been sent from the aircraft, it has to be relayed to the relevant systems in the flight operations and line maintenance process. "ACARS data has to be in a format that meets certain ARINC specifications. In this format, data passing between different applications can be used," says Anderson. "The flight operations and M&E systems use a Type B network interface. Airlines need a data management system on the ground that re-formats messages, sent from the aircraft, before they are sent to the relevant system in the airline departments. This process takes place automatically so that there is a seamless transmission of data. One system ARINC has available is the web-based datalink management system. This reformats messages, which are integrated into the airline's requirements."

Aircraft defects

Defects and technical faults are categorised either as those that are automatically detected by built-in test equipment (BITE) and then given a central maintenance computer (CMC) code, or those which cannot have a CMC code generated for them, and so have to be reported by the crew.

CMC fault codes are generated for aircraft systems and components which have BITE. For many years they have been automatically transmitted to ground servers stations via ACARS, and then on to the M&E system for analysis by the MCC and line mechanics. MCC and line mechanics can thus be notified of these faults while the aircraft is in the air. "The MCC monitors the aircraft's maintenance and defect status and plans defect rectification, and releasing the aircraft for service," says Reed. "Trax shows the fault codes for each aircraft type in the fleet so that MCC personnel can easily diagnose faults, and start planning their rectification."

Faults that cannot be detected by BITE, and so do not have a CMC code generated, have traditionally been written in paper technical logs. Such faults include items known as 'flightdeck' effects. Examples are problems with flight controls, computers not responding correctly to inputs by the crew or problems starting engines.

Paper technical logs have three-ply copies, so that one can be sent to the MCC, one to the line mechanic once the aircraft lands, and one, the 'golden copy', is kept on the aircraft.

The MCC monitors each aircraft's maintenance status and coordinates the diagnosis and deferment or rectification of defects. It uses the tech log to monitor the aircraft's maintenance status.

Line mechanics and the MCC department diagnose faults, and group them as follows: relatively simple ones that can be fixed relatively quickly while the aircraft is at the gate; ones that can be deferred (and how long for); and those that cannot be deferred and so will cause the aircraft to be grounded (referred to as aircraft-on-ground (AOG) defects) and so have to be fixed.

Diagnosis, and deciding whether or not to defer rectification, is traditionally made manually with the aid of various technical manuals, which have traditionally been printed hard copies. These include the fault isolation manual (FIM), troubleshooting manual (TSM), minimum equipment list (MEL), and configuration deviation list (CDL).

"The first inherent problem with using traditional paper tech logs is that line mechanics, and the MCC, have to start diagnosing and deciding to defer or clear defects before the information in the tech log has been keyed into the M&E system, which can take one or two days," explains Tim Spears, vice president on-board systems at Ultramain. "This means that when the information is entered into the M&E system some of it is out of date. In the meantime, the line mechanic will have rectified the simpler and AOG faults during the turnaround following the landing. Their rectification also has to be entered into the M&E system. In many cases, the tech log pages are not actually entered into the M&E system until they are resolved. The corrective action for defects cleared on the line, and deferment of others is all recorded on paper before the next departure, so that the defect and resolution are entered at the same time.

"The mechanic will decide whether to defer other faults in accordance with the MEL and CDL," continues Spears. "Faults that can be deferred fall into four categories: A, B, C and D. Category A faults are those that can only be deferred for a single flight, giving the aircraft enough time to return to home base where it is usually easier to rectify faults. Category B faults can be deferred for three days, category C faults for 10 days, and category D faults for 120 days. The tech log will often also have non-MEL deferred defects. Airlines have different policies on how long they allow defects to be deferred, or the maximum number of outstanding defects they allow.

"The remaining type of defects will be AOG faults, and require a more complex and time-consuming rectification," continues Spears. "The defects are therefore categorised and recorded in the tech log. Those that are deferred will be listed in a dedicated section of the tech log. The tech log also has a rotable parts and components change transaction record, which includes information relating to serial numbers of these parts."

The first problem caused by the delay in manually entering the defects into the M&E system is that defects cleared during the turnaround after the landing and the category A faults are already cleared before they are entered into the M&E system as outstanding defects.

This then inevitably means that the list of outstanding defects on the M&E system is rarely up to date, making it difficult for the MCC to monitor the aircraft's maintenance status. A combination of the MCC, paper log copies not yet entered, and the list of outstanding defects must all be considered to get a full picture of the aircraft's maintenance status.

"Manually keying information into the M&E system also means errors are made, partly due to misinterpretation of handwriting," says Spears.

The process of diagnosing faults and defects will be aided by the fact that most M&E systems now have electronic versions of the FIM, TSM, AMM, MEL, CDL and other manuals. Non-CMC faults, which are written in the technical log and have to be diagnosed after the aircraft lands, have traditionally been diagnosed with the use of printed technical manuals that have to be kept on the flightdeck, or at a line mechanic's workstation at the airport terminal. This means mechanics often make several trips between the aircraft and their office.

Line mechanics therefore laboriously diagnose faults by using different manuals, and then prepare and perform fixes, all during the allotted downtime, with inevitable delays. This can involve several trips by the mechanics between the aircraft and their office. The mechanics will also have to arrange for parts and tools, as well as additional mechanics and facilities in some cases.

This process would clearly be easier and faster if non-CMC defects and faults could be reported while the aircraft is in flight, rather than waiting for the paper log to be handed by the flightcrew.

"Many airlines ask flightcrew to send messages, relating to non-CMC defects, with fault codes via ACARS. These fault codes are not the CMC codes, but are found in a fault reporting manual (FRM) published by the aircraft manufacturer and kept on the flightdeck. The message is keyed in on the flight management computer (FMC) and sent to the M&E system," explains Spears. "These codes are designed to link into the electronic FIM in the M&E system. It is still a long-winded process for flightcrew to find the code that relates to the fault. Only about 10% of the faults get reported this way while the aircraft is in flight, because the pilots are too busy. The remainder are still reported with paper technical logs."

Electronic technical log

The process of registering, reporting and diagnosing all non-CMC faults, defects and flightdeck effects is made easier and faster with the use of an electronic technical log (ETL). The ETL is software that is accessed via the electronic flightbag (EFB) mounted in the flightdeck. An EFB will be standard on modern types, such as the 787 and A350; but has to be retrofitted to many older types. All the technical log information is then automatically transferred to the M&E system via ACARS while the aircraft is in-flight.

"All problems are therefore entered electronically. The ETL has the facility for flightcrew to search for FRM codes," says

ARINC is retrofitting Cathay Pacific's entire fleet with Iridium and TWLU to provide the aircraft with connectivity at all stages of operation. This is the first stage in allowing Cathay Pacific to combine routine line maintenance and defect rectification, and perform the work with the use of tablets and with the absence of paper.

Spears. "Ultramain's system allows the user to navigate by air transport association (ATA) chapter, aircraft system, or find the fault by typing in key words to describe the problem. In most cases, the appropriate description or FRM code can be found in three or four key strokes. The use of FRM codes makes fault reporting accurate, whereas written reports on paper logs are often vague. Additional data and remarks can also be added on the ETL. Ultramain provides ETLs for all Boeing aircraft, and the ETL for the 787 will have the facility to select a pre-programmed flightdeck effect from a menu and record an associated write-up to go with it in the technical log. The completed report is sent to the ground via ACARS. Many airlines are using Iridium and other satellite communications as an alternative. Iridium offers short burst messages, which are basically text messages.

"The ETL will have a corresponding application at a ground station to receive, de-code and diagnose the message sent from the aircraft," continues Spears. "This ground station is a communication end point for all messages sent by the aircraft. The ground station also sends confirmation that the message has been received back to the aircraft. The message is also sent on to the M&E system, so that it is kept up-to-date with all aircraft defects. This makes it possible for line mechanics to start diagnosing most non-CMC faults as they occur during the flight prior to landing. This in turn makes it a lot easier to decide which faults to rectify during the turnaround and which to defer before the aircraft lands. The preparation to fix faults can also be started before the aircraft lands.

"The format for the data in the message is XML, and is defined in Spec 2000, Chapter 17," adds Spears. "What is important to appreciate here is that this process is for ETLs running on class 2 or 3 EFBs. Class 1 EFBs do not have connectivity with the rest of the aircraft, or send messages to the ground."

Using ETLs has several advantages. Defect information does not go missing or get lost. It also removes the problem of paper logs not being examined until after the aircraft has landed, as well as removing the need for manual entries into the M&E system. The paper technical log always stayed on the aircraft, as the golden copy, so that the aircraft could be worked on at remote outstations. If an ETL is used, there is no risk of the aircraft being grounded, since the information can always be accessed. This is because the golden copy is on the ETL.

The ETL can also provide access to electronic versions of the FIM, TSM, MEL, AMM and other manuals. Line mechanics can therefore diagnose faults which they did not have time to diagnose while the aircraft was in flight, more quickly once the aircraft has landed than when using traditional paper manuals.

The A380, for example, has two on-board information terminals (OITs) and an on-board maintenance terminal (OMT). These are used to access the aircraft's central maintenance function, post-flight report, and various manuals. The OIT and OMT will eventually have the ability to access the ETL.

A further benefit of the ETL is that the MCC has access to an almost up-to-date report of the aircraft's maintenance status. The MCC is therefore also able to start diagnosing and preparing maintenance while the aircraft is still in the air.

The line mechanic's office is usually close to the terminal gate. A mechanic needs a computer with a user interface to the M&E system. The Ultramain M&E system has a line maintenance execution tool called Gate Turn Management.

The M&E system, which will now receive information for all types of faults and defects, will be able to correlate the FRM codes of non-CMC faults with the CMC fault codes that have both been sent by ACARS during flight. This leads to faster fault and defect diagnosis by line mechanics and the MCC.

Health monitoring

Another element of providing data and information relating to line maintenance is aircraft health monitoring (AHM). Various systems on the aircraft are monitored for their performance. Several thousand health parameters are monitored for the aircraft's components and systems.

These data have an impact on maintenance, since it indicates the health and reliability of systems. AHM data therefore has to be transmitted to the ground by ACARS. Unlike ETL and CMC codes, there is no standard format for AHM data, and each original equipment manufacturer (OEM) has its own format. Many use XML, since this is the standard adopted for other messages.

Each manufacturer offers its own AHM service to airlines. AHM data are transmitted to the OEM's ground server, and analysed by the OEM using its own software. OEM analysis reveals if the aircraft is performing correctly. Issues can be large, such as if the fuel burn rate is correct, or small, such as if the flight control services are aligned properly. All parameters have implications for maintenance.

The data are then passed to the operator. In a mixed fleet the data go via a translator to be converted into a common standard, and are then passed to the M&E system.

"The AHM data identify symptoms of components or systems, or a group of symptoms, and are used to diagnose a fault," says Spears. "This information can be raised to a fault so that the process for raising a repair can begin."

Line maintenance planning

The traditional process of line maintenance planning starts with the diagnosis of faults as they are reported. Besides the faults that are diagnosed by the line mechanics after the aircraft lands, the MCC analyses faults and overall monitors the fleet's maintenance status. It has the authority to defer or correct faults, and starts the fault correction process. This is done together with a line maintenance planner, and the M&E system is used in this process. This means flight operations, and ETL and AHM data all have to be in, or accessible from, the M&E system and at the fingertips of the MCC and line maintenance planners.

The first steps therefore involve analysis using the various manuals and the decision of whether or not to defer, as described. The tech log is a legal document, and faults and defects must be fixed or deferred in accordance with the MEL. These are signed off by the mechanic when they are cleared; forming a legal maintenance and technical record.

Defects will be deferred if their repair takes a lot of time, if the parts and other resources are unavailable, or if they need lengthy troubleshooting and research, and complicated issues such as technical specialists or complex measurements.

The planning process also has to consider the length of time for which defects can be deferred. Some defects may have to be added to resolve some defects. Non-routine line maintenance tasks to fix defects may also be combined with the replacement of life-limited parts (LLPs) and out-of-phase (OOP) tasks. There may also be smaller engineering orders (EOs) and airworthiness directives (ADs).

Planning therefore has to consider all tasks coming due and that could be included; the time limit on deferred defects, the tools, parts and skills required; the availability of appropriate facilities; and the available downtime in the aircraft's planned operating schedule. Third-party capability and availability also has to be considered.

The M&E system sends a list of tasks or the maintenance work order coming due, plus the estimated downtime and legal limit for performing the work, to the flight operations department, so that it can plan the operating schedule around the maintenance. The M&E system also sends MEL data relating to open defects and what their remaining deferment time is. There is therefore a two-way data exchange between the flight operations and M&E systems.

The task cards for fixing defects will either be standard cards, with some coming from the AMM; or complex tasks which require new cards to be written. The latter category will therefore require engineers available to author and approve task cards for these type of fixes. These task cards are created in the M&E system, just as task cards are written for base maintenance.

The traditional system of planning line maintenance is for routine tasks and the clearing of defects to be treated as two streams. Routine work has to be planned by the line planning department, while non-routine maintenance is handled by the MCC. Cathay Pacific, however, is planning to make full use of its aircraft having connectivity and ETLs by combining routine and non-routine line maintenance. "Our maintenance provider, HAECO, has set up a Technical Maintenance Centre to bring the two functions together," says Rob Saunders, manager engineering division at Cathay Pacific Airways. "Using the ETL in isolation will improve defect management, but we are also planning to add routine maintenance tasks to include them on the ETL. Ultramain, our M&E system, will collect defects from the ETL, bring them together with the routine tasks, and combine them in an electronic tally sheet. This is a list of maintenance tasks to perform."

Maintenance performance

Maintenance task cards, for use by mechanics, can either be created on paper or electronically. This can be referred to as maintenance input.

Similarly, maintenance performed, referred to as maintenance output, can be recorded manually on paper task cards; or electronically or digitally. Electronic and digital signatures have started to be used in hangar maintenance *(see Structuring a M&E IT system to achieve engineering, content management & job card production functionality, Aircraft Commerce, June/July 2012, page 51).* It has recently become possible to use electronic and digital signatures in line maintenance.

Electronically recording maintenance performance without any paper records and manual signatures requires digital signature capability. This is often referred to as level 2 electronic signature. This has to be distinguished from electronic signature, which is often referred to as level 1 electronic signature.

Electronic signature is where the mechanic has a secure method of informing the M&E system that a task card has been completed. A manually-signed paper task card is still required for a legal maintenance record, however.

Digital signature is required for paperless maintenance; that is with electronic task cards and without paper task cards that are manually signed. These are permitted where it can be demonstrated to the regulatory authorities that the electronic task cards have not been tampered with after signature. "Digital signature currently requires several technologies to be in place," says Spears. "This includes particular software, processes and a smart card or a card with a magnetic strip. This is used by the mechanic to digitally sign a task card. The hardware and infrastructure to read the card is required in the overall maintenance hardware and IT system. Smart cards or cards with magnetic strips are only used in hangar maintenance, however."

Spears explains there are three levels for line maintenance execution: paper input-paper output; paper input-ETL output; and ETL input-ETL output.

Maintenance input not only includes tasks to clear defects, but also the initial write-ups in technical logs, and additional must-do or opportunistic tasks.

"The paper-paper system is the system still used by most airlines, since few airlines have yet implemented ETLs," says Spears. "Maintenance, part and component changes, and the clearing of outstanding defects are all recorded in the technical log. Mechanics also record the scheduled line maintenance tasks and cleared defects in the technical log.

"Once the work is completed, a copy of the technical log is taken and manually keyed into the M&E system to inform it that outstanding defects have been cleared," says Spears. "The problem is that this can be done either immediately, or up to two days later.

Under the paper-ETL system, task cards are still generated on paper, but the M&E system is informed of their completion using level 1 electronic signature. "This is made possible with the use of paper task cards generated with barcodes," says Spears. "Mechanics scan the barcode with a reader to inform the M&E system instantly that the task has been performed. The system is flexible, since the ETL on the aircraft or at the ground station can be used to inform the M&E system that tasks have been completed. The ground station sends messages to the ETL hosted on the aircraft. Sign-off from the ETL can remove the need for paper to be signed.

"Another possible route in the paper-ETL scenario is having a reference number on the task card and keying this into the ETL to inform the M&E system the task is completed," adds Spears. "The

ETL is not programmed with the reference number, which is sent to the ground station and then on to the M&E system. The M&E system recognises the reference number, and reconciles it with the task card reference. The benefit of this system over paper-paper is that the M&E system gets immediate feedback, as well as labour being saved for manually keying in data into the M&E system."

This may or may not require signature on the paper task cards.

Under the ETL-ETL system, electronic task cards are pushed out from the M&E system to the ETL ground station. The tasks are sent to the ETL on the aircraft.

"The mechanic can see the summary of tasks on the ETL, and view these along with the AMM and any other relevant manuals," says Spears. "Each maintenance task is summarised along with an AMM reference number. There is also a document reader application, which has hyperlinks to the AMM, MEL and other manuals. The document reader can access anything that traditionally has required paperwork. The content is distributed as XML, and the reader provides annotation and bookmarks.

"To avoid using paper, a system for using digital signature is required," says Spears. "The EFBs in use on aircraft that host ETLs, however, do not have smart card or magnetic strip readers. Electronic signature can only be used if it can be demonstrated to the regulatory authorities that the signature has been made in a controlled environment,with evidence that the signature has not been tampered with after aircraft departure.

"Ultramain has worked with KLM to implement a paperless ETL, using password electronic signature, on its 777-300 fleet. Ultramain has now combined digital signatures with a crytographic timestamp, providing for the possibility of proving non-modification without special control of database servers," continues Spears. "This allows digital signatures to be made on the ETL, the ETL ground station, or at the M&E system, and so avoid the use of paper. The ETL ground station or the M&E system is used to inform the ETL on the aircraft that the task has been completed. One benefit of the system is that even when the aircraft is disconnected from the rest of the world, maintenance can still be performed and the aircraft dispatched, since all manuals and the tech log can be accessed via the EFB."

Tablet computers

Further to the use of ETLs to electronically inform the M&E system that tasks have been completed, iPads and other tablet computers provide hardware that can remotely access the M&E system and ETL.

While all aircraft communications to date have been developed for aircraft in flight, the use of tablet computers in line maintenance requires a wireless communication with the aircraft. "This can be done with WiFi or GPRS signal, as used by smartphones," says Anderson. "The aircraft will need to be equipped with a terminal wireless LAN unit (TWLU) and an appropriate antenna. Data and information already sent from the ACARS to the EFB, which holds the ETL software and applications, will then be interfaced with the TWLU. The TWLU gives the EFB the ability to wirelessly transmit to tablet computers used by mechanics on the ground as they perform line maintenance."

The use of remote tablet computers allows maintenance work to be carried out at all locations on the aircraft, which can be a long way from the flightdeck. Tablets also allow the manuals and the tech log to be accessed remotely, which assists in troubleshooting.

"The use of iPads and tablet computers with a remote connection to the ETL and M&E system not only allows the ETL to be accessed remotely in the ETL-ETL scenario, but they can also be used to replace paper in the paper-paper and paper-ETL scenarios as well," continues Spears. "It is now possible for digital signatures to be made on tablets, in place of scanning of barcodes on paper cards where electronic signature is used.

"Using digital signatures remotely on tablets requires a further level of approval compared to using them on ETLs and the M&E system," continues Spears. "The tablet can be used either on- or off-line. In on-line mode, the system is synchronised with the ETL so that the digital signature process can be finalised on-line. For digital signature to be permitted, the tablet currently has to be used off-line while performing the maintenance outside and at different positions around the aircraft. The tablet can then be taken to the flightdeck, mechanic's office or MCC and then turned on to on-line mode and synchronised with WiFi and GPRS to finalise the digital signature process. This has to be in a controlled environment so that a hacker cannot interfere. Singapore Airlines and British Airways are using tablets for digital signature on the aircraft.

"Ultramain is now working to get approval to use tablets for digital signature in an on-line mode when off the aircraft, and hopes to get approval by the second quarter of 2013. This will require proof that signing off aircraft will be in a controlled environment," continues Spears. "Several airlines are planning to use tablets for digital signature on and off aircraft in an on-line mode."

This type of system is expected to remove the need for a lot of trips the mechanic makes between the aircraft and his ground station and the MCC.

Airline use

While Cathay Pacific has plans to combine its routine and non-routine line maintenance tasks, it has not yet decided exactly how its mechanics will view the tasks. "The first option is to view them via the EFB on the flightdeck," says Saunders. "The second is to view them in the M&E system. The third is to use tablet computers, via either the M&E system or via the EFB. The likely outcome is a combination of access method, but the key objective is that the mechanic should not have to worry about which way he is connected.

"As the first step to achieving this, we are having both the legacy aircraft and new generation aircraft in our fleet e-connected by ARINC," continues Saunders. "The aircraft will be installed with Iridium and TWLU. Iridium will provide air-to-ground communications, in addition to ACARS that is already installed. The TWLU will provide WiFi connectivity while on the ground. This level of connectivity is unique, since the aircraft manufacturers are not providing this as standard. ARINC is also building an application for us. This will automatically choose which of the three communication systems the aircraft will use during all stages of operation based on priority and transmission cost."

The first stage of Cathay's plans to combine all line maintenance tasks on an electronic tally sheet will be to view them on the ETL. "We plan to start this in spring 2013, when we will have some of our 777s e-enabled. More aircraft will be modified during 2014 and 2015, and the whole fleet of 177 aircraft will be e-enabled," says Saunders. "We will use digital signatures on the ETL. HAECO is already deploying mobile devices, so once we have got this working, we will jointly decide what to do with regard to providing the mechanics with tablet computers and finally bringing the new e-enabled world together with the M&E system processes. In the short term-we will still use paper task cards for routine maintenance, and digital signatures on the ETL for defects. The next stages will be to combine the routine tasks on the ETL. This could be followed by putting them on to tablets or a mobile device." AC