

ISRAELI FEEL TO SINGAPORE F-16D ● JAT SIGNS FOR A319 FLEET

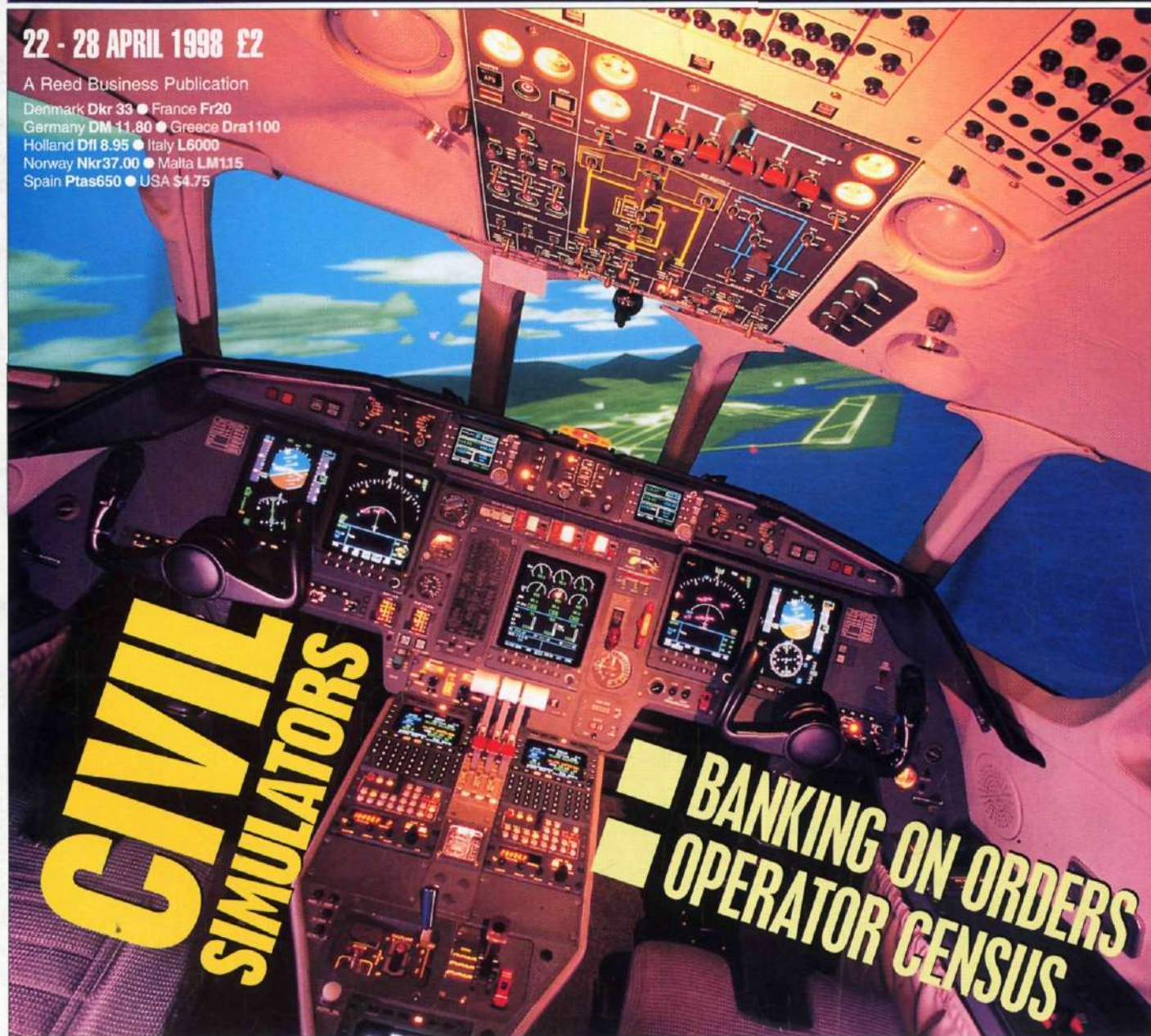
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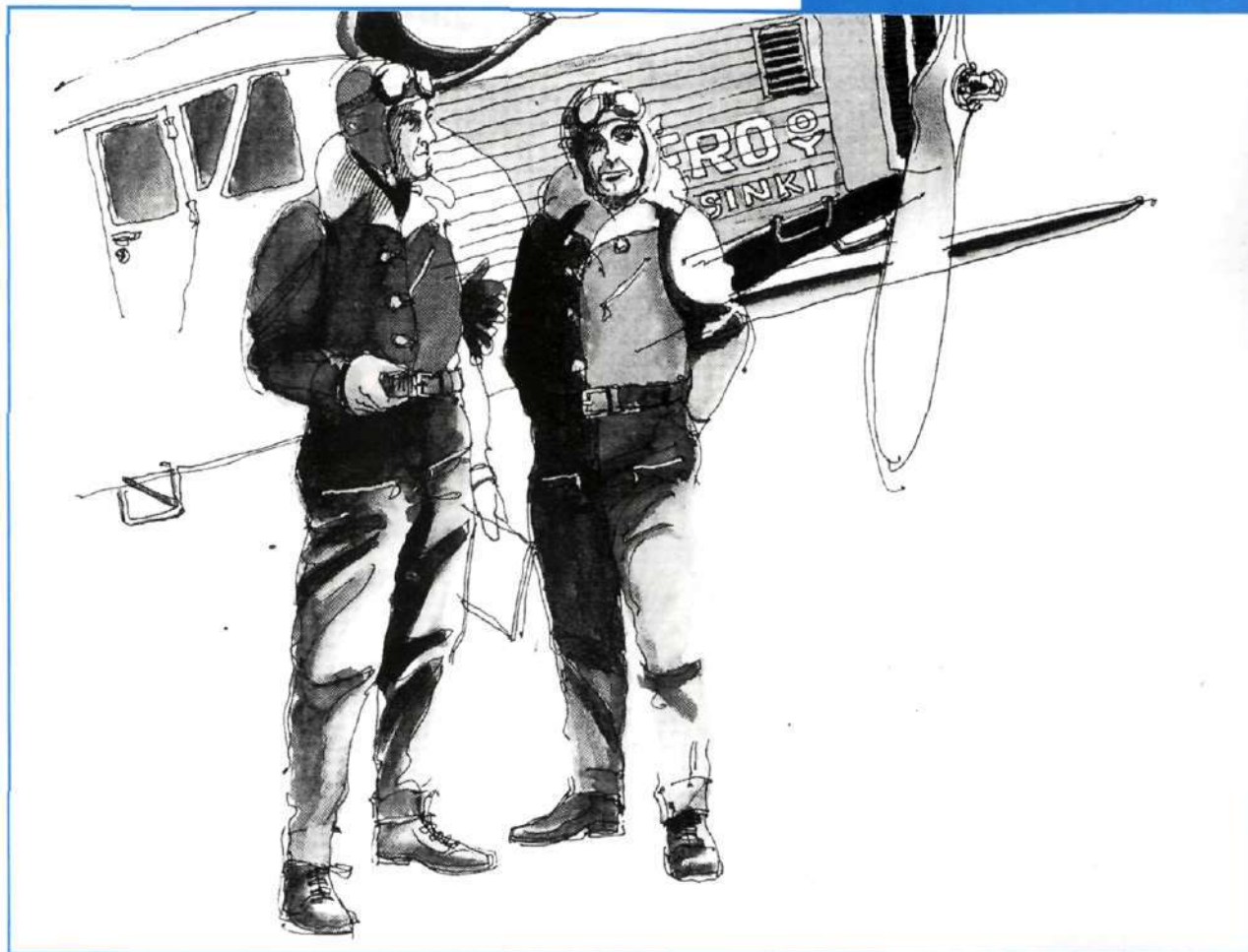
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COMMENT

DRAWING A LINE

IN THE next few days, a US Federal Aviation Administration (FAA) delegation will walk into an ICAO conference chamber and prepare to put their arguments over a key element of the Future Air Navigation System (FANS).

The case that they plan to make may look like genuine concern with smooth technical advancement. Its real aims are nothing of the sort, being more concerned with offering protection to the US industry regardless of the cost to the global aviation community.

If this were an isolated piece of manoeuvring on an obscure issue, then compromise might be the order of the day. Unfortunately, that is not the case. Not only is the particular point too important in itself

to ignore, but it threatens to cripple one of the most promising contenders in the race between competing technologies to underpin FANS.

What the USA hopes to do is to divert or delay the vital ICAO "validation" process of a largely Swedish-developed self-organising, time-division, multiple-access (STDMA) VHF datalink technology. Inevitably, the US intent is masked by rather more soothing language, but happily it has been rumbled and now faces a storm of protest from European interests that have invested hefty amounts of time and money in highly promising experiments with the system.

All this matters, because optimum datalink is at the very heart of the type of "free flight" operations on which the airspace of the future seems certain to be based.

The problem for the USA is that European researchers are rapidly pulling ahead in developing solutions to the fundamental challenge of improving airspace capacity. Not only have they seen the potential of the STDMA technology but, in a model example of government/industry co-operation, they have implemented with some flair a real-world, international demonstration programme. US industry and operational FAA officials are frankly envious – and privately say as much.

Whatever the technical disagreements, there is certainly no question that STDMA works – a series of trials have already been carried out across Europe with dramatic success. The FAA

argues that the Mode-S datalink, already used for Traffic Alert and Collision Avoidance Systems (TCAS), is a more suitable solution. Given that both systems have strong links to their respective aerospace industries – STDMA has been pushed

evangelically by the Swedes and Mode-S is essentially a US system – it would seem to make sense to look to potential users for an unbiased opinion. What one then finds is a band of technically sophisticated airlines, notably Lufthansa and SAS, that have opted to pursue STDMA, not to prove a political point but because it holds out a solution to a pressing commercial problem. If FANS planners had so far paid more attention to the interests of system users and less to those of vendors and service providers, then the whole FANS concept might be substantially further along.

In this instance the logic is overwhelming. The reason that the airlines take the view that they do is that they fear the coming of disastrous airspace congestion, particularly in Europe, and want a robust solution.

They are right to worry. There is something of a mindset in commercial aviation that, given the astonishing success of the industry in its first 80-odd years of existence, everything will come right in the end. That is not necessarily so. There is unquestionably some finite limit to the amount of air traffic that can be accommodated in the world's skies, and the signs are that even that will not fully satisfy passenger and freight demand. We do not know how close to that limit we already are, but compromised technical solutions can only bring the dark day forward.

When the FAA officials turn up for the ICAO meeting they will find arrayed against them just about every expert in Europe – and one or two in the USA. If they look over their shoulders they will be greeted by the sight of a host of similarly knowledgeable US figures keeping a safe distance.

As they know only too well, the progress of FANS is already agonisingly slow, and it can ill-afford to be further hampered by the sort of hometown politics which aims to sell one solution just on the grounds that it was made in the USA and kill another because it was not. □



"It is the sort of hometown politics which aims to sell one solution just on the grounds that it was made in the USA and kill another because it was not."

Europe and USA on course to clash over FANS datalink

KIERAN DALY/LONDON

EUROPE AND the USA are once again set for a clash of wills over a key component of the technology to be used in the satellite-based Future Air Navigation System (FANS).

At an International Civil Aviation Association (ICAO) panel meeting starting this week, European interests will confront what they see as a US Federal Aviation Administration attempt to kill off the potential use of a Swedish-developed digital VHF datalink in automatic dependent surveillance-broadcast (ADS-B) – which is one of the crucial elements of the FANS.

Fears in Europe are that the FAA is manoeuvring to have the largely US developed Mode-S datalink adopted for ADS-B in its place.

The row centres on FAA attempts to have the ICAO validation process for the Swedish STDMA datalink moved from the Aeronautical Mobile Communications Panel (AMCP) into a different panel dealing with navigation and surveillance.

The FAA says that the proposal "...is not as drastic or dire as it may sound", insisting that the move is little more than an administrative exercise, but European officials say that the delay would put back the validation effort irretrievably and give a lead to Mode-S.

A US position paper for the forthcoming AMCP/5 meeting in Montreal proposes that the Mode-S-based system should be adopted as the ICAO standard for future surveillance systems. The FAA argues that the VHF band, in which the STDMA datalink operates, is too congested.

In Europe, extensive STDMA trials are under way with airlines including German flag carrier Lufthansa and Scandinavia's SAS, as well as a range of national aviation authorities and Eurocontrol. Officials say that STDMA datalinking will help alleviate the frequency congestion issue by reducing the dependence on existing communication and navigation aids. □



JAT's ageing and noisy Boeing 727s will be replaced by A319s from 2000, if trade embargoes are lifted

JAT signs deal for eight A319s

ANDRZEJ JEZIORSKI/MUNICH

JAT YUGOSLAV Airlines has signed a preliminary agreement for eight Airbus A319s in anticipation of the end of trade embargoes with the rump of Yugoslavia.

JAT says that contracts will be signed only when the embargoes are lifted, but anticipates delivery of the first two aircraft in 2000, with the rest to be in service by 2005. A similar preliminary agreement has been signed for CFM International CFM56-5A4 turbofans.

JAT says that it wants the new

aircraft to replace its ageing fleets of eight Boeing 727-200 Adv and five McDonnell Douglas DC-9-30s, although some of the DC-9s may stay in service longer with Stage 3 hushkits and cockpit upgrades. An agreement is in place for two ABS hushkits, with options on additional shipsets.

The remaining fleet consists of nine Boeing 737-300s and two Aero International (Regional) ATR 72 turboprops. One McDonnell Douglas DC-10-30 is operated on services to Beijing, and more long haul aircraft will be

required if the airline carries through its plans to revive its long haul network. This could see the re-introduction of services to the Near East by year end, and the airline hopes that services to Canada, the Far East and the USA will be restored as soon as the "international diplomatic situation" allows.

The airline expects to carry more than 1 million passengers and 8,000t of cargo this year. It predicts rapid growth once trade embargoes are raised, aiming for 1.5 million passengers and 13,000t of cargo by 2000. □

BAe and Dassault to seal combat aircraft link

DASSAULT AVIATION and British Aerospace are preparing to take the next step towards their promised joint venture to study future combat aircraft technology, with plans to start firming up the terms of their co-operation pact by mid-year.

French ministry of defence procurement chief Jean-Yves Helmer says that the two companies are "advancing rapidly" and that it is "only a question of months" before the new venture is formed, building on the memorandum of under-

standing (MoU) signed in 1996 pledging joint technical studies.

BAe confirms that the two companies "are moving towards a number of signatures on the MoU by mid-year", adding that technology to upgrade Rafale and Eurofighter will be among the first priorities covered by the new venture.

Work on the MoU has seen recent growth in the number of staff at Dassault and BAe's respective Paris and Warton military aircraft bases. The work is understood to include a series of technical

demonstrations aimed at future aircraft to come after the Rafale and Eurofighter, and could, according to sources, lead to agreement to work together on the UK's Future Offensive Air System (FOAS) programme.

This would be aimed at a replacement for the Panavia Tornado GR4 and Dassault Mirage 2000N, and at other piloted or pilotless future attack aircraft, although Dassault Aviation insists that "there is no French requirement for a FOAS aircraft". □

Virgin group and Sabre Airways discuss link-up at Gatwick

SPECULATION IS growing that the Virgin group is close to a deal with UK charter carrier Sabre Airways to form the basis of Virgin Sun, a new European holiday airline venture.

Details of the new airline, being set up by Virgin Holidays, are expected to be unveiled at the end of April. A short-haul network is due to be launched in 1999 on routes from the UK to holiday des-

tinations mainly in Spain and Turkey.

Virgin's Brussels-based low fare airline, Virgin Express, is reported to be discussing a tie-up with Sabre, which would see the Gatwick-based Boeing 727 operator being taken over and used as the framework for the new charter operation. Such a move would provide Virgin Express with a fast track to a UK air operator's certificate

(AOC) and additional slots at Gatwick. The low fare airline has mooted leaving Belgium for the UK or Ireland due to Belgium's high labour costs.

The two airlines will say only that they are discussing a deal for Sabre to operate two Virgin Express Boeing 737-300s on its AOC. The UK-based aircraft will be flown on Virgin's expanding network of routes from the UK. □

GKN opens Agusta merger talks

DOUGLAS BARRIE/LONDON

LAST MINUTE attempts by French interests to court Italian helicopter manufacturer Agusta have fallen on deaf ears, with owner Finmeccanica throwing its lot in with longstanding partner GKN Westland.

GKN and state owned Finmeccanica announced on 16 May that a merger of their respective helicopter subsidiaries is being actively pursued after the signing of a memorandum of understanding covering "exclusive negotiations" between the two.

GKN Westland is understood to have remained nervous, almost until the Italian signature was secure, that high level political pressure could have resulted in Finmeccanica looking to Franco-German Eurocopter as a partner for Agusta.

Eurocopter has made little secret of its ambition to take Agusta on



GKN Westland has won the race to merge with EH101 partner Agusta

board, and has been increasingly open on the subject since the start of 1998. A senior French Government delegation visited their Italian counterparts earlier this month, with the restructuring of the defence aerospace sector on the agenda.

GKN Westland and Agusta are already partners in the EH

Industries EH101 military helicopter programme being developed for the Italian and Royal Navies, as well as in military utility and civil variants. A link between the two has been on the agenda for years, but had been delayed by the long running restructuring of the Italian aerospace industry. It

received a boost from the Italian Government's renewed drive for privatisations, including sell-offs by Finmeccanica.

Any merger of Agusta and GKN Westland, however, is unlikely to mark the end of consolidation in the helicopter sector. In a joint statement, the companies note that "...it is important for the competitiveness of the European helicopter industry that it participates in the consolidation of the aerospace and defence industry".

Company sources suggest that an eventual tie-up with Eurocopter has not been ruled out. Pulling together Agusta's and GKN Westland's assets, they suggest, would allow negotiations to be undertaken from "a position of relative strength".

Agusta is already a partner in the NH Industries NH90 medium lift military utility helicopter programme, with Eurocopter France and Eurocopter Germany. □

New UK oceanic ATC centre faces major delays

IAN SHEPPARD/LONDON

THE UK NATIONAL Air Traffic Services (NATS) faces another embarrassing delay in upgrading its ageing infrastructure, with warnings that it will have to extend the deadline on completing a new oceanic air traffic control centre within only months of work starting.

Design work on the centre, known as the Flight Data Processing System (FDPS2), began in June with award of a contract to US company EDS. NATS says it has

now had to put "timescales under review" for the three-year project after concluding that it "...is more complex than thought". Delays could be as much as 18 months.

The centre will provide transatlantic traffic with a comprehensive pseudo radar environment based on Automatic Dependent Surveillance (ADS). It is to be co-located with the proposed £200 million (\$333 million) New Scottish Centre (NSC), which will replace the existing Scottish Air Traffic Control Centre at Prestwick in

2003. NATS says that any delay in the FDPS2 will not affect the NSC.

The latest delay comes after a UK Government Select Committee report published earlier this month lambasted NATS and contractor Lockheed Martin Mission Systems for protracted software delays with the £350 million New En Route Centre (NERC) at Swanwick, England.

EDS denies comparisons with the NERC, saying that work to date has been only to "...firm up the specification". □

Pentagon selects UCAV contractors

THE US DEFENSE Advanced Research Projects Agency has officially selected Boeing, Lockheed Martin, Northrop Grumman and Raytheon Systems to conduct initial studies on an unmanned combat air vehicle (UCAV).

The four firms, already identified as the only US groups capable of leading the project, will now undertake initial 10-month trade-off and preliminary design studies. Each will receive \$4 million to conduct the study phase. That includes design of a UCAV operational system and definition of a demonstrator system to allow validation of critical technologies.

The US Department of Defense will then decide whether to continue with an advanced technology demonstration programme. That would see one contractor selected for a \$110 million contract in early 1999, to build two demonstrator vehicles and a mission control station. Flight tests would begin in late 2001. □

FAA fuel tank explosion concerns now extended to 737s

PPOTENTIAL EXPLOSION danger from fuel vapour in Boeing 737 fuel tanks is to be addressed in a new US Federal Aviation Administration airworthiness directive (AD).

The proposed AD, affecting 1,140 US-registered and about 1,600 other 737s, specifies all models from the -100 to the -500. It calls for protection of the fuel quantity indication system against

transient electrical voltage spikes or short circuits, and will require installation of electrical suppressors and/or shielding, and separation of the fuel system wiring from adjacent wiring.

Installation of fuel vent system flame arrestors and pressure relief valves designed to prevent external flames from entering through the wing tip vents, will also be ordered.

The agency issued a similar AD

late last year covering Boeing 747 Classics, following the Trans World Airlines crash in July 1996 blamed on a centre fuel tank explosion for which no ignition cause has yet been established.

A Philippine Air Lines 737-300 fuel tank exploded in May 1990, but the ignition source also remains a mystery. The FAA is considering similar rules for Boeing 707s and 727s. □

Three nations study anti-radiation missile

DOUGLAS BARRIE/LONDON
GRAHAM WARWICK/WASHINGTON DC

THE USA, GERMANY and Italy have begun to explore the joint development of a next-generation anti-radiation missile, with negotiations on a memorandum of agreement (MoA) expected to get under way within the next few months.

The three countries are already collaborating on the precision navigation update (PNU) programme for the Raytheon AGM-88 High-speed Anti-Radar Missile.

Programme sources say that, within the PNU programme, there is an as yet undefined technology assessment and evaluation (TEA) phase which is intended to provide a route for the three countries to jointly examine technology applicable to future suppression of enemy air defence/strike weapons.

The TEA phase would run concurrently with the PNU, but would be covered by a separate trilateral MoA. The PNU MoA has been signed, and the companies are understood to be in precontract discussions.

National level research projects are already under way in the USA and Germany. The latter is providing limited funding for Germany's BGT Armiger rocket/ramjet powered anti-radiation missile. "BGT is open to co-operative anti-radiation missile programmes," noted programme manager Klaus-Eberhard Möller at the recent SMI Missiles 98 conference in London.

In the USA, Raytheon is working on its Advanced Strike Weapon, while Science and Advanced Technologies and Atlantic Re-

search are proposing the Advanced Anti-Radiation Guided Missile.

All three designs use rocket/ramjet propulsion coupled with a dual-mode seeker. The latter covers a broad-band passive radar sensor coupled with either a millimetre-wave radar or an imaging infrared sensor.

BGT carried out captive carry trials of its ARAS dual-mode seeker in 1997, with additional trials also planned for 1998. If adequate funding is made available then a flight demonstration could be carried out as soon as 2001. □

Korean wraps up 737 deal with Boeing/GECAS

KOREAN AIR (KAL) has finalised a series of financially convoluted lease, loan and trade-in deals with Boeing and General Electric Capital Aviation Services (GECAS) for 35 Next Generation 737s.

The agreements entail KAL rolling over its entire fleet of 26 Boeing MD-82/83 and Fokker 100 twinjets. In return, Boeing will supply the South Korean carrier with 22 new 737s, with options on a further five, comprising a mix of -800s and larger -900s. Under an earlier deal GECAS will provide an additional tranche of eight 737-800s. GECAS will deliver its first 737

in May 2000, with Boeing's initial aircraft following that August. It is understood that Boeing will take responsibility for disposing of KAL's 12 Fokker 100s and six MD-80s from 2000, while GECAS will take another eight MD-80s on a sale and leaseback basis, along with six Boeing 747-200s and SPs (*Flight International*, 11-17 March, P4).

The initial sale and leaseback of older aircraft and the long-term lease of replacement jets provides KAL with a welcome injection of cash and avoids future capital expenditure. Leasing also avoids a battle to secure prior Government approval to import newly bought aircraft.

The GECAS deal alone is worth some \$386 million, with a further \$254 million coming in the form of US low interest loans. KAL recently announced a net loss of 397 billion won (\$283 million) and has deferred foreign exchange losses of more than 2 trillion won.

■ Meanwhile, rival South Korean carrier Asiana Airlines has put its first Airbus Industrie A321 into service, after an initial technical balderdash problem with the aircraft's International Aero Engines V2500 turbofans. The problem is believed to be due to overspeed and led to the replacement of a number of fan blades. □



Crandall: Stands down on 20 May

AMR's Crandall is set for May retirement

ROBERT CRANDALL, the combative airline chief of AMR/American Airlines, has announced his retirement after 25 years with the carrier. Crandall hands over control of American on 20 May to Donald Carty, who was named company president three years ago.

Crandall joined American in 1973 as senior vice-president for finance, becoming chairman and chief executive (CEO) of parent AMR group in 1985.

Capt Richard LaVoy, head of the Allied Pilots Association, says that his old adversary "...deserves credit for steering American Airlines through a rocky period when many other established carriers failed". Although Carty's style differs from that of his predecessor, LaVoy expects that Carty "...will likewise prove to be a tough, bottom-line oriented CEO". □

Japanese aircrew strike grinds into its second week

THE STRIKE by pilots and flight engineers over salary cuts at All Nippon Airways (ANA) is moving into its second week with no sign of an end to what is an almost unprecedented level of industrial action for Japan.

By 17 April, the twelfth day, the number of cancelled international flights stood at 74, affecting some 15,300 passengers. ANA says that the action is costing it around ¥200 million (\$1.5 million) per day.

Management and the union remain sharply divided over the new wage system, introduced at the start of April. It aims to link crew pay to actual hours flown, replacing a 26-year-old scheme in which pilots were paid for 65h a month regardless of actual flight hours.



All Nippon began flying its new A321s shortly before the strike action began

Management contends that a crew averages about 50h flying per month and hopes that the new system would cut labour costs by at least ¥1 billion per year.

"If management give in now,

they'll have gained nothing. If they win, it will still take them three years to write off the costs of the strike against the savings," says Paul Smith, airlines analyst with HSBC Securities in Tokyo. □



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ICAO recommends plan to balance NO_x and CO₂ emissions

GRAHAM WARWICK/WASHINGTON DC

A MODIFIED PLAN to reduce harmful aero engine emissions has been recommended by the International Civil Aviation Organisation (ICAO).

ICAO's Committee of Aviation Environmental Protection (CAEP) has approved a plan which would cut emissions of nitrogen oxides (NO_x) while encouraging development of more fuel-efficient engines producing less carbon dioxide (CO₂).

The 1995 meeting of the CAEP had rejected calls to reduce NO_x emissions by 16%, as it would be impossible to develop engines with high enough pressure ratios.

Howard Aylesworth, of the US Aerospace Industries Association, explains that increasing the pressure ratio is desirable in attempting to lower fuel consumption and lower CO₂ production, but that an inevitable by-product of the higher pressures and temperatures is an increase in NO_x emissions.

The revised proposal therefore relaxes the NO_x stringency standards for engines with pressure ratios of 30 to 62.5 - Aylesworth says that the highest ratio achieved to date is in the low 40s.

Meeting in Montreal in early April, the CAEP also approved a fleet protection proposal to only apply the new NO_x rules to new engines certificated from 2004 onwards, while it urged faster progress on air traffic modernisation, which it estimates could reduce emissions by 6-17%.

Conventional wisdom holds that aviation accounts for 2-5% of greenhouse gas production, although a recent study by the Intergovernmental Panel on Climate Change puts the contribution from aircraft emissions at closer to 10% once the ozone created in the troposphere is taken into account.

The protocol signed by the international community at the Kyoto summit in December excludes aircraft emissions, but the CAEP plans a proposal for its next meeting, tentatively scheduled for February 2001, on how aviation should contribute to agreed limits. □

Boeing enters UPS bidding with 767 'Special Freighter'

GUY NORRIS/LOS ANGELES

A "SPECIAL Freighter" (SF) conversion of the 767-200, along with the MD-10, is being offered by Boeing to UPS for its ongoing McDonnell Douglas DC-8 replacement competition.

Boeing is offering these aircraft against freighter conversions of the Airbus Industrie A300B4 and Lockheed L-1011 TriStar for the UPS Widebody Regional Freighter requirement. This covers the eventual replacement of 49 DC-8-70 freighters, generating an eventual requirement for "up to 60 or so aircraft", says Boeing.

If successful, the development of the 767-200SF could considerably

alter the dynamics of the mid-size freighter market. This has only recently begun to develop into the widebody arena with a spate of modification programmes, principally the DC-10/MD-10 conversion for FedEx.

It is widely expected, however, that the relatively high price and limited availability of suitable 767-200s may place question marks over the success of the bid.

In addition, the MD-10 programme, like the competing A300 conversion efforts at British Aerospace and Daimler-Benz Aerospace, has the advantage of being launched.

Boeing confirms that it "...is in the running for that business" and

expects that a decision could be made "in mid-May or possibly June". It has proposed to develop and deliver the first 767-200SF by 2000, if selected.

The baseline 767 conversion would produce a freighter with a range exceeding 3,700km (2,000nm) and an "estimated payload" of 43,100kg, says Boeing. The modification would be done at Boeing's Wichita site in Kansas, and involves completely removing the existing floor and replacing it with the strengthened main deck designed originally for the -300F version. The 2.67 x 3.4m freight door, also developed for the -300F, would be inserted in the front left of the fuselage. □



Unhappy landings: BA will cease operating its DC-10-30 fleet next year

DC-10s go as BA juggles its orders

THE FLEET of eight McDonnell Douglas DC-10s operated by British Airways (BA) from London Gatwick will be retired from service during 1999, following an order for eight more Boeing 757s and 777s.

The airline has also confirmed plans to cancel orders for four 747-400s in favour of three additional 777s, taking its total new orders to 11 aircraft (*Flight International*, 18-24 February). All the new aircraft will be delivered in 1999.

The eight 17-24 year old DC-10-30s, which were acquired through the British Caledonian take-over, will be replaced by two

newly ordered General Electric GE90-powered Boeing 777s, as well as six 767-300ERs transferred from the London-Heathrow base. The 767s in turn will be replaced at Heathrow by six new Rolls-Royce RB211-powered 757s.

The 757s will be acquired on operating leases, says the UK airline, and financing is already in place for the 777s.

Meanwhile, a further three GE-powered 777s have been signed for, in place of existing orders for four R-R RB211-powered 747-400s, boosting BA's total 777 orderbook to 29 aircraft. The order switch cuts its 747 firm backlog to 18. □

United wraps up with widebodies purchase

UNITED AIRLINES has completed its latest round of airliner shopping, with a deal for 23 more Boeing widebodies, worth an estimated \$3 billion.

The deal, which follows an agreement concluded last month with Airbus for 30 more A320-family aircraft, is the third stage in a four part fleet growth strategy, according to United.

The aircraft in the Boeing order are one 747-400, six 767-300s and sixteen 777-200ERs (extended range), with deliveries to begin in the first quarter of 1999 and continue into 2002. All the new aircraft will be powered by the Pratt & Whitney PW4000.

United will receive four 767s and four 777s next year; the 747-400 and six 777s in 2000; four 777s and two 767s in 2001; and the final two 777-200s in 2002. The airline has specified the shorter range (non-ER) version of the 767-300, as the new aircraft will be used on domestic services rather than alongside its existing -300ERs on longer haul routes.

United's fleet will grow to 639 aircraft by the end of 2001, from the 590 operated now. □



Out with the new: Garuda wants to drop some of its newer widebodies, including MD-11ERs (above) and A330s

Thai/Garuda firm up fleet plans as Qantas eyes up Asian 747s

PAUL LEWIS/SINGAPORE
PAUL PHELAN/CAIRNS

THAI AIRWAYS International has been given approval to take delivery of 17 new aircraft over the next three years, despite Thailand's economic difficulties. Financial problems elsewhere are forcing Garuda Indonesia to seek an early return of six leased Boeing MD-11s, while Qantas is seeking to acquire surplus Asian 747-400s.

The Thai national carrier now plans to stick to the original delivery schedule agreed with Airbus and Boeing. Thai says that the aircraft are needed to rationalise its fleet and to improve route efficiency, and that any delay would incur additional storage charges.

Deliveries through to the end of the 1997/8 financial year on 30 September will comprise five

A300-600Rs, three A330-300s, one 747-400 and Thai's first 777-300. A second 777-300 and a 747-400 are due for delivery in 1998/9, with the airline's last A330-300 slipping to the following year. Two 777-300s are due in 1999/2000 and the final two in 2000/1.

Garuda Indonesia has scrapped plans to dispose of five McDonnell Douglas DC-10-30s and instead wants to return to Boeing six leased MD-11ERs, which it says it can no longer afford. The airline has suspended many of the international routes on which the aircraft are used.

It is also looking to lease out six A330-300s it cannot afford and has put four 747-200s and five A300B4s up for sale.

Ongoing financial difficulties are again preventing Garuda from raising funding for its next 12 737-300/400s, half of which are com-

pleted and sitting in Seattle. The first five 737s were only delivered in late 1997 after Boeing stepped in with bridge financing, but it has indicated that this will not be repeated.

Qantas is expected shortly to announce plans to acquire as many as six 747-400s from flagging Asian carriers. The airline's board has discussed using the aircraft on planned new thrice-weekly services from Sydney to Buenos Aires via Auckland, to Zurich via Singapore and between Melbourne and London via Hong Kong.

It is understood that a recent three day closed conference, to discuss Qantas' fleet through to the end of 1999, settled on acquiring second-hand 747s rather than 777s or Airbus Industrie A340s. It is looking at buying an Asiana 747-400, and two Malaysia Airlines -400s. □

Fairchild Dornier aims for fly-by-wire on 728JET family

ANDRZEJ JEZIORSKI/MUNICH

FAIRCHILD DORNIER has requested proposals from avionics suppliers for a fly-by-wire flight control system (FCS) for the 70 seat 728JET and other future members of its proposed regional jet family.

According to Earl Robinson, senior vice-president for product development at Fairchild Dornier, a range of solutions, with and without mechanical back-up, is being examined. A decision is expected to be taken in May, he adds.

Robinson says that while the software would be a more compact package than those used on the Airbus and Boeing airliner ranges, the 728JET system should offer "most of the same functions" of such systems, including flight envelope protection. The company plans not to adopt the side-stick controls used on the Airbus range, preferring the yoke system adopted by Boeing on the 777.

Fairchild Dornier declines to reveal which companies have been asked to bid, but programme sources say that proposals are coming in from a teaming of Sextant Avionique and Parker Aerospace (already linked on the Bombardier Global Express flight controls), German systems company Liebherr Aerotechnik, the UK's Lucas Aerospace and GEC.

Cost remains a crucial issue, but Robinson insists that an advanced FCS need not take the aircraft above its \$20 million target price.

Interest in fly-by-wire systems is coming from potential launch customers, including Crossair and Lufthansa CityLine, which together are looking at a potential firm order for 120 aircraft, including the shrunk, 55 seat 528JET and the stretched, 90 seat 928JET.

If Fairchild Dornier does have trouble meeting its price with an advanced digital FCS, then one compromise solution, understood to be under discussion, is a simple system with no envelope protection, which could either be an upgradable digital unit or an analogue system. □

FAA safety agenda focuses on CFIT and engines

CONTROLLED flight into terrain (CFIT) and engine safety are to head the US Federal Aviation Administration's list of priorities, according to Administrator Jane Garvey, unveiling the FAA's new "safety agenda".

Launching the new agenda in Washington on 14 April, Garvey, together with US Vice President Al Gore and transportation secretary Rodney Slater, promised to target the highest-risk areas, admitting that finite resources meant that lesser safety targets would be set

aside (*Flight International*, 8-14 April, P10). The FAA's action list includes:

- terrain avoidance warning systems (TAWS) are to be mandatory by 2001 on all transport aircraft with more than six seats;

- compulsory turbofan engine inspection regimes at major servicing. Initially the airworthiness directive (AD) will cover only fan disks, but it will later include other high-energy rotating parts;

- runway incursion accidents;
- approach and landing accidents;

- weather related accidents.

Garvey predicts that there will be TAWS proposals by June, and a draft AD on engine inspections by the year end. Meanwhile, the FAA is working with industry and NASA, using data analysis, to identify the causal factors in runway incursion, approach and landing and weather-related crashes.

In the cabin, Garvey says, the FAA backs safety initiatives requiring passengers to keep their seatbelts fastened while seated, and to limit carry-on luggage. □



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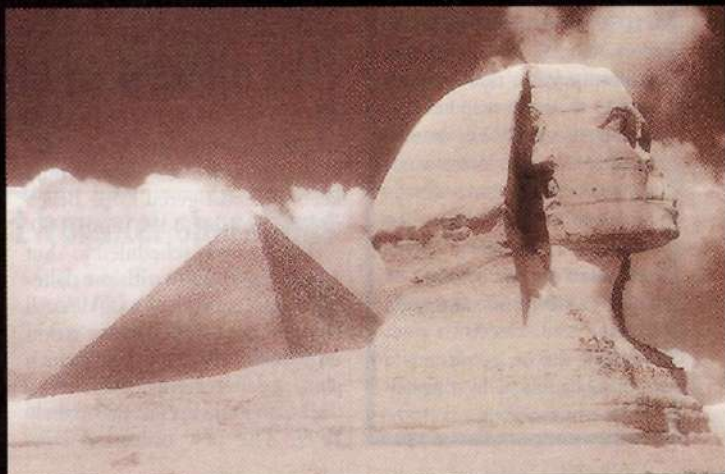
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MARKETPLACE

++ US cargo carrier Atlas Air has signed a long term contract to operate Boeing 747-200 freighter services for **Alitalia**, with an ex-Philippine Airlines 747-200F being converted by Boeing. **++ Stansted, UK based AB Airlines** has leased two ex-Jet Airways Boeing 737-300s from **Ansett Worldwide Aviation Services (AWAS)**. **++ Air Malta** has concluded a deal to take two new Boeing 737-300s from AWAS as well as its first two-400s on seven month lease from Malaysia Airlines, with three year extension options. **++ AWAS** has concluded long term extensions of several existing Boeing 737-300 leases to operators including Varig, Virgin Express, Trans-Brazil (2), Ansett Australia and British Midland, along with a 757-200 to Air 2000, and two Airbus A300-600Rs to China Northern. **++ New Italian carrier Volare**, based in Verona, has begun operations with two ex-Air France Airbus A320s, leased from GATX. A third aircraft is due in November and a fourth in April 1999. **++ Braathens** has received the first of three 134-seat Boeing 737-700s it is acquiring on lease from International Lease Finance. The airline will also take six 737-700s ordered directly from Boeing. **++ GE Capital Aviation Services** has ordered one more Airbus A319, six A320s and three A321s, all powered by CFM International CFM56 engines. **++ Midway Airlines** has converted options on three Canadair Regional Jet 200ERs, worth \$63 million, for delivery in the first half of 1999, boosting its total CRJ orders to 13. **++ US lessor AeroCentury** has agreed to provide the financial resources to assist Embraer in the lease and sale of EMB-120 Brasilias which the manufacturer will take back as it delivers new ERJ-145s. **++ Australian remarketing agent Transasian Air** has acquired an Airbus A300B4 from **Malaysia Airlines**, and placed it with **Finova**: it will be converted to cargo configuration by Daimler-Benz Aerospace Airbus.

Dee Howard sell-off looms

ANDREA SPINELLI/GENOA

ALENIA IS considering the sale of part of its US maintenance business, Dee Howard, while the Italian group's Venice-based Aeronavali unit has received a huge order from a leasing company for converting McDonnell Douglas DC-10s into freighters.

Maintenance represents around 65% of Dee Howard's annual \$100 million sales. The remainder of the company's revenue comes from modification and thrust reverser businesses. Although it is not clear what parts of the unit may be sold, sources within the companies confirm that Alenia is looking at the sale of "some of the division's assets".

The maintenance company, based in San Antonio, California, has been involved in a number of conversion programmes in recent years, including the re-engineing of some 50 Boeing 727-100s with Rolls-Royce Tay 650s, for which it



Alenia is pondering the sale of part of Dee Howard

holds the supplemental type certificate. The company also designs and manufactures thrust reversers both for new build and aftermarket applications.

Meanwhile, Aeronavali has won a \$300 billion (\$165 million) order from leasing company Ten Forty to convert 20 ex-Japan Air Lines McDonnell Douglas DC-10-40s to freighters. The first aircraft is already at Aeronavali's Venice plant undergoing work, and will be

delivered for lease to US freight carrier Challenge Air Cargo later this year. Aeronavali is also undertaking some FedEx DC-10/MD-10 conversions.

Ten Forty, a special-purpose company headed by Irish leasing specialist Omega Air, will take re-delivery of two aircraft after conversion in 1998, with the remaining 18 aircraft being modified at a rate of two or three per year through to 2006. □

IAI closes on partners for FedEx Airtruck project

ISRAEL AIRCRAFT Industries (IAI) is in talks with potential partners in Europe and Asia over its Airtruck project for a small turbo-prop cargo aircraft, and is expected to decide within the next few weeks whether it is able to present formal proposals to customer FedEx.

FedEx has a requirement for a new twin-engined turboprop to replace its fleet of 36 Fokker F27 freighters and has been in talks with IAI, Saab Aircraft and Ayres about

its development (Flight International, 19-25 November 1997).

The cargo carrier has issued a baseline specification that the aircraft should be able to carry five standard-size cargo containers over 1,800km (1,000nm) at 300kt (450km/h). The aircraft must have a unit price of less than \$10 million, and FedEx could buy 100 aircraft and possibly further options.

IAI has prepared an outline design of the Airtruck for FedEx,

and is now in negotiations with manufacturers in the Far East and central Europe about involvement to help reduce the development costs and meet FedEx's price requirements. The companies, which include South Korea's Commercial Aircraft Development Consortium, are being offered production of major airframe sections. If the Airtruck is selected by FedEx, then IAI plans to fly the prototype in 2001. □

TWA offers stay of execution for MD-80 production line

TRANS WORLD Airlines is negotiating with Boeing for up to 24 new MD-83s, which could keep the endangered Long Beach production line open until 2000.

The line was scheduled to shut down in mid-1999 with the delivery of the last MD-83 to TWA. All eight of the current backlog are on order for TWA, says Boeing, which plans to deliver six over the remainder of 1998 and the last two in early 1999. The new orders, if con-

firmed, would see production continue throughout 1999 with delivery of most of the aircraft in 1999 and some in early 2000.

TWA operates 67 MD-80s. The new negotiations came to light when the airline reported the talks in a filing to the US Securities and Exchange Commission (SEC). It also warned that TWA stands to post "significant" losses for the first quarter of the year.

"We don't have a fully signed and

sealed agreement—it's certainly not a done deal," says Boeing, but adds that they would be new aircraft.

The SEC filing also confirms that the airline's nine-year order for up to 20 Rolls-Royce Trent-powered Airbus A330s still stands, with deliveries scheduled in 2001 and 2002. TWA would face an \$18 million bill if it cancelled the aircraft, but has not yet secured financing for them should deliveries go ahead. □

Carriers form a queue to take advantage of North Korea FIR

PAUL LEWIS/SINGAPORE

EIGHT ASIAN, North US and Russian airlines have signalled their intent to launch up to 16 flights a day through North Korea's Pyongyang Flight Information Region (FIR), once it opens to international traffic on 23 April.

Following the successful conclusion of week-long flight trials in early March, the Pyongyang authorities have endorsed an earlier agreement with the International Air Transport Association (IATA) to open up the FIR to scheduled traffic. Aircraft using the new Route B467 transiting North Korean airspace will save up to 50min flight time between the USA and Asia in winter.

Accordingly, Air Canada and Singapore Airlines (SIA) have

applied to operate through the FIR on a daily basis between Seoul and Vancouver, while Cathay Pacific wants to run a similar number of frequencies from Hong Kong on Vancouver and Anchorage routes.

United Airlines is seeking to operate daily through the FIR between Seoul and Chicago and San Francisco, while Delta Airlines wants to use it for its daily Portland-Seoul service. SIA stands to gain the most out of the new agreement, with onward flights of Hong Kong-San Francisco, Taipei-Los Angeles/Anchorage and Seoul-Anchorage.

Flight times between Seoul and the Russian Far East will also be shortened by up to 30min. Korean Air has asked to use the Pyongyang FIR for its twice weekly service

from Seoul to Vladivostok, and competing Asiana Airlines for services from Seoul to Khabarovsk.

According to IATA, the recently modernised air traffic control centre at Pyongyang will initially be able to handle up to 100 flights a day, or 12/h, on the new route. Three flight levels will be available in each direction between 9,600m (31,500ft) and 13,600m.

Meanwhile, the Japanese authorities do not expect to open the planned new Route B332 extension from the Pyongyang FIR to point Miho in the Tokyo FIR until the end of the year. Japan is believed to want to widen the gap between the proposed north-south B332 and the Japan Air Self Defence Force's off limits "Area G" (*Flight International*, 11-17 March, P8).

ROUTES

++ Sabena inaugurated a new service between Brussels and Birmingham on 5 April, and will fly the route four times daily with an Avro RJ85. **++ Australia** and the Solomon Islands have lifted capacity entitlements between Honiara and Australian gateways from three to five weekly services, shared between **Solomon Airlines** and **Qantas**. The new agreement also provides the opportunity for niche services from Melbourne, Sydney, Brisbane and Cairns. **++ Iberia** is to fly three times a week to Johannesburg from 19 May using an Airbus A340. The Spanish flag carrier is exploring links with other African carriers serving countries such as Kenya, Zimbabwe and Mozambique. **++ AirTran** is to begin operating three daily flights between Hartford, Connecticut and Atlanta from 18 May. **++ Sky-Trek Airlines** has started a scheduled service to Le Touquet, France, from Lydd in the UK, using a PBN Trislander. **++ Sicily's Med Airlines** has begun operating its first of two Saab 2000s alongside its ATR 42 on a network of north-south routes connecting Sicily with Rome, Parma and other Italian destinations. **++ Air Sicilia** has started operating three daily return flights between Palermo and Rome using an ex-Air One Boeing 737-200. The service is operated in competition with Alitalia. **++ China Eastern Airlines** will begin two new twice-weekly international routes from Shanghai to Okayama in Japan and to Paris via Beijing from the end of June. Additional frequencies will be added to its San Francisco, Sydney and Fukuoka routes, while domestic routes are to be expanded following its acquisition of local carrier **China General**. **++ China Northern Airlines** has launched a direct service from its Harbin-base in Heilongjiang province to Seoul. The service will be operated four times a week jointly with a South Korean carrier. **Asiana** has further cut back on international services by suspending direct flights to Singapore and now operates a codeshare with Singapore Airlines.

JAA clears 737-800 to take to the skies

THE LARGEST Boeing 737 built to date, the 160-189 seat 737-800, has been cleared to enter service with its European launch customers, following certification by the Joint Aviation Authorities.

The new variant gained US Federal Aviation Administration type certification on 13 March. However, service entry was dependent on JAA approval as the model's two launch customers are both European based - Hapag-Lloyd of Germany and Transavia of Holland.

JAA approval was received on 9 April, and Hapag-Lloyd is scheduled to take delivery of its first 737-800 before the end of this month, while Transavia's first is due at the end of May, over a month later than initially scheduled. Hapag-Lloyd



The 737-800 will be arriving at Hapag-Lloyd soon

will use the 737-800 to replace its smaller 737-400s and -500s.

Flight testing of the 737-800, which began in June 1997, involved three test aircraft flying some 740h during 760 flights. To gain JAA approval for a 189 passenger exit limit, Boeing had to develop and

install a new type of overwing exit.

Scandinavia's SAS will be the first airline to take delivery of the next 737 model, the 108 seat -600, during the third quarter of 1998, while Alaska Airlines will receive the first example of the stretched 737-900 in 2001.

French cargo carrier secures Brasilias to start freighter operations

START-UP FRENCH cargo airline Air Open Sky is preparing to begin operating the first of three Embraer EMB-120 Brasilias which have been configured for quick change (QC) passenger-to-freighter operations.

The airline planned to start flying the Brasilias late in 1997 but hit delays due to problems in securing the aircraft.

The Brasilias are ex-Comair aircraft modified as QCs. They have been acquired from Bombardier,

which took them back as a trade-in as part of the deal with Comair for 75 Canadair Regional Jets.

Air Open Sky is also talking to Bombardier about de Havilland Dash 8-300s to replace two Fokker F27 freighters.

Taiwan steps up safety audits

BRENT HANNON/TAIPEI

IN AN ATTEMPT to rebuild passenger confidence in Taiwan's air safety following a spate of accidents, the country's Civil Aeronautics Administration has announced stricter penalties, including severe fines and grounding, for airlines not in compliance with regulatory standards.

Each of Taiwan's nine commercial airlines has been required to submit training, operations and

maintenance procedures and records to the CAA by 20 April. After a three week review, it will issue guidelines to each airline, and then conduct a series of inspections to enforce them, says Tsang Tsen-lien of the CAA flight safety division.

The policy was instituted by Lin Feng-cheng, Taiwan's new Minister of Transportation and Communications. The previous minister resigned after the 16 February China Airlines Airbus A300-600 accident which killed 202

people, and the 18 March Formosa Airlines Saab 340 crash in which all eight passengers and five crew died.

The CAA is seeking professional help from overseas, but has not yet established a "partnering" arrangement, says Tsang. Meanwhile, the ministry promises that four new CAA inspectors are to be hired, bringing the total of full time inspectors to more than 40. Besides the CAA programme, the Government has formed a five-man cabinet level flight safety committee.

EVA Airways junior vice-president K W Nieh expresses scepticism about the new programme. "The same people will examine the same companies the same way. How can they improve flight safety?" he says. The main problem, he maintains, is that many of Taiwan's airlines fail to tell the CAA about their lack of adherence to procedures.

Most of Formosa Airlines' fleet has already been cleared to fly again and it expects "imminent" CAA clearance to use its Saab 340s. □

NEWS IN BRIEF

■ NTSB PUSHES FOR SB

An Airbus Industrie A320 incident in which the rudder pedal operation remained stiff after autopilot disconnect has led the US National Transportation Safety Board (NTSB) to call for an April 1997 Airbus service bulletin (SB) to be made compulsory. The NTSB cites a pilot report on a November 1996 Northwest Airlines landing during which runway alignment adjustments had to be made with roll controls only. Airbus tests found that, at autopilot disconnect, the rudder artificial feel and trim unit could remain connected to the autopilot, making rudder pedal operation heavy. The SB ensures unit disconnect.

■ IBERIA'S ENGINE CHOICE

Iberia has decided to stick with the CFM International CFM56 for its recent order for up to 76 more Airbus A320-family aircraft. The airline concluded the order in February for 50 firm orders and 26 options (nine A319s, 36 A320s and 31 A321s), and decided to hold a new engine competition despite the fact that the CFM56 already powers 22 A320s in service with the airline. Deliveries of the new aircraft will begin next year.

New airline to resurrect Braniff name at Dallas

A BID TO BRING back the Braniff name has been launched by Montreal-based Airnomics. Company president Michael Low says his plan differs from two unsuccessful attempts to restart Braniff in that the planned carrier would be based in the original's home town of Dallas, Texas.

Low says the plan is to begin twice daily low fare services from

Dallas/Fort Worth to Los Angeles and New York using one or two Boeing 757s on off-season lease from a European charter carrier. Airnomics specialises in arranging off-season leases and has placed aircraft in the USA for airlines such as Aer Lingus, he says.

Operations are due to begin in November, initially using another airline to fly under the Braniff name,

but using its own operating certificate and designator. The initial plan is to test the market. "Our risk is six months. If we prove the concept, we can take it from there," he says.

Low, who owns the Braniff name, believes it still has strong recognition in Texas. Previous attempts to relaunch the airline were centred on Kansas City and Orlando, but "...Braniff belongs in Dallas." □

ADP plans five year investment in Charles de Gaulle

FRANCE'S Aéroports de Paris (ADP) airport authority is embarking on a five year programme of heavy investment at Charles de Gaulle (CDG), its main base and Air France's increasingly successful hub.

As it opened the first half of the new terminal 2F at the airport on 27 March, ADP president Jean Fleury revealed that up to Fr15 billion (\$2.5 billion) would be spent

on further developments to CDG over the period 1998-2002, beginning with the two new runways announced in September 1997.

Further ahead, the authority plans another new terminal, 2E, destined for Air France's exclusive use, to be opened in 2003 at a cost of Fr6 billion. Terminal 9 will also be doubled in size and a new pier added to terminal 2A for long-range aircraft. A new cargo terminal for

FedEx is also under construction.

Spending has run at about Fr2 billion a year over the past two years and will now average Fr3 billion over the next five. Passenger traffic in 1997 rose by 11%, to 35.2 million, but the new terminals will take capacity to around 42 million.

■ ADP's Orly had an 8% traffic decline in 1997, handling just over 25 million passengers, partly because of strikes at Air Liberté and AOM. □



Gulf Air changes its order to A330-200s

GULF AIR HAS revised its order for six Rolls-Royce Trent 700-powered Airbus A330s, with the aircraft now being taken as the smaller longer range -200 rather than the -300 originally specified. Deliveries are due to begin in April 1999 and continue to June 2001. Gulf Air will use the A330s on services to Europe and the Far East.

Singaporean F-16D Block 52s reveal Israeli design heritage

DOUGLAS BARRIE/LONDON

SINGAPORE'S latest batch of Lockheed Martin F-16D Block 52 aircraft is believed to be undergoing a modification by Israel, drawing on elements of the Israeli air force's own F-16D Brakeet (Thunderbolt) strike aircraft.

The Republic of Singapore Air Force (RSAF) has 20 F-16D Block 52 aircraft on order. The first D model of a batch of 18C/Ds which are being procured has the same enlarged spine as the Israeli air force aircraft have.

Although the airframe modification for the RSAF's D model was implemented in the USA, both US and Israeli sources confirm that considerable technical assistance to the RSAF is coming from Israel.

Israeli F-16Ds carry additional avionics in the hump, including Elisra electronic countermeasures. A similar fit may be being provided to the RSAF.

The RSAF is also understood to be interested in acquiring an improved air-to-surface anti-radia-



The national insignia is Singaporean, but the hump has Israeli links

tion missile capability to supersede the AGM-45 Shrike. Sources indicate that its preferred option is the Raytheon AGM-88 High-speed Anti-Radar Missile (HARM). The Block 52 aircraft is HARM-capable. The RSAF's Block 50/52s are also known to be being wired for the carriage of non-US manufactured weaponry. Singapore is understood to have received its first batch of Rafael Python 4 high agility dogfight missiles in the latter half of 1997, although the RSAF officially denies that it has ordered the Python 4.

While the RSAF's only current air-to-air missile (AAM) is the semi-

active AIM-7 Sparrow, it is likely to move rapidly to procure an active radar guided AAM as soon as the Russian Vypel R-77 (AA-12 Adder) appears in the region.

The US Government, according to Washington sources, is unwilling to introduce the Raytheon AIM-120 AMRAAM active radar-guided AAM into the region until such time as a "like system" (ie the R-77) is in evidence.

The Royal Malaysian Air Force is expected to take deliveries of the R-77 during 1999 for its MAPO MiG-29 Fulcrums. Israel may also offer its Derby active radar-guided AAM to the RSAF. □

Sukhoi and Mikoyan told to co-ordinate fifth generation effort

THE RUSSIAN air force (RusAF) wants Sukhoi and the Mikoyan design bureau (OKB) to start to co-operate on fifth generation combat aircraft programmes.

The RusAF, despite being desperately short of cash, is pursuing next-generation fighter aircraft programmes.

Sukhoi and the Mikoyan OKB, however, have at least four such projects under way. The RusAF may be able to support one or two at a low funding level.

Mikhail Simonov, Sukhoi's general designer, says that his company and the Mikoyan OKB "...are close to signing a co-operation agreement to co-ordinate their efforts in the development of an advanced fighter for the air force".

Sukhoi has the S-37 and S-54 fighter developments under way, while MIG MAPO and the associated Mikoyan OKB have the Article 1.42 and LFI projects.

The Article 1.42, or MFI, prototype is expected to fly in August 1998, but only as a technology demonstrator. Sukhoi may want to draw on the aircraft's avionics for the S-37. □

German MoD pushes ambitious helicopter and missile wish list

ANDRZEJ JEZIORSKI/MUNICH

THE GERMAN defence ministry has prepared a lengthy procurement wish-list for the 1999 budget, including key helicopter and missile programmes, but it threatens to overload the parliamentary defence committee's ability to pass all the items this session.

According to sources in Bonn, it seems likely that several items will have to be delayed, and may not make it into next year's budget as a result of additional pressure caused by preparations for September's parliamentary election.

The list includes DM299 million (\$164 million) for the upgrade of 17 GKN Westland Sea Lynx Mk88s to Super Lynx standard. This was in question due to lobbying from supporters of the NH Industries NH90 multi-role heli-

copter (*Flight International*, 1-7 April), but is now "back on track" according to GKN Westland. Talks are still going on in an attempt to push down the price of the upgrade, and this item is due to be cleared by the end of May.

Production investment and series production of the NH90 is also on the list, with DM11.836 billion to be cleared to finance this by the end of June, although this project has been the subject of haggling among politicians recently. Quantity and unit price are still subject to negotiations with manufacturer NH Industries and partner companies Eurocopter, Agusta and Fokker Aerostructures.

The army is expecting purchase clearance for the first batch of 80 Eurocopter Tiger battlefield helicopters at a cost of DM4.826 billion. This project now seems more

secure than the NH90 purchase.

The Luftwaffe is now hoping to get clearance for the long-delayed replacement of its last two Boeing 707 transports by ex-Lufthansa Airbus A310s, at a cost of DM167 million. The air force says if this is not done in 1999, the veteran 707s will become much more maintenance-intensive and costly to run.

On the missiles front, June should see parliament debate the DM115 million definition phase of a medium range air-to-air missile to arm the Eurofighter 2000. The defence committee is urging the start of this project "without delay" in a European industrial partnership, while the controversial seeker selection remains unresolved (*Flight International*, 8-14 April).

Also in June, parliamentarians are due to tackle the DM390 million medium-range Trigat require-

ment for infantry and armoured vehicles. The long-range variant, the Trigat LR, to arm the Tiger helicopter, is notably off the list.

France has already withdrawn from the Trigat LR due to budget cuts. Programme sources say concerns with the missile's range, coupled with the long lead period before the French Tiger enters service in 2011, contributed to the decision. The interdiction variant of the Matra BAe Dynamics Apache and the Horus reconnaissance satellite were also cancelled.

The German MoD hopes for clearance in late April for the DM279 million upgrade of Patriot surface-to-air missiles to improve intercept capability against tactical ballistic missiles. The 1999 funding covers a radar upgrade, while the overall project will cost DM891 million. □

Testing delay forces Pentagon to shuffle F-22 procurement

THE US DEPARTMENT OF Defense (DoD) has forced the US Air Force to rejig the Lockheed Martin F-22A Raptor fighter programme in an attempt to accommodate flight test delays.

Flight testing scheduled originally to begin in May 1997 was delayed until six months September. The DoD is now proposing to use what were originally intended to be the first two low rate initial production (LRIP) aircraft as additional flight test aircraft to get the programme back on track.

The Pentagon move is in response to a March recommendation from the General Accounting Office (GAO) that the \$62.1 billion Raptor programme be delayed by a year because of the hold-ups in the flight test schedule.

Jacques Gansler, the Under Secretary of Defense for Acquisition and Technology, says that following the GAO recommendation would disrupt the programme and add an estimated \$4 billion to the final cost.

Gansler, however, does want at least 200h of flight testing LRIP is approved. "What we're trying to do is gain higher confidence in the product," he adds.

As a result, the two initial LRIP aircraft due for fiscal year 1999 production have been redesignated as "production representative test vehicles". The LRIP decision has been delayed by a year, until November 1999, when the Pentagon is scheduled to sign off on the first six production aircraft, which represent the fiscal year 2000 purchase.

Funding for engineering and manufacturing development of nine F-22s has been approved. The USAF is to buy 10, 16 and 24 F-22s in the three fiscal years 2001-3.

The Quadrennial Defense Review reduction shrank F-22 procurement from 438 aircraft to 339. Lockheed Martin and the USAF harbour ambitions of moving back towards the original procurement figure, so that the aircraft could also be used as a Boeing F-15E replacement. □

Partners re-arrange KTX-II schedule after budget cuts

PAUL LEWIS/SINGAPORE

SAMSUNG AEROSPACE and partner Lockheed Martin are examining ways of re-arranging KTX-II development work and funding schedules, in the wake of the South Korean Government's decision to slash the programme's first year budget.

The new administration of recently inaugurated President Kim Dae Jung has halved the initial year's allocation for the jet trainer/light combat aircraft to 40 billion Won (\$28 million).

The move has been prompted by wider cuts in the defence budget in the face of South Korea's recent economic crisis.

Seoul has asked Samsung and Lockheed Martin to adjust their initial payment schedule accordingly, but at the same time is keen to avoid any slippage in the overall timetable of the programme.

Flight testing of the first of four prototypes is due begin in 2000, with initial deliveries to the

Republic of Korea Air Force (RoKAF) following in 2005.

"We have no firm ideas yet how we will accommodate the shortage of funds, and keep the initial operational capability as planned...We're talking about moving some early workload to latter years," says a South Korean programme official.

In the meantime, Daewoo Heavy Industries is hoping to secure initial funding in 1999 to develop an armed forward air control (FAC) version of its KTX-1 turboprop basic trainer.

The RoKAF planning calls for the acquisition of around 20 FAC aircraft in 2003-4, but this will almost certainly be subject to the country's economy being revived.

The basic design of the armed KTX-1 drawn up by South Korea's Agency for Defence Development is understood to include provision for the installation of four underwing hardpoints for either auxiliary fuel tanks, rockets, bombs or cannon pods. The tandem seat cockpit

would also need to be fitted with a gunsight and weapons management system.

The RoKAF's outstanding FAC requirement continues to attract the interest of competing foreign manufacturers such as Pilatus, offering the PC-9, and Embraer, with the EMB-314 Super Tucano. The two aircraft had originally been contenders for a South Korean trainer order for 20 aircraft, at a time when the KTX-1 was suffering from early development problems.

It was the RoKAF's stipulation that the trainer must be capable of performing the FAC mission that generated considerable controversy over the potential Pilatus deal. This was because of Swiss laws which prohibit the sale of weapons to areas of tension (*Flight International*, 20-26 July, 1994).

This deal eventually collapsed, but competing suppliers continue to show interest in South Korea in the event of the KTX-1 programme once again faltering. □



Romania gets Shadow 600

AAI HAS DELIVERED six Shadow 600 unmanned air vehicles and their associated ground control station to Romania. The \$20 million contract was the first to be financed by the US Government's new Defence Export Loan Guarantee programme. AAI has sold Shadow 600 systems to another, undisclosed, country, believed to be Taiwan, and hopes to close two more sales by the end of this year.

Fortis pushes Il-76 to air force customers

UK AIRCRAFT broker Fortis Aviation has signed a broad agreement with the Tashkent Aircraft Production Factory (TAPO) to market the Ilyushin Il-76 to air force customers worldwide (*Flight International*, 16-22 July, 1997).

Jack Cunningham, managing director of the Stansted, UK-based company, says that the "...relationship is with the factory", not the Ilyushin design bureau. "We do not think we will accomplish civil sales," he says, although he adds that it has not been ruled out.

No sales have been finalised so far but "outline interest" has been shown by Indonesia and India in the Il-76, while Malaysia is interested in using the aircraft as a water-bomber.

The aircraft will be offered with Progress D-30 engines, but a Perm PS-90 option is a possibility. □

Lockheed wins JASSM battle

RAMON LOPEZ/WASHINGTON DC

LOCKHEED MARTIN can expect to earn more than \$2 billion from the Joint Air-to-Surface Stand off Missile (JASSM) programme after winning the first battle against Boeing to provide an initial 2,400 of the cruise missiles to the US Air Force.

The US Department of Defense awarded the competition to Lockheed Martin on 9 April, providing a \$36 million contract to complete the definition and risk reduction phase of the programme and to prepare for engineering and manufacturing development and eventual missile production.

The US Navy could further swell Lockheed Martin's orderbook, but the force's position on the JASSM remains unclear. The USN's waning support during 1997 sparked an independent "analysis of alternatives" which determined that the stealthy JASSM offers "a dramatic increase in effectiveness" over conventional weapons, including the improved Boeing SLAM, a derivative of the



Lockheed Martin's JASSM proved the more accurate shot in meeting the USAF's stand off requirement

Harpoon anti-ship missile.

Capt Grant Begley, the Navy's deputy JASSM programme director, says that the USN remains part of the JASSM project, but considers the SLAM-ER the near term solution. "The USN will continue evaluating JASSM with the potential to procure it in the out-years, but there has been no decision to procure the missile," he says.

USAF officials say: "Lockheed

Martin had a superior JASSM proposal in just about every aspect, including cost." They add that the company's bid is "well below" the USAF's \$400,000 per missile target.

Richard Caime, Lockheed Martin JASSM programme vice-president, says: "This is our entry into the cruise missile business." Boeing calls the loss "disappointing", but says that it is not contemplating a formal protest. Darleen

Druyan, the USAF's source selection authority for the competition, hopes there will be no protest.

Caime says that he drew upon Lockheed Martin's low cost missile manufacturing and low-observable technology experience to win the contest, and worked with the subcontractors to curb additional costs. Caime also says that his missile design allows for much simpler mission planning.

The JASSM production begins with 95 missiles, and 100 missiles in the first two lots. Peak production calls for 360 missiles in each of the following seven years. □

T-38 upgrade is on the way for July first flight

GUY NORRIS/WILLIAMS GATEWAY

THE FIRST complete suite of advanced displays and systems for the US Air Force Northrop T-38C avionics upgrade programme (AUP) will be installed in the first of two test aircraft in May, with the maiden flight still firmly on schedule for July, says Boeing.

The T-38 AUP will upgrade the USAF's advanced trainer with a digital cockpit to provide more commonality with front line fighters and bombers. Managed by Boeing with the Lahav division of Israel Aircraft Industries as major subcontractor, the contract originally covered 427 aircraft, including the two test T-38s, but has now been increased to 509. "We're hoping for a few more on top of that," says Daniel Pettyjohn, T-38C AUP modification site manager at Boeing's Williams Gateway

Airport, Arizona, site. "We're getting ready for a production decision around January or February 1999 and, if it's positive, we're due to go ahead in August 1999 and run through to mid-2006," he adds.

The data to support the go-ahead decision will be collected during flight tests starting in July with the first flight of the initial T-38C upgraded during the engineering, manufacturing and development phase. The first two aircraft will begin initial tests at Edwards AFB, California, for about two months, before transferring to Columbus AFB, Mississippi, for further evaluation to the end of 1998.

"A lot of the testing will be to do with the pilot/vehicle interface. It will also look at the new systems and see how they all work together," says engineering group manager, Bill Switzer. The new systems include global positioning sys-

tem/inertial navigation and traffic alert and collision avoidance systems, as well as multifunction and electronic engine displays, up front control panels and a hands-on-throttle-and-stick. The front cockpit is being equipped with a large field of view head up display.

A "dock system" has been set up in the Williams hangar where the T-38A was maintained when the site was operated by the USAF, says Pettyjohn. Up to 15 aircraft will be held for modification at once with the initial cycle lasting 90 days, later reducing to around 30. "Between seven and seven and a half T-38Cs will be turned out every month," he says.

The contract, aimed at extending the life of the trainer to 2040, includes the provision of 14 aircrew training devices and contractor support for the aircraft and simulators at up to four training bases. □

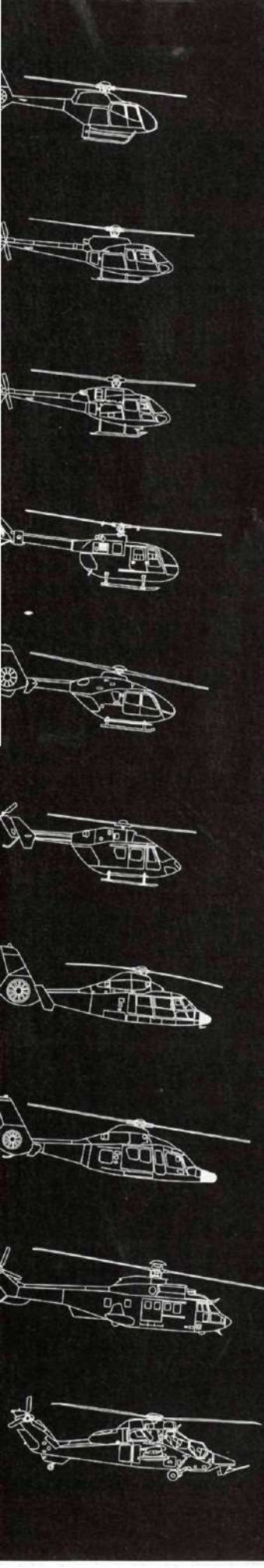
NEWS IN BRIEF

■ APG-77 DELIVERED

Northrop Grumman has delivered the first APG-77 radar for F-22 avionics integration. The active array radar will be integrated with other aircraft avionics at Boeing's laboratory in Seattle. The radar, and initial software allowing simultaneous search and track, is already being flown in Boeing's 757 avionics testbed for the Lockheed Martin F-22.

■ SOGERMA BREAKTHROUGH

French maintenance company Sogerma has signed a contract with the Colombian air force for major checks on a pair of Lockheed Martin C-130H Hercules transports. The work will be carried out at Sogerma's Bordeaux factory.



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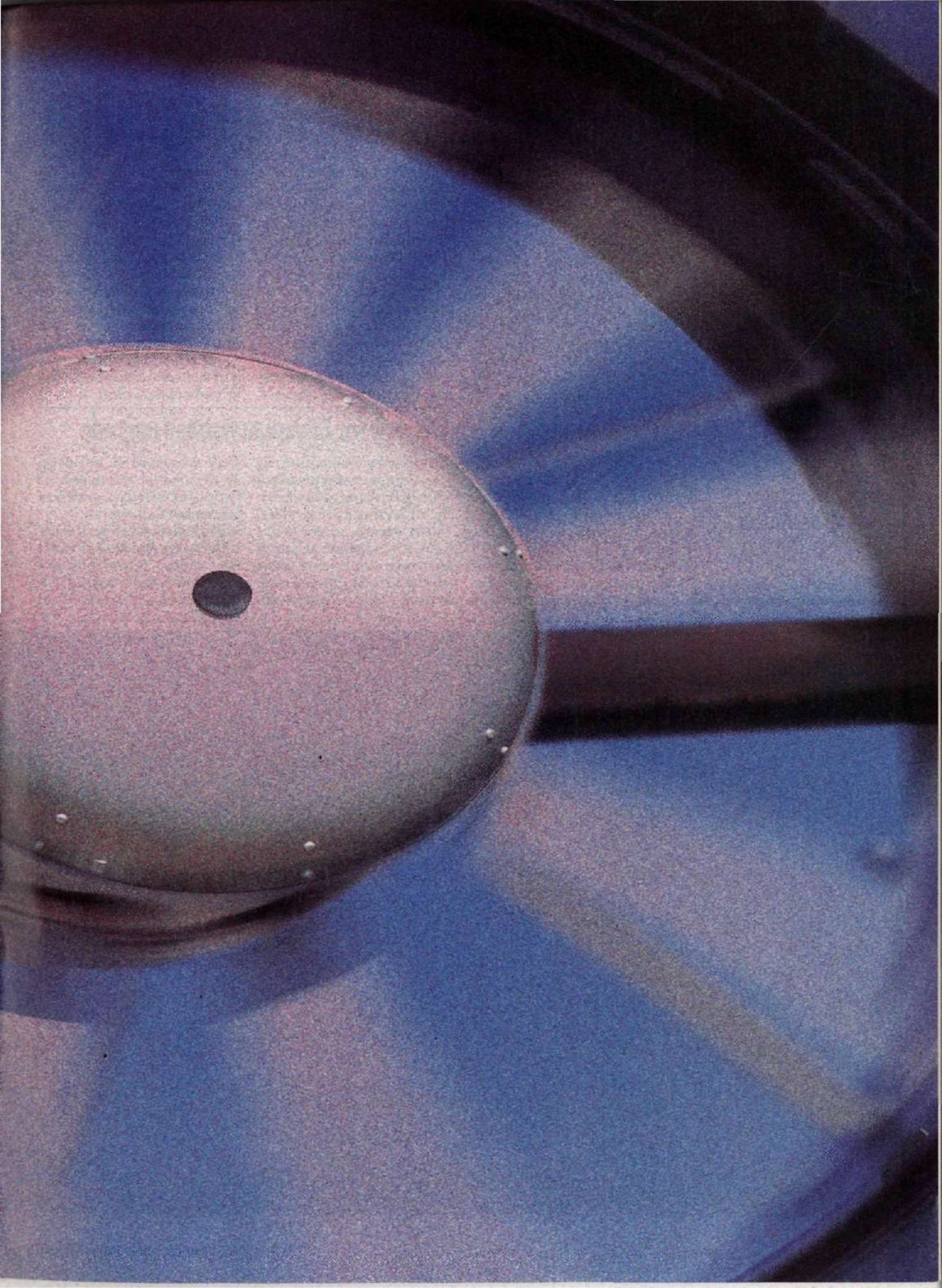
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NEWS IN BRIEF

■ BONN LIGHT SAM

The German parliamentary defence procurement approvals committee has cleared series production of the STN-Atlas Elektronik Light Anti-Aircraft System (LeFlaSys). The LeFlaSys is based around European-produced Raytheon Stinger infrared-guided short range surface-to-air missile (SAM), and is designed to provide anti-aircraft protection to crisis reaction forces and other airborne troop units. According to STN-Atlas, the ministry also plans to adapt the system to use Russian-built Igla missiles procured by the former East German National People's Army. Three anti-aircraft batteries are to be equipped with the tracked vehicle-based system from the year 2000.

Hungary takes uprated L-39ZO

THE HUNGARIAN air force has been handed its first overhauled and upgraded Aero Vodochody L-39ZO Albatros trainer by Danubian Aircraft.

The air force's longer-term hopes of reaching a part exchange deal with Vodochody to swap the aircraft for new-build L-39ZAs appear to have hit financing difficulties, however.

The first upgraded L-39ZO was handed over on 7 April, with another four due by the end of this

year and prospects that the air force will eventually overhaul the remainder of its 19-strong fleet of ex-East German air force trainers. The overhaul covers extending the airframe life as well as upgrading the navigation equipment.

The L-39ZO modifications include the removal of Kvant ranging radar while the original Warsaw Pact Khrom identification friend or foe (IFF) system is supplemented by a Bendix IFF. A global positioning system was also installed.

The aircraft was delivered to the 3rd Squadron of the Kecskemet based 59th Fighter Wing.

The air force has also been in prolonged discussions with Aero Vodochody over exchanging the aircraft for L-39ZAs. The latter L-39 model is NATO compatible, with upgraded navigation and communications equipment. It also offers a wider weapons choice as well as providing a better training and conversion type for Western combat aircraft. □

Three way battle gets under way for Ethiopian Fishbed upgrade

ISRAEL AIRCRAFT Industries (IAI), Elbit and MAPO MIG are involved in a three way battle for a \$100 million contract to upgrade Ethiopia's Mikoyan MiG-21Bis Fishbed fighter aircraft.

The two Israeli companies are offering upgrades based mostly on Israeli developed avionics. The

Lahav division of IAI has recently completed a series of successful test flights of an advanced configuration MIG-21Bis. The new MIG-21-2000 upgrade includes an Elta EL/M-2032 advanced multimode radar, two multifunction liquid crystal colour displays and other advanced avionics. The Elbit up-

grade is based on the one being installed in the Romanian air force's MIG-21s. This also incorporates the Elta Radar.

The Ethiopian air force is evaluating the offers and a decision is expected soon. IAI and Elbit have also offered upgrades for the MIG-21s of Vietnam and Croatia. □

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An-70 bid for FLA nears an end

DOUGLAS BARRIE/LONDON
JULIAN MOXON/PARIS

EUROPEAN Future Large Aircraft (FLA) partners are to meet early next month to discuss the outcome of a critical study into considering the Antonov An-70 as an FLA candidate.

The study, which is widely expected to reject the An-70 as a serious contender, is almost certain to plunge the FLA into further turmoil, say programme sources. Germany, an FLA partner, is running its own study into the An-70, but this will not be completed until the first or second quarter of 1999.

Toulouse sources claim that the An-70 concept is "more or less dead", a sentiment echoed by other project sources, who say that the Ukrainian aircraft "...fails to meet the European Staff Requirement for the FLA".

Germany, with the largest paper requirement – of 75 aircraft – for the FLA, is keen to forge a collaborative programme built around the An-70 involving both Ukraine and Russia. Bonn is also refusing to provide funding for the pre-launch activities (PLA) for the FLA to Daimler Benz Aerospace, despite senior management appeals from the company.

The PLA element of the FLA has been repeatedly delayed, increasingly threatening the FLA's ability to meet the Royal Air Force's preferred in-service date to replace the second tranche of its Lockheed Martin C-130H Hercules.

Programme sources express considerable concern over the impact of Bonn adhering to its position on the An-70. While partner nations plan to develop



The future continues to look rocky for the European FLA programme

the FLA under the auspices of Airbus Industrie's Airbus Military Company (AMC). "Airbus is pretty dubious about the An-70. It represents an enormous area of risk," says a project source.

Airbus Industrie refuses to discuss the FLA or the An-70, saying only that the tactical military transport programme is not yet within its remit.

Should the AMC partnership collapse, sources indicate that Daimler-Benz Aerospace, Alenia and Aerospatiale may form an industrial team with Antonov to pursue a joint programme. This could fall foul of the governments, which have funded initial activity on the FLA, and which will eventually have to come up with the money for full industrialisation and purchase of the aircraft. □

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NEWS IN BRIEF

■ **FRONTIER FINDS INVESTOR**

An unnamed investor has pumped \$15 million into Frontier Airlines in exchange for 33% of the low-cost Denver-based carrier. The investor will gain two seats on Frontier's six-person board. The cash will be used to acquire additional aircraft. Frontier operates a fleet of 14 Boeing 737s.

■ **LITTON LAWSUIT DRAGS ON**

Litton's long-running lawsuit against Honeywell, alleging patent infringement on laser gyros, has been sent back to court, despite earlier rulings in its favour. The move will delay a resolution or make recovery of damages more difficult, Litton admits.

■ **AIRBUS PROFITS FALL**

Airbus Industrie profits slumped sharply to \$150 million in 1997 despite a strong rise in sales to \$11.6 billion, according to figures released by partner Daimler-Benz Aerospace (Dasa). The consortium does not publish its profits, but Dasa made them public for the first time in its 1996 annual accounts. Airbus had then posted profits of around \$450 million on sales of only \$8.8 billion. Analysts point to stiff competition with Boeing as the cause of this year's fall. The figures relate only to the consortium's surplus on aircraft sales and not to earnings from operations at the four partners.

■ **ALLIEDSIGNAL EGPWS**

AlliedSignal estimates that the potential world market for its enhanced ground proximity warning system (EGPWS) is worth some \$1 billion, covering 40,000 civil and military aircraft. AlliedSignal, which holds the only US Federal Aviation Administration licence for the EGPWS, got a boost late last year when the US airline industry decided to install the kit on all aircraft by 2003.

Sabbath flights issue is high on El Al privatisation agenda

ARIE EGOZI/TEL AVIV

AS THE ISRAELI Government attempts again to thrash out agreement on privatising national carrier El Al, the thorny political issue of whether to end its costly ban on Sabbath flights remains high on the agenda.

A decision on the long delayed privatisation was due to take place at the start of April, but the meeting ended without agreement and a decision was postponed for two weeks. A fresh meeting is pencilled in for 22 April, although Israeli sources suggest that a decision could be delayed again with still no resolution over the sensitive issue of flying on Saturdays and other Jewish holy days, opposed by Israel's religious parties.

Shaul Yahalom, the transportation minister, has made it clear that he wants the ban to remain and for the Government to retain control of the airline, with only 49% of shares to be floated on the stock market. That opposition is despite last year's Government report suggesting a full sale.

Sources within the airline believe that, without a clear break from state ownership, the airline will remain "handicapped" in the international market. El Al president Joel Feldschuh warns that the cost of flying fewer than six days a week, together with the airline's heavy security costs, will place an extra cost burden of around \$75 million on the carrier this year.

Nevertheless, the airline managed to show a modest \$4 million profit for 1997, turning around a



Feldschuh: "...time is one resource we don't have"

loss of \$83 million the year before. The improvement, which came despite static sales of around \$1.2 billion, is attributed to the easing in fuel prices, stronger US dollar earnings and also by a re-organisation of the airline. Another small profit is expected this year.

Meanwhile, the airline's new management team is pressing ahead with major changes. Feldschuh, himself a former fighter pilot, has appointed two other ex-air force officers to key positions in

the airline as part of a management overhaul. "We want results, and fast. Time is one resource we don't have," he says.

Fleet renewal is already under way with a deal to purchase five Boeing 737-700/800s and plans for replacement of the medium and long haul fleet. The next competition will focus on the choice of a 350 seat aircraft, with the Boeing 777 and Airbus A340 in the frame.

"Our current fleet cannot answer our needs," says Feldschuh, pointing to ambitions to offer higher frequencies and more direct flights to destinations in North America and the Far East, such as Toronto and Los Angeles.

Co-operation with other airlines is also on the agenda, although political blocks remain. A code-share agreement with American Airlines, signed two years ago, has been left on hold as El Al fights to prevent KLM and Northwest operating a third party link on flights between Amsterdam and Israel. Allowing the deal would open the floodgates to a host of other such deals, says Feldschuh.

An agreement has been put in place with Lufthansa Cargo to use El Al's cargo capacity between Frankfurt and Tel Aviv. "We are willing to enhance this co-operation to passenger traffic," says Feldschuh, confirming that there are also talks with Air France.

Improved yield management is another target, highlighted by the traffic fluctuations that followed the Gulf crisis. An unidentified US company is building a yield management system for El Al. □

Malaysian Airlines fleet refinancing proposals raise doubts

FINANCIAL MARKETS have reacted with alarm to reports that Malaysia Airlines (MAS) chairman Tajudin Ramli is considering a controversial fleet refinancing that would take aircraft off the airline's balance sheet, but also land him a major windfall.

Proposals have been put to the Malaysian Government under

which MAS Capital, a new offshore company controlled by Tajudin, would carry out a sale and leaseback of the aircraft. This would be at the fleet's book value of RM9.2 billion (\$2.4 billion), however. Following the devaluation of the ringgit, the fleet is now estimated to be worth up to RM16 billion.

This would leave Tajudin's com-

pany with a sizeable windfall that investors fear could go into other concerns, including Malaysia Helicopter Services, which has reported a net loss of RM115 million.

Investment house Salomon Smith Barney warns that the deal cannot go ahead "without substantially destroying shareholder confidence in the company". □

European mergers take shape

JULIAN MOXON/PARIS

BATTLELINES are hardening between the groups competing for the lead in Europe's defence electronics and space restructuring, with a new ownership structure laid down for the French grouping being built around Thomson-CSF, and confirmation from Italy's Alenia that it is close to choosing a space partner.

After months of speculation, details have been firmed up for ownership of the newly enlarged defence electronics giant centred on Thomson-CSF. The French Government confirms that it will see its holding cut from 58% to just under 43% in the group, while new partners Alcatel Alsthom, Dassault Electronique and Aerospatiale will together account for another 26%. The remainder is accounted for by publicly floated shares.

Alcatel will emerge as the largest single industrial investor with

16.4% of the new group, in return for handing over its aerospace interests. Alcatel president Serge Tchurk says that his company will have the right to take "major strategic decisions affecting the development of Thomson-CSF", although there will be little influence on day-to-day management.

Alcatel will also take a controlling 51% of the new satellites business, which has been formed from the pooling of assets with Aerospatiale and Thomson-CSF, which will hold the remainder.

Dassault Industries will hold another 6% of the new Thomson-CSF in return for merging its Electronique unit into the business, while Aerospatiale will also receive a 4% stake in the defence electronics giant and another Fr1.25 billion (\$152 million) in cash as recompense for the loss of its satellites operation.

The plan for the group will now be submitted for approval to the

French privatisation committee. Although it has blocked past sell-off plans involving wider European integration, it is due to give assent within the coming weeks to what is now a purely French merger.

The French Government has made clear that it wants to see the new grouping form the nucleus for wider European consolidation and has indicated that it could further reduce its stake in Thomson-CSF to make room for investment by GEC-Marconi. However, the UK group, with partner Alenia Difesa secured, has kept options open for a transatlantic alliance.

Lagardère, through its Matra subsidiary, also continues to build its rival space and missiles alliance. Daimler-Benz Aerospace (Dasa) has already pooled its LFK missiles subsidiary with the Matra BAe Dynamics venture and is in the process of linking its space business with that of Matra-Marconi. "We want to be the world leader in

space, and we have the same objective in missiles," says Philippe Camus, one of Lagardère's two newly appointed co-presidents.

Meanwhile, both rival groupings continue to court Italy's space business. Alenia Aerospazio president Giorgio Zappa confirms that a choice of merger partner is due "within the next few months".

"We think it is essential to maintain a strong role in the satellites business," says Zappa, although he discounts any interest in the launcher business, led in Europe by Aerospatiale/Arianespace. He adds that, while Alenia may currently have lower sales than its potential partners, it offers "considerable capacity" for development and manufacture as well as investment.

"We believe Europe should become a centre of excellence for global multimedia," he says. "We also think that navigation satellites and small satellites will be very strong growth areas." □

Lockheed Martin/Northrop Grumman respond

LOCKHEED MARTIN and Northrop Grumman have issued an official response to the US Government's anti-trust complaints against their proposed merger, arguing that the deal is necessary if they are to compete with Boeing in military aircraft and Raytheon in defence electronics.

The complaint was filed with the court on 10 March by the US competition watchdog, the Department of Justice, and backed by the Pentagon.

A start date for the hearing has now been set for 8 September and is likely to last around six weeks, with a final judgement not promised before the end of December.

The Government maintains that the merger would result in "...unprecedented vertical and horizontal concentration in the defense industry". Its challenge cites combat aircraft, electronic warfare and airborne early warning as areas where competition could suffer.

The concentration of stealth



A cloud hangs over combined stealth technology in the proposed merger

technology within the two groups is also mentioned. Northrop Grumman is building the B-2 bomber, but lost the F-117 fighter project to Lockheed Martin, which also holds the F-22. It is unclear what classified programmes the two groups may hold.

In their joint statement, the companies claim that such arguments refer to past contract com-

petitions. "Northrop Grumman is no longer a competitor to supply military aircraft," they say, noting that the company elected not to bid as a prime contractor for the Joint Strike Fighter programme.

They add that Boeing is now twice the size of Lockheed Martin in military aircraft, following its McDonnell Douglas and Rockwell acquisitions. In defence electronics, they claim that Raytheon's \$15 billion annual sales would still dwarf their own post-merger tally of \$11 billion. In the key areas of airborne radars and electro-optical countermeasures, the companies argue that Raytheon has emerged as the strongest future competitor.

The response saves its strongest wording for the "particularly flawed" claims on vertical integration, claiming that it would be "economic suicide" for the newly merged group to discriminate in favour of in-house suppliers or to stop offering systems to other prime contractors and so risk of losing positions on future procurements. □

NEWS IN BRIEF

■ CHINA SOUTHERN BUYS

China Southern Airlines has acquired a 60% stake in provincial carrier Guizhou Airlines for \$5.8 million. The company wants to develop the Guiyang-based airline into a regional subsidiary operation servicing nearby Indo-China. China Southern is to transfer three Boeing 737s to nine-year-old Guizhou to supplement its existing six Xian Y-7 turbo-prop aircraft.

■ B/EA ACQUIRES AMP

Airliner cabin systems specialist B/E Aerospace (B/EA) is to acquire leading business aircraft interior manufacturer Aircraft Modular Products (AMP), for \$118 million. AMP, based in Miami, Florida, makes components for executive interiors in new and modified aircraft, including VIP-configured airliners.

China signs for Canadian N-5 production

PAUL LEWIS/SINGAPORE

THE CANADIAN Aerospace Group (CAG) has concluded a second collaborative agreement with a Chinese aviation manufacturer covering the final assembly and sale of up to 240 Hongdu N-5A agricultural aircraft to North American buyers. China in return, has been given rights for local production of the Windeagle light aircraft and Monitor jet trainer.

Hongdu, formerly Nanchang Aircraft, is due to ship the first of an initial two N-5 airframes to Canada in May. CAG will then install a Lycoming IO-720 eight-cylinder engine, non-retractable tricycle

gear and cockpit instruments. Company president Philip Nelson claims to have customers already lined up and expects to deliver the first N-5 by August.

In a reciprocal move, China has signed a tentative agreement to produce either CAG's Windeagle all-composite light aircraft or Monitor tandem-seat jet trainer, formerly known as the Peregrine Falcon. They are aimed at China's military trainer and slowly emerging civil general aviation markets.

"If China's military were to say they would like a version of Windeagle or Monitor, we have an agreement signed on the basis we will go together with Hongdu, but

we still have some marketing issues to clear up," says Nelson. The Chinese firm would initially build components to prove its production quality.

This latest agreement follows a similar deal struck with Harbin Aircraft Manufacturing, to supply Y-12 airframes to CAG for completion and sale (*Flight International*, 8-14 April, P11). Hongdu has to date only produced 15 N-5s for the Chinese market, but hopes to sell as many as 40-50 single-engined crop dusters a year to US and Canadian operators.

"We will make aircraft available for lease as well as sale," adds Nelson. The company is planning

to develop uprated versions of the N-5, fitted either with the more powerful liquid-cooled Orenda Canada 600 or the Pratt & Whitney PT6-11 turboprop. Other options would include a global positioning system. Prices will range from \$250,000 for the basic version up to \$700,000 for the turboprop-powered version.

The single-seat N-5 has been designed to US Federal Aviation Administration standards, but has only been certificated in China. It will initially be able to operate in North America under a restricted category. "Our intent is to see the programme through to a full US FAA certification," says Nelson. □

NEWS IN BRIEF

■ ROTORWAY SELLS WELL

Rotorway International has increased production of its Exec 162F kit-built helicopter, from 10 to 12 a month, to keep pace with demand. The company, based in Chandler, Arizona, attributes growing sales to the availability of long-term financing from Greentree. Seven international sales and service representatives have also been appointed. The company says that about 60% of the \$62,350 kits are averaging 300-400h to complete.

■ K-C GETS AVIONICS OK

K-C Aviation has received supplemental type certification for installation of the BFGoodrich Avionics Systems GH-3000 electronic standby instrument system in the Bombardier Challenger 604. The flat-panel display is already installed in several other business jet types.

■ HALF-PRICE FUEL OFFER

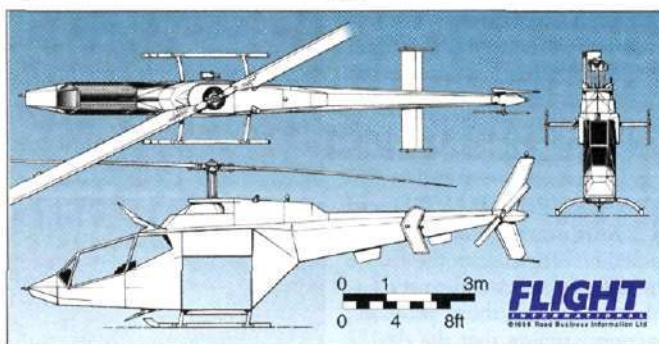
Raytheon Aircraft Services is offering fuel discounts to operators bringing their aircraft to one of its 14 US service centres for maintenance. Discounts of up to 55¢ per US gallon are available.

Agricultural sprayers are lined up for stripped down, ex-surplus, rebuilt JetRanger variant

FLORIDA-BASED Load Ranger plans to develop a stripped-down derivative of the Bell 206 JetRanger, aimed at the agricultural spraying market, but key aspects of the programme remain undefined.

A prototype of the Load Ranger 2000 was displayed at the Helicopter Association International show in February, to gauge interest. "I have 13 sprayers waiting for the aircraft," says company president Tom Navickas. He hopes that certification will be achieved within two years, although a source of finance has yet to be found.

The concept is to marry a new lightweight tubular-steel airframe to a used JetRanger dynamic system, to achieve a \$500,000 helicopter capable of carrying a 900kg useful load and able to lift a 758litre spray tank, compared with a 455litre



tank for the original Bell 206.

The price is based on using components from military surplus Bell OH-58s. The Allison T63 (military 250-C18R) turboshaft is available for around \$50,000, with 1,000h life remaining, compared with almost \$250,000 for a new 250-C20R, says Navickas. An all-new aircraft would cost around \$1.2 million.

The company has been informed by the US Federal Aviation Administration that the helicopter will have to be certificated as a new aircraft. Navickas thus plans to obtain restricted-category certification with a new -C20R, then gain supplemental certification for the change to a used -C18R. He says he will only take orders once the helicopter has been certificated. □

BDE is developing rapid-installation firefighting kit for Caribou

SPANISH COMPANY BDE is developing a firefighting modification for the de Havilland DHC-4A Caribou transport aircraft. The Madrid-based firm is developing a 4,500litre-capacity retardant tank kit designed to be installed or removed from the aircraft's cargo hold in less than 4h. Certification work is under way

at BDE's Miami plant, and US approval is expected to be gained in September.

The company plans to market the firefighting kit to Caribou operators, but has also acquired three ex-Spanish air force DHC-4s which it wants to remarket. Kit-equipped aircraft will be available in January 1999.

As a firefighting aircraft, BDE argues that the Caribou offers the advantage of short take-off and landing, plus the ability to operate into unprepared airstrips, allowing landings close to sources of available water.

The roll-on/roll-off firefighting kit will also be suitable for the later DHC-5 Buffalo, BDE says. □

ESA identifies cause of Ariane 5 roll as new launches approach

TIM FURNESS/LONDON

THE EUROPEAN Space Agency (ESA) has confirmed that roughness inside the first stage engine nozzle was to blame for the roll that endangered the success of the second Ariane 5 launch in October 1997. A solution is in prospect as Arianespace prepares the launcher for fully commercial flights.

ESA looked at two potential causes for the 900 Nm (Newton metre) torque roll experienced with the firing of the Ariane 502's Vulcain first stage (*Flight International*, 25 February-3 March). One possibility focused on a mechanical breakage, but ESA now believes that the problem lay with "roughness" of the internal surface of the Vulcain nozzle, causing the boundary layer of

the main exhaust plume to spiral.

Although ESA has not given full details, the "roughness" is thought to involve the surface configuration of the coolant pipes that spiral around the interior of the nozzle.

An additional attitude control unit is already planned for the Ariane 503 mission, the third and final ESA funded demonstration flight, to obtain inflight confirmation of the roll problem. A solution is also proposed to counteract the roll by a slight repositioning of the two turbine exhaust ducts that run down either side of the nozzle.

The Ariane 503, which will fly with the Aerospatiale-built Automatic Re-entry Demonstrator capsule, should be ready to launch by July. A commercial payload still needs to be found, which makes a September launch date more likely.

European commercial launcher organisation Arianespace has ruled out flying without such a payload, and is still committed to the target of launching a fully commercial Ariane 504 flight by year-end.

Talks are known to have taken place with Eutelsat, the European communications satellite organisation, on flying the Matra Marconi Space built Hot Bird 3, or an Aerospatiale Eutelsat W24 on 503.

Under an agreement with ESA, in which one of the Ariane 5s ordered by Arianespace was transferred to the 503 mission, Arianespace will pay ESA about \$35 million of the commercial launch fee.

Only two of more than 40 craft on Arianespace's orderbook – the ESA Envisat and X Ray Multi Mirror telescope – are too heavy to be carried on the Ariane 4. □

First EOS launch suffers a six month setback

THE LAUNCH of the first satellite in the Earth Observing System (EOS), the centre-piece of NASA's Mission to Planet Earth programme, has been delayed by at least six months after the discovery of a series of ground control software faults.

Faults in the EOS Data and Information System (EOSDIS) are now expected to delay the launch from June to "at least the end of the year", says NASA. Around another 10 EOS craft are to be launched in

the controversial programme, which has suffered delays, budget cuts and specification changes.

The first 5,185 kg spacecraft, the EOS AM-1, was due to have been launched from Vandenberg AFB, California, aboard an ILS International Launch Services Atlas 2AS, carrying 20 instruments to observe the Earth from polar orbit.

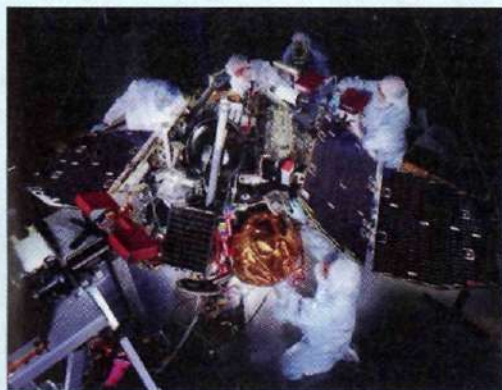
"Significant performance problems" were found in the EOSDIS control centre flight operations segment (FOS) that supports the

command and control, spacecraft instrument health and safety, the planning and scheduling of instrument operations, and analysis of spacecraft trends and anomalies. The FOS was developed by Raytheon under contract to Lockheed Martin, the manufacturer of the EOS AM 1.

Programme managers expect it to take "several weeks" to understand clearly whether the best approach is to correct the software or to take other measures. □

Microprobes team selected

A NINE-STRONG SCIENCE TEAM has been selected by NASA to manage the Mars Microprobes, which will fly as piggyback payloads aboard the Mars '98 Polar Lander, pictured at Lockheed Martin Astronautics in Denver, Colorado. The Microprobes, to be launched in January 1999, are flying as the Deep Space 2 mission in the New Millennium programme and will separate from the lander before it enters the atmosphere. Each Microprobe will search for water ice in the soil using a small drill to bring a soil sample inside the probe, heat it and look for water vapour.



NEWS IN BRIEF

■ ARTEMIS UNVEILED

The European Space Agency's geostationary orbiting Artemis communications technology satellite has been unveiled at Alenia Aerospazio in Rome amid fears that its scheduled launch on a Japanese H2 Alpha Plus in 1999 is likely to be delayed at least until February 2000 because of development problems with the new booster.

■ SUPERBIRD CONTRACT

Hughes Space and Communications has won its sixth satellite manufacturing order in a month, with a contract to build the Superbird 4 for Space Communications of Japan. The HS-601 High Power model will be launched in 2000 on an Ariane 4 booster.

■ SLOVAK MISSION

Lt Col Michal Fulier and Maj Ivan Bella of the Slovak Air Force have started training at Russia's Star City near Moscow for a proposed seven to 10 day mission on the Mir 1 space station in early 1999.

■ ASTRO MESH

Astro Aerospace, a subsidiary of Canada's Spar Aerospace has won a C\$30 million (\$20 million) contract from Hughes Space and Communications to build two 12.25 m diameter AstroMesh unfurlable antennas for the Thuraya communications satellite system. They will provide mobile communications services to the developing regions within Asia, Africa and Europe in 2000.

■ NEW ATLAS

ILS International Launch Services has unveiled an upgraded version of its Atlas 2AR, now rebranded under the Atlas III name. The basic Atlas IIIA uses a Russian RD-180 for the first stage, plus a single RL-10A second stage, while the uprated version, dubbed the Atlas IIIB, will use two RL-10As.

NEWS IN BRIEF

■ BARCO A3XX TEAMING

Belairbus, the Belgian group of companies involved in manufacturing for Airbus Industrie, has accepted the membership of Barco Display Systems as a partner for the Airbus A3XX large airliner programme.

■ NASA SUPERCONDUCTS

Nasa and TRW have demonstrated the first satellite infrared imaging system to exploit superconducting electronics, a system "hundreds of times" smaller and lighter than previously possible. Improved image capability will allow ballistic missiles to be detected mid-flight.

■ LUCAS TEAM FLOWS

Lucas Aerospace has selected US software developer CFM's TeamFlow package for its 24 worldwide sites to map operational processes and "share best practices". TeamFlow is the Bedford, Massachusetts-based company's flagship product, combining its team-centred products in one suite.

■ FORT WORTH MACHINE

Lockheed Martin has installed a new \$1.5 million Makino machining centre at its Fort Worth, Texas, plant. Part of its advanced affordability initiative, the centre offers four to seven times faster processing speeds, including a 15,000rpm spindle speed, five times faster than on its F-16 line, and feed rates up from 2.5-12m/min. Demonstration components will be produced this year.

■ ELBIT DIGITAL MAPS

Elbit Systems has won a contract to supply 40 of its Digital Map systems to an unnamed customer, the system's first use for a military aircraft programme. The Haifa, Israel-based company already supplies the systems for the Boeing V-22 tilt rotor aircraft.

GE's revolutionary laser surface treatment improves on peening

IAN SHEPPARD/LONDON

GE AIRCRAFT Engines is pioneering use of a laser surface treatment technology to increase significantly the crack resistance, fatigue life and impact strength of turbine engine blades.

The technique, known as laser peening, introduces compressive stresses in metals to four times the depth achieved with traditional shot peening, the current *de facto* standard for surface hardening of engine components.

GE confirms that it has a customer which is putting funding into the technology but declines to give further details. The company

is reported to be using the process to treat the blades of its F101 engines for the US Air Force's Rockwell B-1B bomber fleet, and is preparing to use it on the F110-100B engine upgrade for the Lockheed Martin F-16C/D.

Traditional shot peening involves blasting beads at the component at very high speed, helping to introduce compressive stresses and therefore prevent crack propagation to a depth of around 10mm. It may, however, damage the aerodynamic effectiveness of a surface. By contrast, a laser does not affect the finish and has been found to reach a depth of 40mm.

Meanwhile, Lawrence Liver-

more National Laboratories, based at the University of California, and Curtis Wright's Metal Improvement Company (MIC), based in New Jersey, are working together to commercialise the technology as "Lasershot" peening.

The companies are developing a \$1 million next-generation pulsed solid-state laser, which MIC says has become available thanks to advances in laser cooling. It will be up to 50 times more powerful and have a frequency 20 times faster than anything in commercial use today, says MIC, which expects to spend around two years experimenting on components such as gas turbine blades and shafts. □

USN raises more backing for JSF prognostics

LOCKHEED Martin Tactical Aircraft Systems (LMTAS) has received a further \$6 million contract from the US Navy to continue work on the Air Vehicle Prognostics and Health Management (AVPHM) demonstration programme for its X-35 Joint Strike Fighter (JSF) demonstrator.

The original \$6 million contract for AVPHM was awarded in September 1997 with the aim of minimising life-cycle costs by boosting in-service reliability.

Prognostics, also known as case-based reasoning, uses artificial intelligence software to recognise patterns which could be the first warning signs of impending failure. A suspect part or system can then be withdrawn well before significant and costly damage occurs.

The extra funds will allow LMTAS to extend prognostics to real-time monitoring of other aircraft systems such as structure and stealth features, the flight control system, mission systems and the

joint distributed information system (JDIS).

In service, the aim is for the airborne predictive monitoring system to inform the engineering support organisation automatically via the JDIS of maintenance actions required. This will allow many current inspections to be removed from the maintenance schedule.

LMTAS intends to test a prototype system in 2000 as a risk-reduction measure for its JSF preferred weapon system concept. □



Boeing avoids redesign for Super Hornet wing

BOEING HAS selected a remedy for the wing drop problem on the F/A-18E/F Super Hornet after flight testing at the Naval Air Station at Patuxent River, Maryland. A slotted fairing allows air to flow both ways through the wing fold hinges, making it aerodynamically invisible and preventing the asymmetric stall which led to a roll of up to 30° in high speed subsonic manoeuvres.

Carrier-based F-18 simulator succeeds on *Independence*

GRAHAM WARWICK/WASHINGTON DC

BOEING REPORTS THAT an F-18C flight simulator installed on the US Navy aircraft carrier USS *Independence* is "performing well" in the first test of a carrier-based weapon system trainer (CVWST).

The simulator supplied by Boeing has been in operation since mid-January and may be transferred to another carrier or to a shore base when the *Independence* proves of concept trial ends.

Keith Hertenberg, general manager of training and support systems at Boeing's aerospace support unit, admits that the installa-



Tight space aboard the carrier made installation a challenge

tion of the CVWST in a ready room on the carrier was a "challenge". The device had to be broken down, fitted through the ready room door, and re-assembled, but has operated "nearly flawlessly"

since being installed, he says.

The availability of a simulator has allowed crews to perform weapon tactics training "...which there is no other way to do while under way", Hertenberg says. The CVWST includes a simulated F-18 cockpit and compact Boeing developed visual system. The device is less than 2.4m tall and occupies only 6.1 x 4.6m of floor space, running off normal power.

The concept demonstration was intended to show "...we could install a device in a compact area, provide the weapons training and rehearsal necessary and prove that the device was hardy enough [for shipboard use]", says Hertenberg. □

FSI plans two more ERJ-145 simulators

FLIGHTSAFETY International (FSI) has announced plans to build two additional full flight simulators for the Embraer RJ-145 regional jet. The US company is the official training organisation for the ERJ-145 and has so far completed two simulators.

One ERJ-145 simulator has entered service at FSI's Houston, Texas, centre, where it is being used to provide training for Continental Express. A second machine is operational at FSI's Tulsa, Oklahoma, simulator manufacturing plant, where it is being used by American Eagle, but will be relocated closer to an ERJ-145 operator. Both have Level D training approval.

The two new simulators will be delivered in 1999, six months apart, to locations that will be decided by Embraer. The training company already operates several simulators for the Brazilian manufacturer's EMB-120 regional turboprop.

FSI also plans to build a third simulator for the Bombardier Canadair Regional Jet. The first two Level D devices are in service at the company's Cincinnati, Ohio, and Wilmington, Delaware, training centres. □

BA cadets start US training

PAUL RICHFIELD/BATTLE CREEK

THE FIRST CLASS of British Airways cadets has begun training at Western Michigan University (WMU) as part of the airline's drive to take on some 2,500 pilots over the next decade.

A second group of BA trainees will arrive at Michigan in May under the two year \$6 million deal signed by BA last December. An optional third class is due in the fourth quarter. Two UK flight schools - Cabair College of Air Training and Oxford Air Training School - also provide *ab initio* training for BA.

Two-thirds of the 2,500 new hires will be "direct entry pilots", with the rest trained as cadets. The initial group of 16 arriving at Battle Creek, Michigan, in March will cost £65,000 each to train.

WMU has invested heavily in its

aerospace sciences programme to attract customers, receiving \$8.2 million in grants from the Kellogg Foundation - set up by the area's largest employer. Following UK Civil Aviation Authority approval of its programme last July, the school began training 16 self-sponsored students from the UK and Ireland. In January, 24 Aer Lingus cadets entered *ab initio* training at WMU.

Of the 33 flight instructors on the WMU payroll, nine are UK citizens dedicated to the CAA training curriculum. The 56-week course runs from 141h primary training in Cessna 172Rs through to aerobatics, simulator training and 10h of cockpit resource management.

BA cadets will complete four weeks of jet transition training at British Aerospace Flying College in Prestwick, Scotland, before joining the airline as first officers. □

Schreiner adds Belgium's EATC to portfolio

SCHREINER Luchtvaart Groep of the Netherlands, which owns Schreiner Airways, has acquired European Aviation Training (EATC) at Brussels Airport through its newly founded Simubel subsidiary.

EATC has six flight simulators for

the Airbus A310, Boeing 727-100, and 727-200, McDonnell Douglas DC-10 and MD-80 and Lockheed Martin C-130. EATC gains 85% of its Bfr200 million (\$5.3 million) turnover training pilots from 34 countries, and in 1997 made a net profit of Bfr18 million. □

NEWS IN BRIEF

■ FSBT PICKS CAE

FlightSafety Boeing Training International (FSBTI) has selected CAE Electronics to supply a Boeing 737-700 Level 5 flight training device for delivery to its Seattle simulator centre in August, where it will be used as a classroom-based maintenance trainer.

■ TTS UPGRADES C-5

The first of seven Lockheed C-5 weapon system trainers upgraded with flight management/global positioning systems by Thomson Training & Simulation (TTS) has been delivered to Flight-Safety Services, which operates the C-5 aircrew training system for the US Air Force.

■ SEOS FITS DISPLAYS

SEOS Displays is completing a £3 million (\$5 million) contract to install 220°-wide Panorama displays on four flight simulators at the US Air Force's special-operations training base at Kirtland AFB, New Mexico. MC-130P, MH-53J and MH-60G simulators have been upgraded and the final, TH-53A, device will be ready for training in May.

■ FIRST FOR DUTCH ATC

The Netherlands has accepted into operation the FIRST air traffic control (ATC) tower simulator supplied by Raytheon Systems UK and installed in a new training centre at Amsterdam Schiphol-East. Controller training is scheduled to begin in the third quarter.

■ DHFS GETS TWIN SIM

The UK Defence Helicopter Flying School (DHFS) has taken delivery of a Frasca built Bell 412 flight training device for multi-engine training. The device is fitted with a full flight package, complete aircraft systems modelling and a Frasca FVS-200 visual display.



Air Chief Marshal Tananit Niamtan

Thailand's new commander in chief must maintain readiness while cutting costs

Hornets nest

PAUL LEWIS/BANGKOK

NEW JOBS inevitably entail fresh challenges and the position of commander in chief of the Royal Thai Air Force (RTAF) is certainly no exception. Air Chief Marshal Tananit Niamtan reached the pinnacle of his 27 year air force career in October 1997, just as Thailand's economy was diving headlong into the worst financial trough in decades. He faces the unenviable task of reeling in spending while maintaining operational readiness.

The RTAF is one of the world's oldest air forces, tracing its origins back to 1911 and, with more than 250 aircraft in service, ranks today as one of the largest in South East Asia. Before the recent financial onslaught, the air force was facing a bright future, with a second squadron of 18 Lockheed Martin F-16A/B fighters just delivered, eight Boeing F/A-18C/D Hornets on order and new transport, tanker and airborne early warning (AEW) aircraft in prospect.

Much of this has fallen victim to Thailand's fiscal implosion and subsequent \$17 billion bail out from the International Monetary Fund. A succession of defence cuts has slashed the RTAF's 21.5 billion baht (\$542million) budget for 1998 by more than 23%. More damaging has been a dive of over 50% in the value of the baht against the US dollar, pushing many planned procurements beyond the reach of the military.

Tananit explains: "When we signed some of these contracts about four years ago, the dollar was worth around 25-26 baht. Right now it is trading at around 45-46 baht, so this means we have to pay almost double the amount for which we signed these contracts."

The RTAF is being forced to curtail spending on seven major programmes already in the procurement pipeline. The chief casualty has been the air force's order (placed in 1996) for four F-18C and four tandem seat F-18Ds. Thailand had paid only \$74.5 million of the \$392 million due in total under the US Foreign Military Sales (FMS) contract when the cash crunch came.

THREE CHOICES

Tananit continues: "This year we were due to pay them \$93 million, but we didn't have the money." As a result, the RTAF faced three choices: postponing delivery of the fighters by three years, selling them to a third country or cancelling the programme. Tananit's preference was for either of the latter two options, but none of them proved financially attractive.

Thai officials estimate that, with interest rates at 9%, extending the FMS deal would cost

another \$40 million. Furthermore, the 1996 deal represented only the first stage of a planned two part purchase and by itself did not contain a sufficient quantity of spares, weapons or aircraft. "If we were to buy another eight fighters to get a full squadron, we would have to spend another \$300 million," adds Tananit.

The search for a third party buyer has proved elusive. While countries such as Chile and the Philippines have outstanding fighter requirements, none is ready to make an immediate decision. In the interim, Thailand would have had to continue to make scheduled payments until a customer could be found.

Equally unattractive was an outright cancellation of the two year old deal. With vendor systems ordered and parts production already under way to meet an initial June 1999 delivery schedule, Thailand faced contractual default penalties of some \$250 million. Adjustments by the US Defence Security Assistance Agency subsequently reduced this.

Tananit recalls: "They sent a team to Bangkok after Mr Cohen's [US Secretary of Defence] visit. We asked them to check out the details - what we would have to pay if we cancelled. They finally came back and told us we would be left to pay \$130 million."

Nonetheless, it was \$130 million that Thailand simply either could not afford or did not have. Implicit recognition of this came in mid-March with US President Bill Clinton's announcement relieving Thailand of its F-18 FMS obligations. The decision served as a political gesture to Thai premier Chuan Leekpai during his visit to Washington. The US Navy now has to find a home for the aircraft and the RTAF is expected to forfeit its downpayments.

The latter appears to be a moot point with the senior air force officers, who had been wishing for a refund on some if not all of the \$74.5 million. The RTAF had hoped to use the money to revive earlier stalled plans for an avionics upgrade of its F-16s and older Northrop F-5s in lieu of new F/A-18s. "We've already looked at the specifications for an upgrade, but without a budget we can't do it," concedes Tananit.

Thailand is understood to have all but signed an initial \$45 million deal for a mid-life upgrade of its first squadron of 18 Block 15 standard F-16A/Bs before the recent crisis. The aircraft, comprising 12 single seat As and six tandem seat Bs, were first delivered to the Nakhon Ratchasima-based 103 Squadron in 1988. A second batch of 18 fighters was delivered in 1995-6.

An F-16 mid life update would give the aircraft the capability to carry the Raytheon AIM-120

Advanced Medium Range Air-to-Air Missile (AMRAAM). The US Government has promised to make the AMRAAM available to Thailand once other similar active radar guided missiles were supplied to the region, such as the Vypel R-77 (AA-12 Adder) delivered to Malaysia and Vietnam. "We've asked...but the money is not there at the moment," adds Tananit.

Other future enhancements include funding for Leigh Aerostystems' development of an extended range GBU-12 Paveway II laser guided bomb. The Longshot modification consists of a strap on global positioning system antenna, flight control computer and extendible wings, giving the weapon a range of up to 30km (16nm).

"This [the Longshot] is still going ahead...if it works and becomes commercially viable, we'll get some percentage share of the money," explains Tananit. Longer term RTAF interest in an enhanced stand off weapon capability for the F-16 appears to focus on the development of a lightweight Lockheed Martin/Rafael AGM-142/Popeye II missile. The RTAF had earlier also selected Elbit of Israel as prime contractor for a follow-on navigation and weapons systems upgrade for its some 35 surviving F-5E/Fs. A contract is being finalised in the expectation that money will be forthcoming eventually.

PYTHON 4

There is also speculation that the aircraft could be armed with the new Rafael Python 4 air to air missile in place of the Python 3, necessitating a helmet mounted sight. For cost reasons, a planned retrofit of a new multimode radar has been dropped in favour of a refurbishing the existing Emerson APG-153/157/159.

A 1980s US Air Force administered modernisation provided for new GEC-Marconi head up displays, Litton LN-39 inertial navigation systems and ALE-40 chaff/flare dispenser and ALR-46 radar warning receiver. Local sources say a single F-5E, believed to be flown by Thai Crown Prince Watsilalongkon Machidon, has received unspecified improvements in Chile.

Thailand's financial difficulties have meant that lower priority acquisitions have had to be put aside. These include a longstanding interest in an AEW aircraft to augment the Royal Thai Air Defence System's (RTADS) ground-based radars. Officials warn in the meantime that Phase 3 of the RTADS project awarded to Northrop Grumman, formerly Westinghouse, is another project facing refinancing and delay.

Other planned procurements on the backburner include more transport aircraft and an inflight refuelling capability. The RTAF operates 12 Lockheed Martin C-130H/ H-30s and six Alenia G222s, but needs more to complete the replacement of its Fairchild C-123s and Douglas C-47s. Talks had also been held with Israel Aircraft Industries on acquiring boom equipped Boeing 707 tankers to support the F-16s.

The Thai military is also facing growing pressure for a long overdue reform of the procurement system, to become more cost effective.

THAILAND'S AIR FORCE DATA BASED ON INFORMATION AVAILABLE



	Aircraft	Squadron		Aircraft	Squadron
Wing 1	L-39ZA	102Sqn	Wing 6 (cont)	Learjet 35, Merlin IV, Arava	605Sqn
	F-16A/B	103Sqn	Wing 21	F-5E/F	211Sqn
Wing 2	S-58T	201Sqn	Wing 23	F-5/RF-5A	231Sqn
	UH-1H/N, 412, AU-23	202Sqn	Wing 41	OV-10C	411Sqn
Wing 4	L-39ZA	401Sqn	Wing 46	N-22B	461Sqn
	FT600	402Sqn	Wing 53	AU-23	531Sqn
	F-16A/B	403Sqn	Wing 56	Bare base	-
Wing 6	C130H/H-30	601Sqn	Wing 71	F-5E/F	711Sqn
	A310, 737	602Sqn	Flying training school	L-39ZA, PC-9, CT-4, T-37B	
	AC-47, G.222, HS748	603Sqn	Royal Rain Making Flight (Wing 41,4)	N-22/C123K/T-37	
	T-41D, SF260	604Sqn			

ient. "Each service has the freedom to select and choose a weapon to suit their forces," explains Tananit. This has resulted in the purchase of three different types of similar helicopters, the Sikorsky S-70B Seahawk for the Royal Thai Navy's (RTN) anti-submarine role, the Bell 212 for army transport and the Eurocopter AS332

Super Puma for the RTAF Royal Flight.

The RTAF faces a period of austerity, while the Thai economy struggles to rebuild itself. The daunting challenge now before Tananit is to steer the air force through and try to fine tune the system to perform to the same standard, but with substantially fewer resources. □

Commercial Simulation & Training

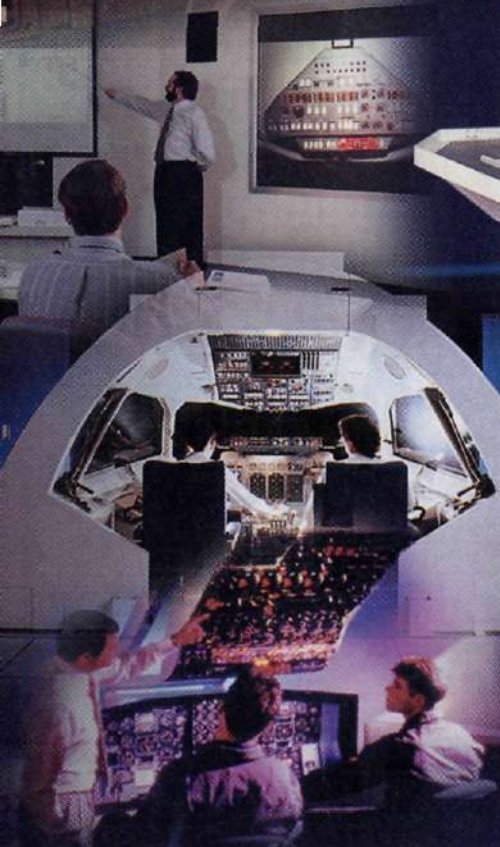
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High fidelity pays off

Simulator makers' investment in new technology is now paying off in sales

GRAHAM WARWICK/WASHINGTON DC

SIMULATOR MANUFACTURERS have started 1998 as they ended 1997 – busy. As expected, orders for commercial flight simulators are tracking closely the recent surge in airliner sales. At least 45 full flight simulators were sold last year, short of the last peak of 55 in 1989, but well above the recent low of 15 in 1996. Sales this year are expected to approach those achieved in 1997, but a levelling off to a sustained 25-30 orders a year is predicted from 1999 onwards.

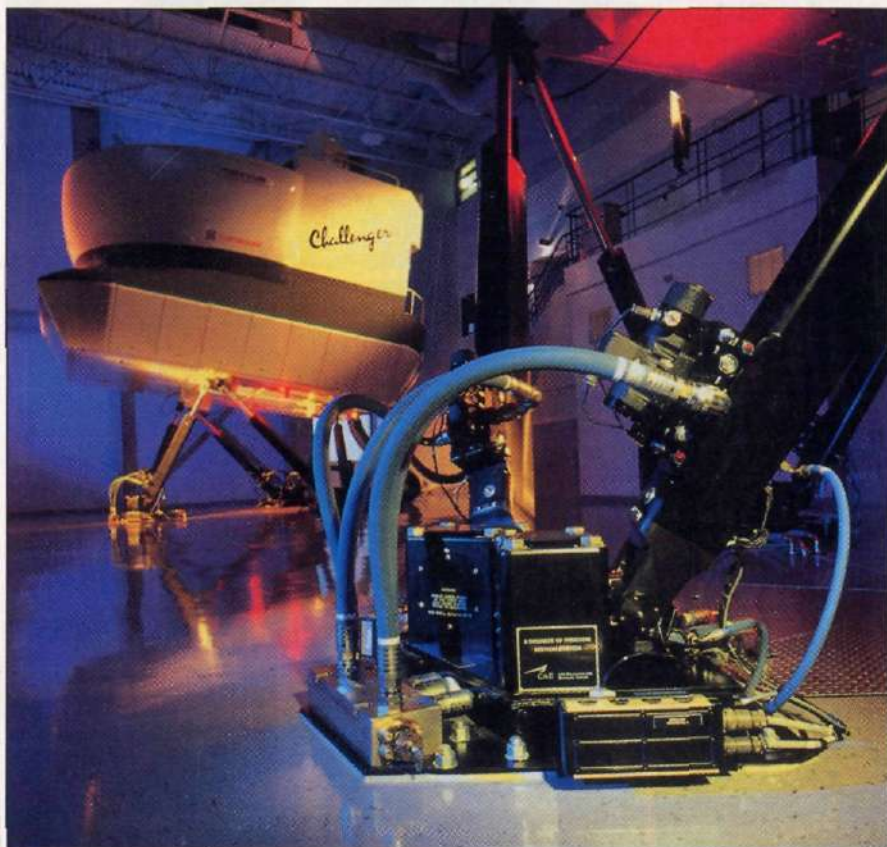
The new year has started strongly, with simulator orders – announced and unannounced – already into double figures. Canada's CAE Electronics, which ended 1997 in pole position with about two-thirds of booked orders, has led the charge in 1998, but rival Thomson Training & Simulation (TTS) is known to have unannounced orders in hand, as have competitors Flight-Safety International (FSI) and Reflectone.

Deals announced so far this year include:

- Continental Airlines – CAE: Boeing 737 Next Generation and 777 full flight simulators (FFSs) and flight training devices (FTDs);
- Delta Air Lines – CAE: a 777 FFS and an FTD to add to 13 flight simulators and training devices ordered last year from CAE;
- Finnair – CAE: an Airbus A320 FFS;
- Boeing – CAE: a 717 FFS for the Flight-Safety Boeing Training International (FSBTI) joint venture;
- Mexicana – TTS: an A320 FFS;
- Sabena – TTS: an Airbus A340 FFSs to join an A320 FFS ordered last year from TTS; and
- SAS Flight Academy – CAE: a second 737-700 FFS.

Several key deals remain to be announced, including US Airways' selection of CAE to supply simulators to support its new Airbus fleet, beginning with three A320 FFS. FSBTI, meanwhile, has ordered four 737-700 simulators into production at FSI to meet projected demand for training on the type – and despite buying a 737-700 machine from CAE in 1997.

The Continental and US Airways deals are similar to "preferred supplier" contracts signed by CAE last year with American Airlines and



Product improvement through good times and bad produced this CAE-built Challenger 604 simulator

Delta Air Lines, to support large-scale orders placed with Boeing. These have resulted so far in orders for 10 FFSs from the two airlines, and include priced options for additional machines required as fleet renewal progresses.

While CAE led the market last year, securing sales of 29 FFSs, followed by TTS with 14, FSI remained a formidable force despite selling only one machine to an "outside" customer – a 717 FFS to Boeing for use by FSBTI. In 1997, the US training company ordered no fewer than 22 full flight simulators into production at its Tulsa, Oklahoma, manufacturing plant.

SECOND SOURCE

After ending 1996 in pole position, TTS was forced into second place last year – but sold more simulators than in the year before. Two customers featured prominently in its 1997 orderbook: United Airlines, with three A320 and two 777 FFSs; and the TTS-owned Orbit Flight Training centre, with A320, A340 and 737-800 FFSs plus an A320 simulator jointly owned with the Pan Am International Flight Academy.

Reflectone secured two orders last year, but they were important ones for the US company – its first for A320 FFSs. They were placed by Airbus, with one machine destined for its Miami, Florida, training centre and the other for the Asia-Pacific Simulation & Training centre in Singapore.

One marked characteristic of last year's orderbook is the preponderance of sales involving narrowbody airliners – A320 family aircraft and Next Generation 737s. The last peak, in 1989, followed a surge in sales of widebody aircraft as airlines worldwide renewed and expanded their long haul fleets. The intervening years, although lean by comparison, were sustained by continued sales of simulators for widebodies – mainly from Asian carriers.

This time around, the peak is mimicking the recent surge in orders for narrowbodies as airlines – principally North American and European – get to grips with renewing their short/medium haul fleets. Orders for some 20 A320 family simulators have been placed since the beginning of 1997, while around 14 Next ►

CIVIL SIMULATORS

Generation 737 devices have been ordered over the same period.

This trend is good news for simulator manufacturers, as many more narrowbodies than widebodies are on order with Airbus and Boeing. Tempering their optimism is the fact that, historically, the aircraft-to-simulator ratio for narrowbodies is significantly higher than for widebodies. This has to be factored into forecasts of simulator demand based on aircraft orderbooks, but still leaves the picture looking healthy, at least for the near term. Even the Asian carriers are expected to bounce back, possibly as early as 1999.

Airbus has been actively encouraging operators to buy simulators – offering them as part of package deals with the aircraft, or supplying its customers with a standard specification to provide to simulator manufacturers when conducting their own procurement competitions. Several recent deals have involved Airbus acting as buyer or broker.

TRAINING DEMAND

Boeing has expressed concern to suppliers that there may be too few Next Generation 737 simulators on order, but it has not followed the Airbus example. Instead, it appears to be relying

on operators, independent training centres and its own joint venture with FSI to meet the anticipated training demand. Based on sales so far, particularly to European operators, Ash Sarin, CAE's director of marketing and sales, does not anticipate a shortage of 737 training capacity.

Airline fleet replacement programmes have played a major part in the recent order boom. The American, Continental, Delta and US Airways deals together account for 15 of the FFSs on CAE's orderbook, and options included in the contracts cover a large number of additional machines. These preferred supplier deals do not restrict airlines to ordering simulators from CAE, but give the Canadian manufacturer the incumbent's advantage when competing for follow-on orders.

United has elected to follow a two-track approach, ordering additional A320 and 777 simulators from original supplier TTS while buying further Boeing 747-400 and 757 machines from CAE. The airline was by far the most active buyer of simulators last year, ordering a total of eight FFSs from the two firms.

US fleet replacement programmes also boosted sales of flight training devices last year. CAE booked orders for 21 FTDs in 1997, including no fewer than eight for Delta. Other customers included FedEx (five) and United (two). Although Asian and European carriers purchased a handful of devices last year, CAE's Sarin sees demand for FTDs as mainly a US phenomenon. Buying FTDs allows an airline to cut down on the number of more expensive FFSs purchased, provided they are used within an approved syllabus which provides training credits for using the lower fidelity devices.

DESKTOP TRAINING

TTS says that it sold two FTDs last year, plus another four desktop trainers. While the latter are not certificatable devices, they allow pilots to practise operation of the aircraft's flight management system without tying up an expensive full motion, full visual simulator. Among US airlines, United is a large user of such trainers.

Rounding out last year's simulator sales was another significant group of aircraft – regional airliners. Predictably, regional jets loom large in simulator orderbooks, as they now do in aircraft sales. CAE sold four regional aircraft FFSs last year, including its first for the Embraer RJ-145 and Fairchild Dornier 328JET.

FSI is the official training organisation for the ERJ-145, and its first two simulators for the Brazilian regional jet are already in service. Now the training company has ordered two additional FFSs into production, for 1999 delivery, to meet the training demand anticipated based on the aircraft's sales success. FSI has also begun construction of its third simulator for the Bombardier Canadair Regional Jet (CRJ).

CAE sold a CRJ simulator to Air Canada last year in a deal which Sarin expects could set a trend. Rather than buy the regional jet FFS, and another for the A340, the Canadian airline will



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- Nacelle System - On Board Software Development - Systems Integration Ground Tests - EMI/EMC
- Systems Engineering
- Aerotactics • Electrical • Avionics • Air Conditioning • Ice Protection
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pay by the hour to use the CAE-owned simulators. The machines will be based at the airline's training centre, and Air Canada will market any excess training capacity, sharing the revenue generated with CAE. Sarin says that CAE expects to conclude similar deals in the future.

TTS, meanwhile, has been building up its Orbit training centre, which is being relocated to the UK's London Heathrow Airport to be closer to customers. Orbit will be equipped with A320, A340, 737-800 and 777 simulators. A 737-200 machine has been sold by Orbit to the Pan Am academy in Miami, Florida, where the jointly owned A320 simulator will be based.

INDEPENDENT MINDED

The last boom period saw a substantial number of sales to independent training centres. So far, few have placed orders this time around – although German training centre RWL has just ordered a 737-700/800 simulator from CAE to join a 737-300/400/500 supplied previously.

There may be some ownership changes still in store for the training centre sector. The owner of Friendship Simulation in the Netherlands has purchased the Brussels-based European Aviation Training Centre, for example. The former Hughes Flight Training centre near London Gatwick Airport, meanwhile, is now part of Raytheon Systems UK following the Raytheon/Hughes merger.

Looking ahead, CAE's Sarin sees one comparatively new market sector that could emerge in the near future – commercial helicopter flight simulation. He highlights the entry into service at SAS Flight Academy of a Bell 412/212 FFS. FlightSafety would agree with him. The training company is adding Bell 412/212, Bell 430 and Sikorsky S-76C+ machines to its fleet of helicopter simulators.

The keys to growth in the helicopter market



TTS' Boeing 737NG desktop flight management system trainer is an example of product innovation

are both technological improvement and regulatory advances. The eventual aim is to provide training credits similar to those available in a Level D airliner simulator – the highest fidelity recognised by regulatory agencies.

Visual system advances are a key to achieving that capability, as they have been to improving the training available in airliner simulators. CAE's own MaxVue visual is used already on several military helicopter simulators.

The Canadian company is close to selling its 100th MaxVue since entering the visuals market in 1992, including 10 systems sold last year, but the undisputed industry leader is Evans & Sutherland (E&S). The US company claims over 80% of the 1997 market for commercial visuals, including upgrades.

Almost all TTS simulators, and many of

CAE's, are now fitted with E&S visuals. FSI meets all of its visual simulation requirements with its own ChromaView system, and is targeting the upgrade market. E&S has been successful, in part, because of its once-dominant visuals marketing partnership with Rediffusion and the large installed base that it now supports. CAE, Sarin says, is focused on the new-build market and on increasing the proportion of its own simulators that are equipped with the MaxVue.

The commercial flight simulation industry has been intensely, even destructively, competitive in recent years. Visual system prices are now half of what they were during the last peak, and, while simulator prices have remained basically stable, four surviving manufacturers makes competition tough even in good times like these. □

COMMERCIAL FLIGHT SIMULATOR SALES - 1997

Customer	Aircraft	Supplier	Visual	Customer	Aircraft	Supplier	Visual
Airbus Industrie	A320	CAE	CAE	FlightSafety Boeing	717-200	FSI	FSI
	A320	Reflectone	E&S		737-600/700/800	CAE	CAE
	A320	Reflectone	E&S	KLM	737-700	CAE	CAE
Air Canada	A340	CAE	CAE	Korean Air	A330	TTS	E&S
	Canadair Regional Jet	CAE	CAE		747-400	CAE	E&S
Air China	737-800	CAE	E&S	NATCO	A320	CAE	E&S
	777-200	CAE	E&S		Saab 340	CAE	
Airtours	A320	TTS	E&S	Orbit Flight Training	A320	TTS	E&S
All Nippon Airways	A320/A321	CAE	FSI		737-800	TTS	
American Airlines	737-800	CAE	E&S	Pan Am/Orbit	A320	TTS	E&S
	737-800	CAE	E&S	RWL	737-700/800	CAE	E&S
	767-300ER	CAE	E&S	Sabena	A320	TTS	E&S
	777-200	CAE	E&S		A330/A340	TTS	E&S
	Embraer RJ-145	CAE	E&S	Swissair	A330/A340	CAE	CAE
British Airways	777-200 (FBS)	CAE		TAP Air Portugal	A320	TTS	E&S
British Midland	A320	TTS	E&S	United Airlines	A320	TTS	E&S
Delta Air Lines	737-200	CAE	E&S		A320	TTS	E&S
	737-800	CAE	E&S		747-400	CAE	E&S
	767-300	CAE	E&S		747-400	CAE	E&S
	767-400	CAE	E&S		757-200	CAE	E&S
Emirates	A330/A340	CAE	E&S		777-200	TTS	E&S
Fairchild Dornier	328Jet	CAE	CAE		777-200	TTS	E&S
FedEx	MD-11	CAE	CAE				

Narrowbody-airliner simulators, like this FSI 737 machine, account for most new sales

Civil Simulation Census

COMPILED BY AVIATION INFORMATION RESOURCES/ATLANTA

NOTES AND ABBREVIATIONS

The *Flight International* Civil Simulator Census lists full flight simulators in service or on order, alphabetically by operator, then by aircraft type. Simulator supplier, computer, visual system, motion axes, year of entry into service, certification level and associated training devices are listed for each simulator, plus any additional remarks.

Visual suppliers are: AAI G2000; CAE MaxVue; Evans & Sutherland ESIG3350; Frasca FVS; Hitachi Hivis; Ivex VDS; FlightSafety ChromaView; Vital; Tector Opdis; Vistar; Thomson Training & Simulation N2000, N6000, NVS, DNVS, Image, Space, SP, SPX. For monitor based displays, the number of windows is shown; for wide angle displays, the horizontal field of view in degrees is shown adjacent to the visual type.

US Federal Aviation Administration certification Levels A to D for full-flight simulators and

Levels 4 to 7 for flight training devices. Other national approvals include: Australia (ACAA); Canada (TC); Europe (JAA); France (DGAC); Germany (LBA); Japan (JCAB); Norway (NBA); South Korea (KMoT) and the UK (CAA). The listings are not intended to be complete, and are intended to indicate a simulator's level of fidelity.

Abbreviations used include: ARI Aviation Resources; AVT audio-visual trainer; CAE CAE Electronics; CBT computer based training; CPM cockpit procedures mock-up; CPT cockpit procedures trainer; CSS cockpit systems simulator; EFIS electronic flight-instrumentation system; FBS fixed base simulator; FFS full flight simulator; FSI FlightSafety International; FTD flight training device; IQTG International Qualification test Guide; MPT maintenance procedures trainer; MTS maintenance training simulator; TBD to be decided; TTS Thomson Training & Simulation - includes heritage companies Link-Miles, Rediffusion and Thomson-CSF (T-CSF)

Operator (location - telephone number) Type (Simulator location, # different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
AER LINGUS, Dublin Airport, Ireland +353 (1) 705 2820								
B737-200	Rediffusion	DDP-124	Vital IV/4w	3	1969	CAA L2B	AVT mockup	
B737-3/4/500	Rediffusion	Encore MultiSEL	SPX500/150	6	1989	CAA L3	737-300 FMST (Xionix)	
BAC One-Eleven 2/500	Rediffusion	Encore 32/67	Vital IV/4w	3	1964	CAA L3		Training available
AERO CALIFORNIA, La Paz, Mexico +52 482 26655								
DC-9-30	Cond/ARI	DDP-124	Vital IV/2w	3	1967	FAA LA		Ex Midway
AEROFLOT-RUSSIAN INTERNATIONAL AIRLINES, Moscow, Russia +7 (95) 155 6648								
A300-600	Link-Miles	Encore 32/97	SP1T/6w	6	1998	LC standard		Ex Delta, Reflectone u/g
Il-86	T-CSF			6	1983			
Il-96-300	Penza			6	1993			
Tu-204-100	Penza			6	1991			
Tu-204-200	Penza			6	1993			
AEROLEASING, Geneva, Switzerland +41 (22) 717 0000								
Learjet 35/36	ARI	Encore 32/67 & Motorola	VDS-2000	6	1994	FAA LC		
AEROLINEAS ARGENTINAS, Buenos Aires, Argentina +54 (1) 313 5694								
B737-200	Rediffusion	Encore 32/67	SP1/4w	3	1971	FAA LB		
B747-200	Rediffusion	Encore 32/77x2	SP1/4w	6	1981	FAA LB		
AEROMEXICO, Mexico City, Mexico +52 (5) 723 8198								
DC-9-15	Link	GP-4	SP1	6	1968	FAA LA		
DC-9-32	Link	Encore 32/77	Image II	6	1985	FAA LC		
AEROSERVICE AVIATION CENTER, Miami, USA +1 (305) 871 5557								
B727-100	Link-Miles	GP-4	NVS/2w	3	1990	FAA LB	Cabin trainer	Ex Northwest
B727-200	Link	GP-4	Image II	3	1975	FAA LB		Ex SimuLite
B727-200	CAE	VAX 11/780	SP1T/2w	6	1980	FAA LC		Ex Air Canada

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
B737-200Adv	Conductron	DDP-124	Vital IV/2w	3	1967	FAA LA		Ex Reflectone, ex Midway
DC-8-62/63	Conductron	DDP-124	N6000/2w	3	1971	FAA LA	CPT, door trainer	Ex Braniff
DC-8-62/63	Link	GP-4	SP1	3	1995	FAA LA	CPT	Ex-First Air, ex Flying Tiger
AIR ALGERIE, Algiers, Algeria +213 (2) 583 317								
B727-200	Rediffusion	Encore 32/77	SP2/4w	6	1983	CAA	CBT (Wicat)	
B737-200	Rediffusion	Encore 32/77	SP2/4w	6	1983	CAA	CBT (Wicat)	
AIRBORNE EXPRESS, Wilmington, USA +1 (513) 382 5591								
B767-200	Rediffusion	Encore 32/77	SP3/5w	6	1997	FAA LC		Ex All Nippon Airways
DC-8-62	Cond/Rediffusion	Encore 32/97	SP1/5w	3	1990	FAA LB		Ex Japan Airlines
DC-9-30	Rediffusion	Xionix XT/Link GP-4	Vital IV/2w	3	1966	FAA LB		Ex Air Canada
AIRBUS INDUSTRIE (AEROFORMATION), Blagnac, France +33 (61) 93 21 50								
A320	CAE	IBM 6000	MaxVue	6	1998	LD standard		Location TBA
A330/A340	TTS	Power PC	ESIG3350/180	6	1998	LD standard		Location TBA
Toulouse								
A300-600R/A310-2/300	T-CSF	Encore 32/77	Vital IV/6w	6	1984	DGAC, LBA, CAA L3	CSS	
A310-2/300/A300-600R	T-CSF	Encore 32/77	Vital IV/6w	6	1982	DGAC, LBA, CAA L3		
A320-1/200	T-CSF	Encore 32/67	SP1T/6w	6	1987	DGAC CAA L3, FAAL C	FBS (T-CSF)	
A320-1/200	T-CSF	Encore 32/67	SP1T/6w	6	1989	DGAC CAA L3, FAAL C	FBS (T-CSF)	
A330/A340-2/300	T-CSF	Harris Night Hawk	SPX500/170	6	1992	DGAC, LBA	FMGST (Wicat)	
A330/A340-2/300	T-CSF	Harris Night Hawk	ESIG3350/180	6	1992	DGAC, LBA		FBS upgraded to FFS
AIRBUS SERVICE, Miami, USA +1 (305) 871 3655								
Dallas/Fort Worth								
A300-600R	Link	Encore 32/6780	SP1T	6		FAA LC		At American Airlines
Miami								
A300B2/B4	T-CSF	Encore 32/77	Vital IV/6w	6	1980	FAA LC		Ex Aeroformation
A310-300	Link-Miles	Encore 32/97	SP3T/6w	6	1987	FAA LC		Ex Airbus; Ex PA, Ex Delta
A320-200	T-CSF	Encore 32/6780	SP1T	6	1987	FAA LC	FMGST (Wicat)	
A320-200	T-CSF	Encore 32/6780	SP1T	6	1991	FAA LC	FMGST (Wicat)	
A320-200	Reflectone	Power PC	ESIG3350/180	6	1998	LD standard		CFMI and IAE engines
A330/A340	T-CSF	Harris Night Hawk	SPX500/170	6	1992	FAA LC	FMGST (Wicat)	
AIRBUS TRAINING CENTRE - BEIJING, Beijing, China +86 (10) 645 67626								
A320	TTS	Power PC	ESIG3350/180	6	1997	LD standard		Airbus/CASC centre
A330/A340	TTS	Power PC	ESIG3350/180	6	1997	LD standard		Airbus/CASC centre
AIR CANADA, Toronto, Canada +1 (905) 676 2384								
Toronto								
A320-200	CAE	Encore MultiSEL	SPX500/150	6	1990	TC LD	FMST (Tricom)	
A320-200	CAE	Encore MultiSEL	SPX500/150	6	1991	TC LD		
A340	CAE	IBM 6000	MaxVue A+	6	1998	TC LD	FMST (Tricom)	
B747-100	CAE	Sigma 2	SP1/2w	6	1971	TC Visual		
B767-200	CAE	Encore MultiSEL	SP1T/4w	6	1982	FAA LC, TC LC		
DC-9-30	TTS	DDP-124	SP1/2w	3	1969	TC Visual		
DC-9-32	CAE	T1980B x 2	SP1/2w	6	1975	TC LB		
Miami								
DC-8-70	Link/GMI	GP-4	SP1/2w	3	1975	FAA LB, TC Visual		At Pan Am Academy
Montreal								
Canadair RJ	CAE	IBM 6000	MaxVue A+	6	1998	TC LD		At CAE plant
AIR CHINA, Beijing, China +86 (10) 456 3203								
B737-300	CAE	IBM 6000	MaxVue	6	1995	FAA LD	L5 FTD (CAE)	
B737-800	CAE	IBM 6000	ESIG3350/180	6	1998	LD standard		
B747-400	CAE	IBM 6000	MaxVue	6	1995	FAA LD	L5 FTD (CAE)	
B757/767-300	CAE	IBM 6000	MaxVue	6	1995	FAA LD	2 x 767-300 L5 FTD (CAE)	
B777	CAE	IBM 6000	ESIG3350/180	6	1998	LD standard	FTD (CAE)	
AIR FRANCE, Massy, France +33 (1) 64 47 78 61								
Charles de Gaulle								
A300-600/A310-300	T-CSF	Encore MultiSEL	SPX500/180	6	1991	FAA LD, JAA LD	L7 FBS	
A320-200	T-CSF	Encore MultiSEL	SPX500/4w	6	1988	FAA LD	L7 FBS	
A340	T-CSF	Harris Night Hawk	SPX500/180	6	1993		CBT, FMST	
Concorde	T-CSF	XDS 530	Vital IV/2w	6	1975	DGAC		Ex Aeroformation
DC-10-30	CAE	Sigma 3	Vital IV/6w	6	1972	FAA LD		Ex UTA
DC-8-63/72/73	CAE	Sigma 3	N2000/2w	3	1968	FAA LB		Ex UTA
Massy								
A300B2/B4	T-CSF	Encore 32/77	SP1/6w	6	1981	FAA LB	CPT	
B707-320	Link	GP-4	SP1/2w	3	1970	DGAC		
B727-200Adv	T-CSF	Encore 32/77	SP1/6w	6	1982	FAA LB	CPT (Gemco)	
B737-200	Rediffusion	Encore MultiSEL	SPX500/4w	6	1988	FAA LD, JAA LD	L4 FTD	
B737-500	Rediffusion	Encore MultiSEL	SPX500/180	6	1991	FAA LD	CBT, FMST	
B747-200	Rediffusion	Encore 32/77	SP1/6w	6	1987	FAA LB	CSS	
B747-400	Rediffusion	Encore MultiSEL	SPX500/180	6	1990	FAA LD	L7 FBS	
Orly								
A300B2/B4	T-CSF	Encore MultiSEL	Image IV-500/4w	6	1989	LC standard	CBT (Matra)	Ex Air Inter

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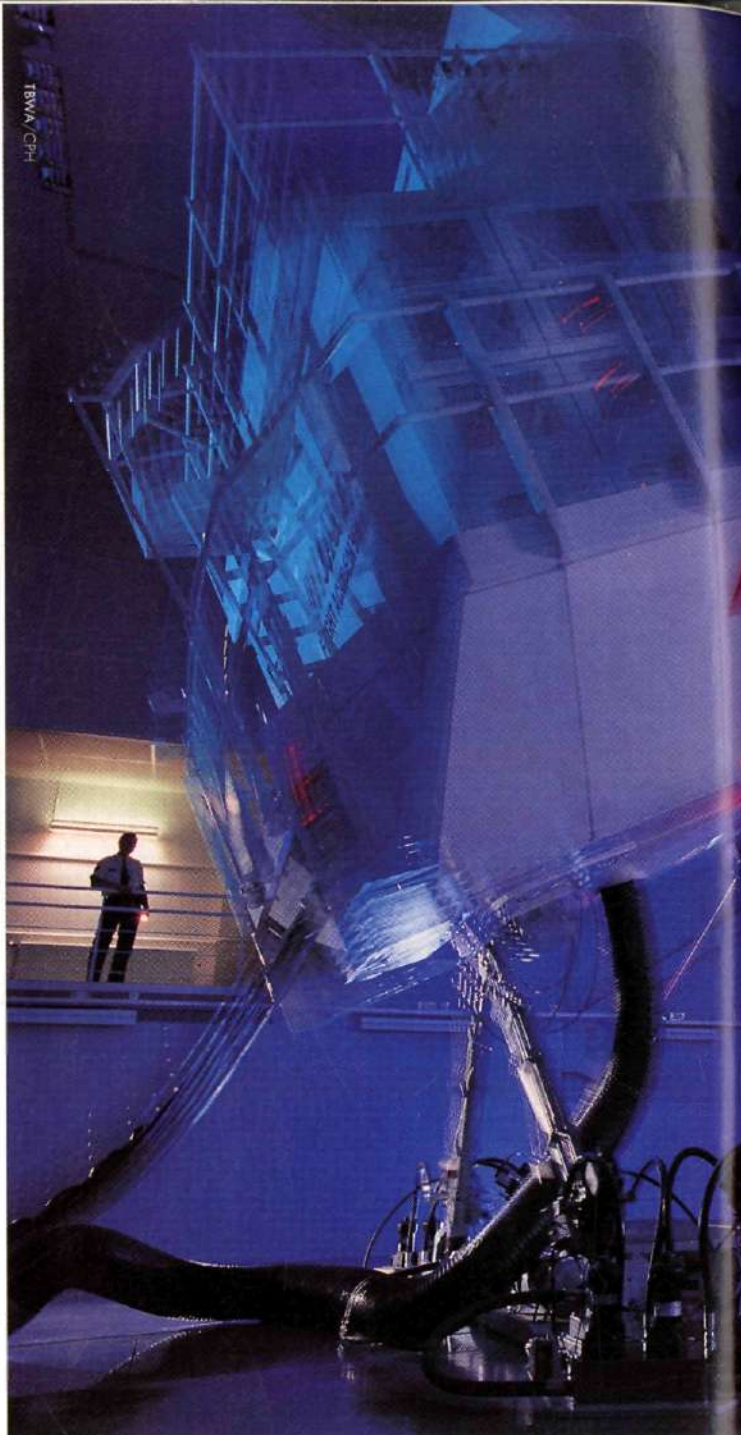
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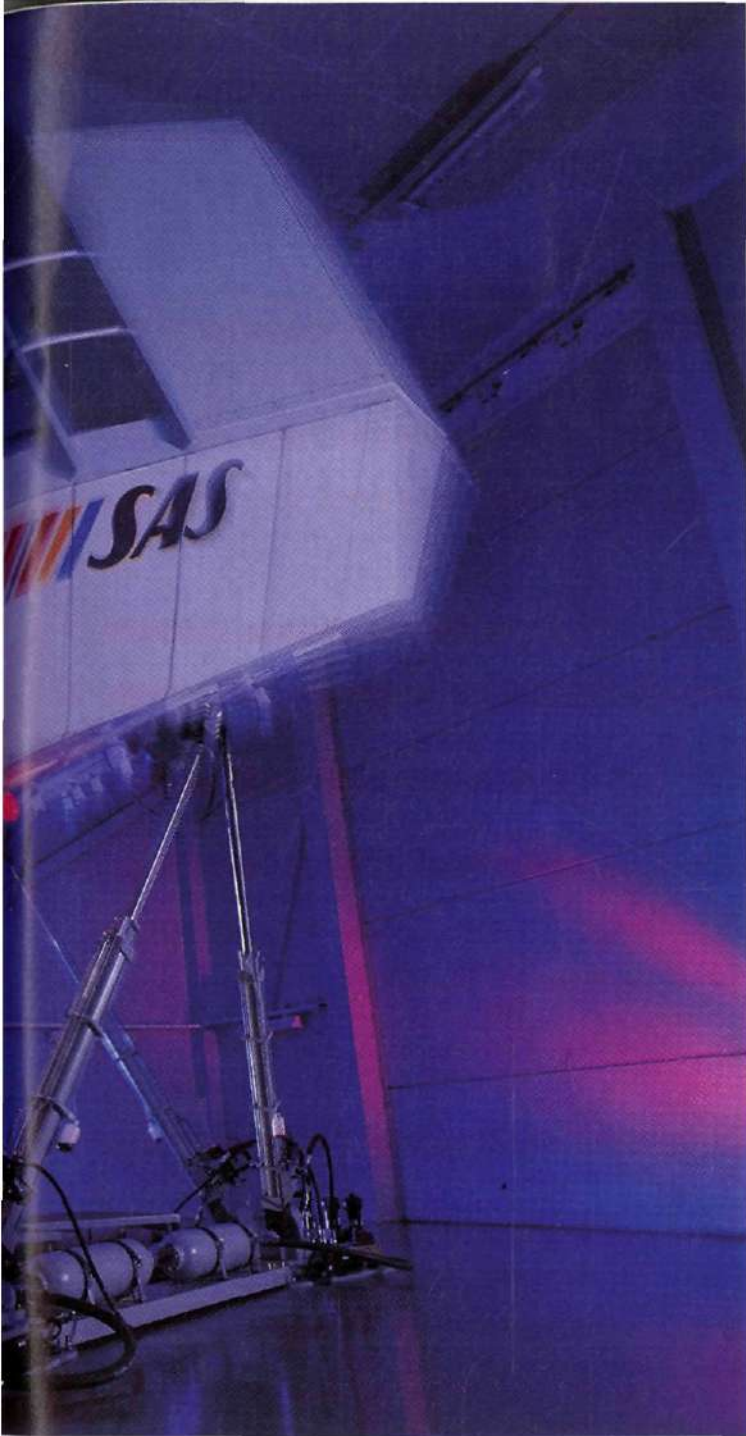
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CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
A300B2/B4	T-CSF	Sigma 2	Vital IV/2w	6	1982		CPT	Ex Aeroformation
A320-200	T-CSF	Encore MultiSEL	Image IV500/4w	6	1989	LD standard	CBT (Matra)	Ex Air Inter
A320-200	T-CSF	Encore MultiSEL	Image IV600/150	6	1991	LD standard	CBT (Matra)	Ex Air Inter
AIR INDIA, Bombay, India +91 (22) 202 4142								
A310-300	CAE	Encore 32/67	SPX500/150	6	1988	FAA LC	FTD (Wicat), CBT	
B747-200B	CAE	Encore 32/97	SPX500/150	6	1971	FAA LC	FTD (Wicat), CBT	Updated '93
B747-400	CAE	IBM 6000	MaxVue/150	6	1993	FAA LC	FMST (Wicat), CBT	
AIRLINES TRAINING INSTITUTE /FLIGHT SIMULATION, San Carlos, USA +1 (415) 508 0424								
B720	Rediffusion	DDP-124	CCTV/2w	3	1965	FAA LA		Ex Western Airlines
AIR NEW ZEALAND, Auckland, New Zealand +64 (9) 256 3885								
B737-200	Rediffusion	Encore SCI-Clone	SP1T/4w	6	1987	FAA LC; NZ L5		
B747-200B	Rediffusion	Encore 32/77	SP1/4w	6	1981	NZ L4		
B747-400	Rediffusion	Encore SCI-Clone	SP1T/150	6	1989	NZ L5		
B767-200ER	Rediffusion	Encore 32/77	SP2/4w	6	1986	NZ L5		Ex PWA
AIRTOURS INTERNATIONAL AIRWAYS, Manchester, UK +44 (161) 232 6740								
A320	TTS	Power PC	ESIG3350/180	6	1999	LD standard		
AIR TRANSAT, Mirabel, Canada +1 (514) 476 1011								
Toronto								
L-1011-100	CAE	SIGMA 2	SP1	6	1972	TC Visual		Ex Air Canada
ALASKA AIRLINES, Seattle, USA +1 (206) 433 6806								
B737-300	Rediffusion	Encore MultiSel	SPX200/4w	6	1992	FAA LC		Owned by RFTL
MD-83	Rediffusion	Encore MultiSEL	SPX200/4w	6	1989	FAA LC		
ALITALIA, Rome, Italy, +39 (6) 6563 2654								
Rome								
A321	TTS	Harris Night Hawk	Image 600PT/180	6	1995	JAA LD	CBT (TRO)	
B747-200	CAE	Encore 32/87	Vital IV/6w	6	1986	JAA LC	CSS (Burtek)	Plus 767 FMST (Wicat)
DC-9-30	Link	GP-4	Vital IV/6w	3	1967	JAA LB		
MD-11	Rediffusion	Encore MultiSEL	SPX500/150	6	1990	JAA LC, FAA LC	CBT (Wicat)	
MD-82	Rediffusion	Encore 32/87	SP3T/150	6	1982	JAA LC	CSS, CBT (Wicat)	Plus MD-80 FMST (Wicat)
MD-82	Rediffusion	Encore 32/87	SP3T/150	6	1984	JAA LC, FAA LC	CSS, CBT (Wicat)	
MD-82	Rediffusion	Encore 32/87	SP3T/150	6	1986	FAA LC	CSS, CBT (Wicat)	
MD-82	Rediffusion	Encore MultiSEL	SPX500/150	6	1992	JAA LC	CSS, CBT (Wicat)	
Alghero, Sardinia								
Cheyenne IIIA	Rediffusion	Encore MultiSEL	SP1/4w	6	1989	JAA LC		
ALL NIPPON AIRWAYS, Tokyo, Japan +81 (3) 3745 8230								
Kumamoto, Japan								
Cheyenne IIIA	FSI	Concurrent Micro 5	Vital VIII/4w	6	1990			
Cheyenne IIIA	FSI	Concurrent Micro 5	Vital VIII/4w	6	1992			
Tokyo								
A320-200	T-CSF	Encore MultiSEL	SPX500/150	6	1990	JCAB PIII		
A320/A321	CAE	IBM 6000	ChromaView	6	1999	LD standard		
B737-200	Rediffusion	Encore 32/97	SP3T	6	1986	JCAB PII		
B737-500	CAE	IBM 6000	Vital VIII/180	6	1995	JCAB PIII		For Air Nippon
B747-200B	Rediffusion	Encore MultiSEL	SPX500/150	6	1990	JCAB PIII		
B747-400	CAE	Encore MultiSEL	SPX500/150	6	1990	JCAB PIII		
B747-400	CAE	Encore MultiSEL	SPX500/150	6	1991	JCAB PIII		
B747-400	CAE	IBM 6000	SPX550/200	6	1993	JCAB PIII		
B747SR	Link	PDP 11/55	DIG	6	1980	JCAB Cat 2		
B767-300	Rediffusion	Encore MultiSEL	SPX500/150	6	1989	JCAB PIII		
B767-300	Rediffusion	Encore MultiSEL	SPX500/150	6	1991	JCAB PIII		
B767-300	Rediffusion	Motorola	SPX550/200	6	1993	JCAB PIII		
B777-200	TTS	Motorola	Vital VIII/225	6	1995	JCAB PII	MTS (TTS)	
B777-200	TTS	Motorola	Vital VIII/225	6	1995	JCAB PII		For Air Nippon
AMERICAN AIRLINES, Dallas/Fort Worth, USA +1 (817) 967 5232								
A300-600/A310-300	Link-Miles	Encore 32/97	SP1T/6w	6	1988	FAA LC	CBT (TRO)	Owned by Airbus
B727-200	Link	Encore 32/77	SP3T/4w	6	1981	FAA LD		
B727-200	Link	Encore 32/77	SP2/4w	6	1983	FAA LC		
B727-200	Link	GP-4/Encore 32/27	SP2/2w	3	1967	FAA LB		Ex Air France
B727-200	Link	GP-4/Encore 32/27	SP1/2w	3	1988	FAA LB		Ex Air France
B737-800	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard		
B737-800	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard		
B757-200	CAE	VAX 3800	SPX500/150	6	1990	FAA LD		
B757-200	CAE	VAX 3800	SPX200/150	6	1992	FAA LC		
B767-200	Link	Encore 32/77	SP2/4w	6	1982	FAA LC		
B767-200	Link	Encore 32/77	Image III/4w	6	1987	FAA LD		
B767-300ER	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard		
B777-200/GW	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard		
DC-10-10/30	Rediffusion	Telefile T85	SP1/4w	6	1971	FAA LC		
DC-10-10/30	Rediffusion	Telefile T85	SP1/4w	6	1971	FAA LC		

All Nippon's new visuals have the VITAL difference.

Leaders prefer leaders.

When All Nippon Airways chose to enhance its service with a fleet of Boeing 777s, that decision was clearly in keeping with ANA's leadership position as Japan's largest airline.

And so was its choice of simulator training technology — FlightSafety Simulation's VITAL



ChromaView
visual system,
specified for

installation on ANA's two B777-200 full flight simulators.

"With all its advances, the 777 truly represents the new generation in airliners," says Captain Ryosuke Kinoshita, ANA's General Manager, Flight Crew Training Center. "Our passengers deserve the best, and so do our pilots. That is why we also wanted the new generation in training technology. Our search for the most realistic training environment possible led us, after thorough evaluation, to the VITAL ChromaView visual system."

Any search for new-generation training technology should include a visit to FlightSafety Simulation. Follow ANA and other leaders to FlightSafety, and see the VITAL difference.

The photo-imagery-based VITAL ChromaView visual system specified by ANA for its two B777 full flight simulators (and a B737-500) has a high performance raster-calligraphic projector system that provides new levels of clarity and reality in aviation simulation. Its MultiView 225" display offers an uninterrupted panoramic scene with cross-cockpit viewing. Geospecific, full color texture greatly enhances scene realism.



"After a careful search for the best visual, we selected ChromaView."

Captain Ryosuke Kinoshita
General Manager of Flight Crew Training Center, Flight Operations
All Nippon Airways



To see the latest in
simulator technology
from FlightSafety
Simulation, please
contact Derek Maeer
at (918) 251-0500.
Fax (918) 251-5597.

FlightSafety
international
Simulation

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
Fokker 100	CAE	VAX 3800	SPX500/150	6	1992	FAA LC	FMST (Xionix)	
Fokker 100	CAE	VAX 3800	SPX500/150	6	1991	FAA LD		
MD-11	CAE	VAX 4300	SPX500/150	6	1990	FAA LD		
MD-80	Link	Encore 32/77	Image III/4w	6	1985	FAA LD		
MD-80	Link	Encore 32/77	Image III/4w	6	1985	FAA LD		
MD-80	Link	Encore 32/77	Image III/4w	6	1986	FAA LD		
MD-80	Link	Encore 32/77	Image III/4w	6	1988	FAA LD		
MD-82	CAE	VAX 3800	SPX500/150	6	1991	FAA LD		
AMERICAN AIRLINES CONTRACT TRAINING, Dallas/Fort Worth, USA +1 (800) 678 8686								
B707-320C	Link	GP-4	VDS-1000/2w	3	1969	FAA LA		
Citation I	Rediffusion	GP-4	VDS-1000/2w	3	1967	FAA LA		Leased to SimuLite/Quickturn
AMERICAN EAGLE, Dallas/Fort Worth, USA +1 (817) 967 5691								
ATR 42-300	CAE	Encore MultiSEL	SPX200T/4w	6	1991	FAA LC		Ex ATI
Embraer RJ-145	CAE	IBM 6000	ESIG3350/180	6	1998	LD standard		
Saab 340B	CAE	VAX 3800	SPX200T/4W	6	1991	FAA LC		
AMERICAN TRANS AIR TRAINING, Indianapolis, USA +1 (317) 243 4522								
L-1011-500	Link	PDP 11/55	SP1	6	1980	FAA LB	CSS, CPT	Ex Pan Am. At Miami
AMERICA WEST AIRLINES, Phoenix, USA +1 (602) 693 8534								
A320-200	CAE	IBM 6000	SPX200/4w	6	1992	FAA LC		
B737-200	Rediffusion	Encore 32/67	SP1/4w	6	1983	FAA LC		Ex PWA
B737-200	Rediffusion	Encore 32/77	SP1/4w	6	1986	FAA LB		Ex Ansett
B737-3/400	CAE	IBM 6000	SPX200/4w	6	1992	FAA LC		
B757-200ER	CAE	Encore 32/67	SPX200/4w	6	1990	FAA LC		
ANSETT AUSTRALIA, Melbourne, Australia +61 (3) 339 6909								
A320-200	Rediffusion	Encore SCI-Clone	SP1T/150	6	1988	ACAA L5		
B727-200LR	Link	GP4/Encore 32/77	Vital III-6000	3	1975	ACAA L3		For sale
B737-300ER	Rediffusion	Encore SCI-Clone	SP1T/6w	6	1987	ACAA L5		
B767-200	Link	Encore 32/77	SP1T/6w	6	1982	ACAA L5		
BAe 146-300	Reflectone	Encore RSX	Vital VII/150	6	1992	ACAA L5		
ASIANA AIRLINES, Seoul, South Korea +82 (2) 3662 7493								
B737-3/4/500	Rediffusion	Encore MultiSEL	SPX500/150	6	1991	FAA LC		
B747-400	CAE	IBM 6000	MaxVue/150	6	1994	FAA LC		
B767-300/300ER	CAE	IBM 6000	MaxVue/150	6	1995	FAA LC		
ASIAN ATR TRAINING CENTRE, Bangkok, Thailand +66 (2) 513 0221								
ATR 42/72	TTS	Harris Night Hawk	Space/180	6	1997	LD standard		ATR/Thai Airways/TTS centre
ASIA-PACIFIC TRAINING & SIMULATION, Singapore, +65 543 2188								
A320-200	Reflectone	Power PC	ESIG-3350/180	6	1998	LD standard	FMGST, CBT	BAe/STAE centre
C-130/L-100	Reflectone	Encore MultiSEL	SPX20/4w	6	1992	LB standard		BAe/STAE centre
ATR TRAINING CENTRE - AERO INTERNATIONAL (REGIONAL), Blagnac, France +33 (56) 221 6360								
ATR 42/72	FSI	Concurrent Micro 5	Vital IV/4w	6	1990	FAA LC	CBT	
ATR 42/72	TTS	Harris Night Hawk	Space/180	6	1996	DGAC LD	CBT	
AUSTRALIAN AIRLINES, Melbourne, Australia +61 (3) 339 8429								
A300B4	T-CSF	Encore 32/77	SP1/4w	6	1982	ACAA L4		At Qantas
B737-3/400	CAE	Encore MultiSEL	Vital VII/150	6	1989	ACAA L5		
B737-300ER	CAE	Encore 32/6780	Vital IV/6w	6	1986	ACAA L5		
AVANTI AIR, Santa Monica, USA +1 (310) 396 4273								
B727-200	Rediffusion/ARI	R2000A	Vital IIS/2w	3	1991	FAA LB		Formerly First Air
AVIA TRAINING, Costa Mesa, USA +1 (714) 756 1060								
B727-100	Link	Solid State Drum 960	N6000/2w	3	1965	FAA LB		Ex TWA
AVRO INTERNATIONAL AEROSPACE TRAINING CENTRE - AERO INTERNATIONAL (REGIONAL), Woodford, England +44 (161) 439 5050								
Hatfield								
BAe 146-200	Rediffusion	Encore 32/67	SP3T	6	1986	CAA L3	CPT, CAT	
Woodford								
Avro RJ100	Reflectone	Encore RSX	SPX250T/150	6	1993	FAA LC, CAA L3	CAT	
BAe 146-2/300	Reflectone	Encore MultiSEL	SPX200T/150	6	1992	CAA L3	CPT, CAT	Interchange EFIS/analogue
BOMBARDIER REGIONAL AIRCRAFT, Montreal, Canada +1 (514) 344 6620								
Canadair RJ-200	CAE	IBM 6000	MaxVue A+	6	1992	TC/FAA LD	CBT (CAE)	
Canadair RJ-200	CAE	IBM 6000	MaxVue A+	None	1995	TC/FAA L7	CBT (CAE)	Fixed based simulator
Challenger 604	CAE	IBM 6000	MaxVue A+	6	1996	TC/FAA LD	CBT (CAE)	
Global Express	CAE	IBM 6000	MaxVue/210	6	1998	LD standard		
BRAATHENS SAFE, Oslo, Norway +47 (6) 759 7492								
B737-4/500	CAE	VAX 3200	Vital VII/150	6	1989		FBS/MTS (CAE)	FBS has VDS-1000 visual

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
BRISTOW HELICOPTERS, Aberdeen, Scotland +44 (122) 472 3151								
AS332L Super Puma	Flysim	Analogue/digital	VDS-1000/2w	4	1983	CAA L2A		
BRIT' AIR - ICARE FLIGHT TRAINING CENTRE, Morlaix, France, +33 (98) 88 10 10								
ATR 42/72	FSI	Concurrent Micro 5	SPX200T	6	1991	FAA LC	CBT (VACBI)	
Canadair RJ-200	FSI		ChromaView/180	6	1996	LD standard	FMST (Fara)	
BRITANNIA AIRWAYS, Luton, England +44 (158) 242 4155								
B757/767-200ER/300ER	Rediffusion	Motorola	ESIG3350/180	6	1995	CAA L4		
BRITISH AIRWAYS, Heathrow Airport, England +44 (181) 562 5356								
Cranebank								
B737-200	CAE	VAX 11/780 x 2	DNVS/4w	6	1980	CAA L3		
B737-200	Rediffusion	Encore 32/8705	SP1/4w	6	1985	CAA L4; FAA LC		
B737-400	Rediffusion	Encore MultiSEL	SPX500/150	6	1991	CAA L3		
B737-400	Rediffusion	Encore MultiSEL	SPX500/180	6	1991	CAA L4; FAA L7		Upgraded to FFS 8/97
B747-200Combi	CAE	VAX 8500	SPX500/4w	6	1988	CAA L4		
B747-200	Link	PDP 11/55 x 2	NVS/2w	6	1980	CAA L3		
B747-400	Rediffusion	Encore MultiSEL	SPX500/150	6	1988	CAA L4		
B747-400	Rediffusion	Encore MultiSEL	SPX500/150	6	1988	CAA L4		
B747-400	Rediffusion	Motorola 187	SPX500/150	6	1994	CAA L4		
B747-400	Rediffusion	Encore MultiSEL	SPX500/180	6	1989	CAA L4		
B757-200	CAE	VAX 4200 x 2	SP1/4w	6	1982	CAA L4		
B757/767-200	CAE	VAX 3800 x 2	SPX500/150	6	1989	CAA L4		*Convertible
B767-300ER	CAE	VAX 3800 x 3	SPX500/150	6	1991	CAA L4		
B777-200	CAE	IBM 6000	ESIG-3350/180	6	1995	CAA L4		
B777-200	CAE	IBM 6000	TBD	6	1999		MTS (CAE)	FBS, FFS u/g later
BAC One-Eleven-4/500	Rediffusion	R2000A	NVS/2w	3	1973	CAA L3		
L-1011-2/500	Link	PDP 11/55 x 2	NVS/2w	6	1980			Not active; For sale
Filton								
Concorde	Link/Rediffusion	R2000A x 3	SPX500/150	6	1978	CAA L3		At BAe
BRITISH INTERNATIONAL HELICOPTERS, Aberdeen, Scotland +44 (122) 477 1353								
S-61N	Rediffusion	R2000A	SP1/2w	6	1978			
BRITISH MIDLAND AIRWAYS, Coalville, England +44 (133) 285 2021								
A320	TTS	Power PC	ESIG3350/180	6				
B737-3/4/500ERS	Rediffusion	Encore MultiSEL	SPX500/W150	6	1990	CAA L4	FMST	
BRITISH WORLD AIRLINES, Southend, England +44 (1702) 354 435								
Viscount					None			
CAAC FLYING COLLEGE, Guanghan, China +86 (8) 2232 2601								
B737-300	CAE	IBM 6000	MaxVue/150	6	1995	FAA LC	L5 FTD	
Cheyenne IIIA	CAE	IBM 6000	MaxVue/150	6	1994		FBS (CAE)	FBS has MaxVue visual
Cheyenne IIIA	CAE	IBM 6000	MaxVue/150	6	1994		FBS (CAE)	FBS has MaxVue visual
Cheyenne IIIA	CAE	IBM 6000	MaxVue/150	6	1994			
Xian Y7-100	Beijing Aviation	Encore	VDS-2000/4w	6	1992			
CANADIAN AIRLINES INTERNATIONAL, Richmond, Canada +1 (604) 270 5350								
Phoenix, Arizona								
B737-200	Conduction	DDP-124	Vital IV/2w	3	1968	FAA LA		Ownership transferred
Toronto								
B737-200Adv	Rediffusion	R2000A	Vital IV	6	1977	FAA LA	CBT	Ex PWA
Fokker F28		Alpha XP		6		TC LC		For Canadian Regional A/L
Vancouver								
B737-200 Adv	CAE	TI980B	Vital IV	6	1977	FAA LA	CBT, CPT	Ex EPA
B767-300ER	TTS	Encore MultiSEL	SPX200/150	6	1991	FAA LC	CBT	
DC-10-30	CAE	VAX 11/780	Vital IV	6	1982	FAA LC	CBT	
CASA, Madrid, Spain +34 (1) 585 5680								
Seville International Airport								
CN235	CASA	Encore RSX	Ball 944/150	6	1994	FAA LC	L5 FTD, CBT	Programmed in Ada
CATHAY PACIFIC AIRWAYS, Hong Kong +852 (2) 747 8539								
A330-300/A340-200	CAE	IBM 6000	SPX550/150	6	1994	HKCAA L4		
A330-300/A340-200	CAE	IBM 6000	MaxVue	6	1997	HKCAA L4		
B747-200	Link/CAE	IBM 6000	SPX200T/4w	6	1980			
B747-400	Rediffusion	Encore SCI-Clone	SPX500/150	6	1988	HKCAA L4	FMST (Xionix)	
B747-400	Rediffusion	Encore SCI-Clone	SPX500/150	6	1991	HKCAA L4		
B747-400	CAE	IBM 6000	SPX550/150	6	1994	HKCAA L4		
B777-200	CAE	IBM 6000	SPX550/150	6	1995	HKCAA L3		
CHINA AIRLINES, Taipei, Taiwan +886 (2) 712 3141								
A300B4	CAE	VAX 11/780	Vital IV/4w	6	1986	FAA LC		Ex SIA
B747-200	Rediffusion	Encore 32/77	SP2/5w	6	1981	FAA LC		
B747-400	CAE	Encore MultiSEL 3216	SPX500/150	6	1989	FAA LC		
MD-11	CAE	IBM 6000	SPX500/150	6	1991	FAA LD		

CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
CHINA EASTERN AIRLINES, Shanghai, China +86 (21) 6255 8899								
A300-600R	TTS	PowerPC	ChromaView	6	1998	FAA LC	Trainer	
MD-82	Rediffusion	Encore SCI-Clone	Vital VI	6	1987	FAA LC		Ex MDC
CHINA NORTHERN AIRLINES,								
MD-82								
CHINA SOUTHERN AIRLINES, Zhuhai City, China +86 (75) 6333 1788								
A320	CAE	IBM 6000	MaxVue+	6	1999	LD standard	CBT (Wicat)	
B737-300	CAE	IBM 6000	Image IV-500/150	6	1992	FAA LC	CBT, FTD	
B737-300	CAE	IBM 6000	MaxVue/150	6	1994	FAA LC	CBT, FTD	
B757-200	CAE	IBM 6000	Image IV-500/150	6	1992	FAA LC		
B777-200	CAE	IBM 6000	MaxVue A+/150	6	1995	FAA LC	CBT	
CONTINENTAL AIRLINES, Houston, USA +1 (713) 230 6500/6503								
B727-200	Link	GP-4	Image II/2w	3	1965	FAA LA		Ex Eastern
B727-200	Link	GP-4	N6000	3	1968	FAA LB		
B737-200	Conductron	DDP-124	Vital IV	3	1968	FAA LA		Ex Lufthansa; ex Frontier
B737-300	Rediffusion	Encore MultiSEL	Vital IV/4w	6	1982	FAA LC	FMST (Xionix)	
B737-300EFIS	Link/Miles	MST	Image IIT/6w	6	1987	FAA LC		Ex Orbit
B737-500	TTS	Harris Night Hawk	Space/180	6	1994	FAA LC	FTD (Burtak)	
B737-6/7/8/900	CAE	IBM 6000	MaxVue+/180	6	1999	LD standard	FTD (CAE)	
B757-200	TTS	Harris Night Hawk	Space/150	6	1995	FAA LD		
B777-200	CAE	IBM 6000	MaxVue+/180	6	1998	LD standard	FTD (CAE)	
DC-10-10/30	Link/Miles	PDP 11/45	NVS	6	1977	FAA LB		
DC-9-30	Link/GMI	GP-4	Vital IV/4w	6	1983	FAA LC		
MD-80/82	CAE	VAX 11/780	Vital IV/4w	6	1984	FAA LC		Leased from FSI
CROSSAIR, Basle, Switzerland +41 (61) 325 4490								
Saab 340A/B	FSI	Concurrent Micro 5	Hivis IV Wide	6	1991	FAA LC		
Saab 2000	FSI	Concurrent Micro 5	Hivis V/Wide	6	1995	FAA LD		
CITYLINE SIMULATOR & TRAINING, Berlin, Germany +49 (30) 8875 5767								
Avro RJ100	Reflectone	Harris Night Hawk	MaxVue A+	6	1996	LBA	CPT	Lufthansa CityLine
Canadair RJ-200	CAE	IBM 6000	MaxVue A+	6	1992	FAA LD, LBA	CBT, CPT	Lufthansa CityLine
Canadair RJ-200	CAE	IBM 6000	MaxVue A+	6	1996	FAA LD, LBA	CBT, CPT	Lufthansa CityLine
DELTA AIR LINES, Atlanta, USA +1 (404) 715 0874								
B727-200	Link	PDP 11/55	SP1/4w	6	1981	FAA LC		Ex Pan Am
B727-200	Link	Encore 32/77	SP2/4w	6	1982	FAA LC		
B727-200	Link	Encore 32/77	SP2/4w	6	1979	FAA LC		
B727-200	Rediffusion	Encore 32/77	SP1/4w	6	1983	FAA LC		
B727-200	Rediffusion	GP-4	N6000	3	1973	FAA L6		
B737-200	Rediffusion	Encore 32/77	SP3/150	6	1983	FAA LC		Ex Air Florida
B737-200	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard	L5 FTD & 2 L2 FTDs (CAE)	
B737-6/7/800	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard		
B757-200	Rediffusion	Encore MultiSEL	SPX550/150	6	1992	FAA LD	2 L5 FTD & 6 CPT	
B757-200	Link	Encore 32/77	SP1/4w	6	1984	FAA LC	2 L4 FTDs (CAE)	
B757-200	Link	Encore 32/77	SP1/4w	6	1989	FAA LC		
B767-200	Link	Encore 32/77	SP1	6	1983	FAA LC	L4 FTD (Link)	
B767-300ER	CAE	Encore MultiSEL	SPX550/150	6	1991	FAA LD	L5 FTD	
B767-300/300ER/400ER	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard	L5 FTD & L4-400 FTD (CAE)	
B767-300/300ER/400ER	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard		
B777-200	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard	FTD (CAE)	
L-1011-100/250	Link	Encore 32/77	SP1	6	1971	FAA LC	CPT & 2 L4 FTDs	Ex FSI; Ex TWA
L-1011-250	Link/ARI	Encore MultiSEL	SPX200/4w	6	1971	FAA LC*		Ex TWA
L-1011-250	Link	GP-4	SP1	6	1972	FAA LC		Ex EA
L-1011-500	Link/ARI	Encore 32/77	SPX200/4w	6	1972	FAA L6		Upgraded 1993
MD-11	Rediffusion	Motorola 8000	SPX200/150	6	1992	FAA LC		Ex Hughes
MD-11	CAE	Encore MultiSEL	SPX550/150	6	1990	FAA LD	L6 FTD	
MD-88	CAE	IBM 6000	SPX550/150	6	1992	FAA LD	2 L6 FTDs	
MD-88	Link/BSC	Encore 32/77	SPX550/150	6	1988	FAA LD	2 L4 FTDs (Link)	
MD-88	CAE	IBM 6000	SPX550/150	6	1991	FAA LD	2 L6 FTDs (CAE)	
MD-90	CAE	IBM 6000	SPX550/150	6	1993	FAA LD	L6 FTD (CAE)	
EGYPTAIR, Cairo, Egypt +20 (2) 245 6654								
B707-320	Link	PDP 11/45	NVS/2w	6	1971			
EMBRAER, San Jose dos Campos, Brazil +55 (12) 345 1000								
EMB-110C	Atkins & Merrill	PDP 11/45	Vital IV/2w	2	1976	FAA LB		
EMB-120 Brasilia	Intersim	Encore 32/77	Vital IV/2w	6	1989	FAA LB	CPT	
EMBRY-RIDDLE AERONAUTICAL UNIVERSITY, Prescott, USA +1 (520) 708 4300								
B727-100	Link	Solid-state drum 960	NVS/2w	3	1994	FAA LA		Ex United, ex Avia
B727-100	Link	Solid-state drum 960	NVS/2w	3	1994	FAA LA		Ex United, ex Avia
EMIRATES, Dubai, UAE +971 (4) 703 7567								
A300-600R/A310-300	CAE	IBM 6000	MaxVue/180	6	1994	CAA L4	L5 FTD A310	Plus EET, combined A310/777

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CIVIL SIMULATORS

Continued from A3000000

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
A330/A340	CAE	IBM 6000	ESIG3350/180	6	1998	LD standard		
B777-200	CAE	IBM 6000	MaxVue/180	6	1995	FAA LD	2 FTDs	
ETHIOPIAN AIR LINES, Addis Ababa, Ethiopia +251 (1) 188 800								
B707/720	Link	GP-4	NVS/2w	3	1967			Ex Continental
B757/767	Rediffusion	Motorola	SPX550/180	6	1993	LD standard	CPT (Wicat)	
EUROPEAN AVIATION, Mascot, Australia +61 (2) 9691 7885								
Melbourne								
B727-200	Rediffusion	Encore 32/77	SP1/4w	6	1979	ACAA L4	AVT	Ex Qantas
B-737-300ERIS	CAE	Encore MultiSEL	Spit/6W	6	1986	ACAA L5	AVT	Ex Qantas
EUROPEAN AVIATION AIR CHARTER, Christchurch, England +44 (1202) 56111								
BAC One-Eleven 500	Rediffusion	R2000A	NVS/2w	3	1969	CAA L3		Ex BA
L-1011-1 (100 series)	Rediffusion	R2000A	NVS/2w	3	1974	CAA L3		Ex BA
EUROPEAN AVIATION TRAINING CENTRE, Melsbroek, Belgium +32 (2) 752 9430								
Brussels								
A310-200	Reflectone	Encore 32/97	Hivis IIA/6w	6	1994	BCAA LC	FMST, VACBI	Ex Swissair
B727-200	Rediffusion	Encore 32/55	SP2/4w	6	1994	BCAA LB, CAA L1	CBT	Ex Lufthansa
B737-300ERIS	FSI	Concurrent Micro 5	Vital IV/6w	6	1990	BCAA LC	CBT, CPT & FMST	
C-130H/L-100	Reflectone	Encore 32/77	Vital IV/4w	6	1990			
DC-10-30	CAE	Sigma 3	Vital IV/6w	6	1994	BCAA LB	CBT	Ex Swissair
MD-82	CAE	Encore 32/77	Hivis IIA/6w	6	1984	BCAA LC		Ex Swissair
EVA AIRWAYS, Taoyuan, Taiwan +886 (3) 351 6551								
B747-400	TTS	Motorola 88000	SPX550/180	6	1992	RoC CAA LD	CPT, CBT	
B767-300ER	TTS	Motorola 88000	SPX550/150	6	1992	RoC CAA LD	CPT, CBT	
MD-11	TTS	Motorola 88000	System 3000/180	6	1994	RoC CAA LD	CPT, CBT	
FAIRCHILD DORNIER, San Antonio, USA +1 (210) 824 9421								
Dornier 328JET	CAE	IBM 6000	MaxVue+/180	6	1999	LD standard		Location TBD
Portland, USA								
Dornier 328	Rediffusion	Motorola	System 3000	6	1994	FAA LC	CPT, FMST	
Oberpfaffenhofen, Germany								
Dornier 328	Rediffusion	Motorola	System 3000	6	1993	LBA, FAA LC	CBT	See also SIMTEC
FEDERAL AVIATION ADMINISTRATION, Oklahoma City, USA +1 (405) 954 4562								
B727-200	CAE	Encore 32/7780	SP1T/6w	6	1984	FAA LC		
FEDEX, Memphis, USA +1 (901) 797 6560								
Memphis								
A300-600R	CAE	IBM 6000	SPX550/150	6	1993	FAA LD	L6 FTD (CAE)	
A310-200	CAE	IBM 6000	SP2/150	6	1994	FAA LC		Ex Lufthansa
A310	TTS	Motorola	SP3250	6	1997	FAA LC		Ex Swissair
B727-25C	Link	Harris Night Hawk	SP1/4w	6	1981	FAA LC	L5 FTD	Computer u/g Reflectone
B727-252F	Rediffusion	Encore SCI-Clone	SPX550/150	6	1987	FAA LD	L5 FTD	
DC-10-10F	Link-Miles/BSC	Harris Night Hawk	SP1/4w	6	1983	FAA LDI	DC-10-30 L4 FTD	
DC-10-15	CAE	VAX 3800	Vital IV	6	1983	FAA LC	DC-10-30 L4 FTD	Ex Mexicana
MD-11F	CAE	VAX 3800	SPX550/150	6	1990	FAA LD	FBS, 2 FTDs (CAE)	Plus 2 MD-10 L7 FTDs (CAE)
MD-11F	CAE	IBM 6000		6	1998	LD standard		
Anchorage								
MD-11F	CAE	VAX 4300	MaxVue	6		FAA LD		Ex American Airlines
FINNAIR, Helsinki, Finland +358 (9) 818 4740								
Helsinki								
A320	CAE	IBM 6000	MaxVue+/200	6	1999			Three-channel visual
ATR 42/72	GMI/Rediffusion	Encore 32/6780	Hivis IIF/4w	6	1985	NBA PII	CBT (VACBI)	
DC-10-30	Link	GP-4B	Vital IV/6w	6	1972	NBA PI	CBT (Wicat)	Ex AZ, Alitalia
DC-9-10/30/50	Rediffusion	GP-4	NVS/2w	3	1971	FAA LB; NBA PII	CBT (Wicat)	Ex Saudia
MD-11	CAE	IBM 6000	Vital VII/150	6	1990	FAA LD	FBS (Wicat), FMST	
MD-82/83/87	Link	Encore 32/67	Image IIT/6w	6	1988	FAA LC; NBA PII	FTD and (Wicat), FMST	
Pori								
King Air 300	FSI	Concurrent Micro 5	Vital IV/4w	6	1991	LC standard	CBT	
FLIGHT TRAINING CENTRE, Dragor, Denmark +45 (32) 82 80 80								
Copenhagen								
A300B4	CAE	Encore 32/55	N2500 RSM/4w	6	1980	Danish CAA		Ex SAS
B727-200	Rediffusion	R2000A	N2500 RSM/4w	3	1967	Danish CAA		Ex TAA; Ex Australian
FLIGHTSAFETY BOEING TRAINING INTERNATIONAL, Renton, USA +1 (206) 662 8748								
Bethany, Oklahoma								
B727-200B	CAE	VAX 11/780	Vital IV/4w	6	1980	FAA LC		
College Park, Georgia								
DC-9-30	Link	GP-4	N6000/2w	3	1994	FAA LA		
MD-80/82	CAE	VAX 11/785	Vital IV/4w	6	1984	FAA LC		
Dallas/Fort Worth, Texas								
B727-200	Rediffusion	Encore 32/35	SP1/4w	6	1978	FAA LC		Ex Dalfort

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B727-200	Rediffusion	Encore 32/35	SP1/4w	6	1978	FAA LC		Ex Dailfort
B737-200	Rediffusion	Encore 32/77	SP1/4w	6	1989	FAA LC		Ex Dailfort
Daytona Beach - Embry-Riddle								
B737-300								
Houston, Texas								
B737-2/300	CAE	VAX 11/785	Vital IV/4w	6	1987	FAA LC		
Kunming, China								
B737-300	FSI	Harris Night Hawk	ChromaView	6	1997	FAA LD		
B757/767	FSI	Harris Night Hawk	ChromaView	6	1997	FAA LD		
MD-80	CAE	Encore RSX	ChromaView	6	1998	FAA LC		For China Northern, ex MDC
Longacres, Washington								
B737-3/4/500	CAE	Encore RSX	Image IV/150	6	1987	FAA LC		Formerly Boeing
B737-700	CAE	IBM 6000	MaxVue	6	1997	FAA LC	3 L6 FTDs	Formerly Boeing, was 737-300
B737-6/7/800	CAE	IBM 6000	MaxVue	6	1998	LD standard	L5 FTD/MTS	
B747-400	Link-Miles	Link FDS II	Image IV/150	6	1988	FAA LC	FBS	Formerly Boeing
B757-200	Rediffusion	Encore 32/7780	Image IV/150	6	1982	FAA LC		Formerly Boeing
B767-300ER	Rediffusion	Encore MultiSEL	SPX500/150	6	1991	FAA LC		Formerly Boeing
B777-200	CAE	IBM 6000	MaxVue/210	6	1994	FAA LC		Formerly Boeing
Long Beach, California								
B717-200	FSI	Harris Night Hawk	ChromaView	6	1999	LD standard		
B717-200	CAE	IBM 6000	MaxVue+/180	6	1999	LD standard		
B737-2/300	CAE	VAX 11/785	SP1/150	6	1987	FAA LC		
MD-80/82	CAE	VAX 11/780	Vital IV/4w	6	1984	FAA LC		
MD-88/87	CAE	VAX 8350	Vital IV/4w	6	1988	FAA LC		
MD-90-30	CAE	IBM 6000	Vital VII/150	6	1994	FAA LD		Formerly Douglas
MD-11P/F	CAE	IBM 6000	Vital VII/150	6	1990	FAA LD		Formerly Douglas
Louisville, Kentucky								
B747-200B	Rediffusion	Encore 32/75	SP1/4w	6	1988	FAA LC		Ex Dailfort
Miami, Florida								
A300-600/A310-300	T-CSF	Encore 32/67	Vital VII/150	6	1989	FAA LC		Ex CP
B727-200	AST	PDP 11/55	Vital IV/4w	6	1992	FAA LC		Ex EA
B757-200	FSI	Concurrent Micro 5	Vital IV/4w	6	1990	FAA LC		
DC-9-31	Link/FSI	PDP 11/55	Vital IV/4w	6	1992	FAA LA		Ex EA
DC-9-31	Link/FSI	Encore 32/77	Vital VI/4w	6	1992	FAA LC		Ex EA
MD-88/87	FSI	Concurrent Micro5	Vital IV/4w	6	1992	FAA LC		
Paris/Le Bourget, France								
Fokker 100	FSI	PE 3280	Vital VIII	6	1992	FAA LC, DGAC, LBA		
St Louis, Missouri								
B727-200	CAE	VAX 11/780	SP1/2w	6	1980	FAA LB		Ex TW
B727-200	CAE	VAX 11/780	SP1/4w	6	1981	FAA LC		Ex TW
DC-9-30	Link	GP-4	Vital IV	6	1977	FAA LB		Ex TWA
DC-9-30	Link/FSI	DEC 11/45 (dual)	Vital IV/4w	6	1981	FAA LC		
Salt Lake City, Utah								
B737-300	CAE	VAX 11/785	SP1	6	1986	FAA LC		Contracted to DL
Seattle, Washington								
B737-300	CAE	VAX 3200	Vital IV/4w	6	1987	FAA LC		
B737-300ERS	FSI	Concurrent Micro 5	Vital IV/4w	6	1990	FAA LC		HUD installed
B737-700	FSI	Harris Night Hawk	ChromaView	6	1998	LD standard		First of four for FSBTI
B767-300ER	FSI	Concurrent Micro 5	Vital IV	6	1990	FAA LC		
B777	FSI	Harris Night Hawk	Vital VIII	6	1995			
Wilmington, Delaware								
Fokker 100/70	FSI	P-E 3280	Vital IV/4w	6	1992	FAA LC		
FLIGHTSAFETY INTERNATIONAL, Flushing, New York +1 (718) 565 4100								
Atlanta, Georgia								
EMB-120 Brasilia	FSI	P-E 3251XP	Vital IV	6	1992	FAA LC		
Jetstar I/II 731	FSI	PDP 11/55	SP1	3	1983	FAA LA		
King Air 200	FSI	PDP 11/55	SP1/2w	4	1988	FAA LB		
Bethany, Oklahoma								
Commander 840/900/980/1000	FSI	P-E 3240	SP1	4	1982			
Cincinnati, Ohio								
Canadair RJ	FSI	Harris Night Hawk	ChromaView	6	1997			
EMB-120 Brasilia	FSI	P-E 3251XP	Vital IV	6	1991	FAALC	CPT	
Daleville, Alabama								
Beech C-12	FSI	PDP 11/55	Vital IV	6				
Beech C-12	FSI	PDP 11/55	Vital VII	6	1995			
Beech C-12	FSI	P-E 3260	2000	6	1995	FAA LB		
Beech U-21A	FSI	P-E 3251XP	SP1	6	1988			
Beech U-21A	FSI	P-E 3251XP	SP1	6	1986			
Dallas/Fort Worth, Texas								
Saab 340A/B	FSI	Concurrent 3280	ChromaView	6	1997	FAA LC		
Daytona Beach, Florida - Embry-Riddle								
Beech 1900D	FSI	Harris Night Hawk	ChromaView/180	6	1997	FAA LD		
Fort Lauderdale, Florida								
EMB-120 Brasilia	Intersim	PDP 11/45	Vital IV/2w	6	1987	FAA LB		At Embraer Aircraft
Fort Worth, Texas								
Bell 230/222	FSI	PDP 11/55	ChromaView	6	1980	FAA LC+	CPT	Visual upgraded
Bell 412/212	FSI	Harris Night Hawk	ChromaView	6	1993	FAA LC+		Visual upgraded

CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
Bell 412/212	FSI	Harris Night Hawk	ChromaView	6	1998	LC+ standard		
Bell 412/212	FSI	Harris Night Hawk	ChromaView	6	1998	LC+ standard		
Bell 430	FSI	Harris Night Hawk	ChromaView	6	1998	LC+ standard		
Houston, Texas								
ATR 42-300	FSI	P-E 3260	Vital IV/4w	6	1988	FAA LD		
ATR 42/72	FSI	P-E 3280	Vital IV/4w	6	1991	FAA LC, CAA L3		* Convertible
BAe 125-700	FSI	PDP 11/55	SP1	4	1979	FAA LA		
Challenger 601.3A/3R	FSI	Concurrent 3280	ChromaView	6	1990	FAA LD		Visual upgraded
EMB-120 Brasilia	FSI	P-E 3260	Vital IV/4w	6	1990	FAA LC		
Embraer RJ-145	FSI	Harris Night Hawk	ChromaView	6	1998	FAA LD		
Falcon 20	FSI	PDP 11/55	SP1	4	1982	FAA LA		
Falcon 50	FSI	Concurrent 3280	ChromaView	6	1993	FAA LD		Visual upgraded
Gulfstream I	FSI	PDP 11/55	SP1	4	1983	FAA LA		
Hawker 800	FSI	P-E 3260	SP1T/150	6	1987	FAA LC		
King Air 200	FSI	PDP 11/55	SP1	4	1981	FAA LB		
Mitsubishi Mu-2	FSI	PDP 11/55	N6000-1910	4	1980	FAA 61.66		
Mitsubishi Mu-2	FSI	PDP 11/55	SP1	4	1983	FAA 61.66		
LaGuardia, New York								
Beech 1900A/B/C	FSI	P-E 3251XP	Vital IV/4w	6	1989	FAA LC	CBT	
Beech 1900D	FSI	Concurrent 3280	Vital II	6	1995	FAA LC	CBT	
Beech -1900D	FSI	Concurrent 3280	Vital VII	6	1994	FAA LC		
Saab 340A/B	FSI	Concurrent 3280	Vital VII	6	1995	FAA LC		
Shorts 360	FSI	P-E 3250XP	Vital IV/4w	6	1989	FAA LC		
Lakeland, Florida								
Cheyenne I/II	FSI	PDP 11/55	SP1		1981	FAA Training		
Cheyenne I/II	FSI	PDP 11/55	SP1		1981	FAA Training		
Cheyenne IIIA	FSI	PDP 11/55	SP1		1983	FAA Training		
King Air 200	AA	Encore 32/27	IVEX	None				
King Air 200	FSI	Gould	Vital VII					
Navajo Chieftan	FSI	PDP 11/55	N6000		1983	FAA Training		
Long Beach, California								
Cessna 300/400	FSI	PDP 11/55	SP1			FAA LA		
Citation II	FSI	P-E 3251XP	Vital IV	6	1987	FAA LC		
Gulfstream II	FSI	P-E 3240	Vital IV/4w	6	1985	FAA LC		
Gulfstream III	FSI	Harris Night Hawk	ChromaView	6	1997			
Gulfstream IV	FSI	Harris Night Hawk	ChromaView	6	1997			
King Air 200	FSI	PDP 11/55	Vital IV	6	1988	FAA LB		
Melbourne, Australia								
Saab 340A/B	FSI	Harris Night Hawk	ChromaView	6	1997	ACAA L4		At Ansett Australia
Miami, Florida								
Citation I/II	FSI	PDP 11/55	SP1/2w	4	1981	FAA LA		
Montreal, Canada								
Challenger 600-1A	CAE	Ti 980	SP1	4	1979	FAA LA		
Challenger 600/601	FSI	P-E 3251XP	SP1/150	6	1987	FAA LC		
Challenger 601.3A	FSI	P-E 3260	Vital VII/150	6	1993	FAA LC	CPT/CSS	
Paris/Le Bourget, France								
Citation I	FSI	PDP 11/55	SP1		1989	FAA LA		
Citation II/V	FSI	P-E 3260	Vital IV	6	1993	FAA LC, DGAC, LBA		
Falcon 10	Link	PDP 11/45	SP1	3	1979	FAA LA, DGAC, LBA		
Falcon 20	Link	PDP 11/45	SP1	3	1977	FAA LA, DGAC, LBA		
Dash 8	FSI	P-E 3260	Vital IV	6	1991	LEVEL C, DGAC, LBA		
EMB-120 Brasilia	FSI	P-E 3260	Vital IV	6	1991	FAA LC		
Falcon 50	FSI	Concurrent 3262	Vital IV	6	1989	FAA LC, DGAC, LBA		
Falcon 900	FSI	P-E 3251XP/VME	SP1T	6	1989	FAA LC, DGAC, LBA		
Falcon 900EX	FSI	Harris Night Hawk	Chromaview	6	1997	LD standard		
King Air 200B	FSI	PDP 11/55	SP1	4	1989	FAA LB		
St. Louis, Missouri								
Jetstream 31/32	FSI	P-E 3251XP	Vital IV	6	1991	FAA LC		* Convertible
Jetstream 31/32	FSI	P-E 3251XP	Vital IV/4w	6	1989	FAA LC		
Metro II/III	FSI	PDP 11/55	N6000	4	1979	FAA LA		
Metro III	FSI	PDP 11/55	SP1/2w	4	1982	FAA LB		
Saab 340A/B	FSI	Concurrent 3260	Vital VI	6	1990	FAA LC		* Convertible
Sabreliner 40/60	Link	PDP 11/55	N6000	4	1974	FAA LA		
Sabreliner 60/65	FSI	PDP 11/55	SP1/2w	4	1982	FAA LA		
Sabreliner 75A/80	Link	PDP 11/45	N6000	3	1975	FAA LA		
San Antonio, Texas								
Citation II	FSI	Concurrent?	Vital?	6	1997	FAA LC		
Metro II/III-C26	FSI	P-E 3260	Vital VII		1994	FAA LB		
Metro II/III	FSI	PDP 11/55	SP1/2w	4	1986	FAA LB		
Metro III	FSI	PDP 11/55	SP1	4	1988	FAA LB		
Saab 340A/B	FSI	P-E 3260	Vital IV	4	1984	FAA LB		
Saab 2000	FSI	P-E 3260	Vital VIII	6	1994	FAA LC		
Mooney 252	FSI	P-E 3240	VDS1000	None	1990			
Savannah, Georgia								
Gulfstream I	FSI	PDP11/55	SP1/2w	4	1978	FAA LA		
Gulfstream II	FSI	P-E 3251XP/VME	SP1T/150	6	1988	FAA L C		
Gulfstream III	FSI			6				
Gulfstream III	FSI	P-E 3250	SP1/150	6	1985	FAA LC		



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CIVIL SIMULATORS

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Gulfstream III	FSI	PDP 11/55, AD10	Vital IV/4w	6	1984	FAA LC		
Gulfstream IV	FSI	Concurrent 3250XP		6	1991		L4 FTD	
Gulfstream IV	FSI	P-E 3250XP/VME	SP1/150	6	1988	FAA LC		
Gulfstream IV	FSI	P-E 3251XP/VME	Vital IV	6	1990	FAA LC		
Gulfstream IV	FSI	Concurrent 3280/VME	Vital VII	6	1993	FAA LC		
Gulfstream IV-SP	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
Gulfstream V	FSI	Harris Night Hawk	ChromaView	6	1996	FAA LD		
Seattle, Washington								
Dash 8-1/300	FSI	Concurrent 3260	Vital IV/4w	6	1991	FAA LC; TC		
Dash 8-300	FSI	P-E 3251XP/APU	Vital IV/4w	6	1990	FAA LC		
EMB-120 Brasília	FSI	Concurrent 3260	Vital IV/4w	6	1990	FAA LC		
Jetstream 31/32	FSI	P-E 3251XP	Vital IV/4w	6	1990	FAA LC; TC		
Metro III	FSI	PDP 11/55	SP1/2w	4	1991	FAA LB	CBT, CPT	
Teterboro, New Jersey								
Falcon 10	FSI	PDP 11/55 (Dual)	Vital IV	6	1982	FAA LC		
Falcon 20	FSI	PDP 11/55 (Dual)	Vital IV	6	1982	FAA LC		
Falcon 50	FSI	P-E 3251XP	SP1/150	6	1987	FAA LC		
Falcon 50EX	FSI	Harris Night Hawk	ChromaView	6	1998	FAA LD	L4 FTD	
Falcon 900	FSI	P-E 3251XP/VME	SP1/150	6	1987	FAA LC		
Falcon 2000	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
Falcon 2000	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
Toledo, Ohio								
Citation III	FSI	P-E 3240	Vital IV/4w	6	1987	FAA LC		
Citation SII/II*	FSI	P-E 3251XP	Vital IV	6	1987	FAA LC		
Citation V/II	FSI	P-E 3260	Vital IV	6	1993	FAA LC		
Citation V Ultra	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
King Air 200	FSI	PDP 11/55	SP1/2w	4	1983	FAA LB		
King Air 200	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
Toronto, Canada								
DHC-6-300	FSI	P-E 3251XP	VDS-2000/2w	4	1992	FAA LB; TC LB	FTD L6	
Dash 7-100	FSI	P-E 3251XP w/APU	Vital IV/2w	4	1990	FAA LB; TC LB		
Dash 8-100	FSI	P-E 3260MPs/VME	Vital IV/4w	6	1987	FAA LC; TC LC		
Dash 8-1/300	FSI	P-E 3251XP/APU	Vital IV/4w	6	1989	FAA LC; TC LC		
Dash 8-1/2/300	FSI	Concurrent 3280	ChromaView	6	1997	FAA LC		
Dash 8-1/2/300	FSI	Concurrent 3280	ChromaView	6	1997	FAA LC		
DASH 8-400	FSI	Harris Night Hawk	ChromaView	6	1998	LD standard		
Tucson, Arizona								
Canadair 601-3A/3R	FSI				1996	FAA LD		
Challenger 604	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
Learjet 23/24/25	FSI	PDP 11/55	Vital III	4	1978	FAA LA		
Learjet 31A	FSI	Harris Night Hawk	Vital VII	6	1994	FAA LD		
Learjet 35/36	FSI	PDP 11/55	Vital III	4	1979	FAA LA		
Learjet 35LR/35A	FSI	P-E 3251XP	Vital IV	6	1989	FAA LC		
Learjet 55	FSI	PDP 11/55VME	SP1	4	1982	FAA LB		
Learjet 60	FSI	Concurrent 3280	Vital VII	6	1995	FAA LD		
Learjet 45	FSI				1996	FAA LD		
West Palm Beach, Florida								
Learjet 35/36	Link	PDP 11/45	N6000	3	1977	FAA LA		
Sikorsky S-76	Reflectone	Harris Night Hawk	SP1/4w	6	1988	FAA LA		
Sikorsky S-76A/B	FSI	PDP 11/55	SP1/150	6	1988	FAA LC		
Sikorsky S-76C/C+	FSI	Harris Night Hawk	ChromaView	6	1998	LC standard		
Wilmington, Delaware								
ATR 42/72	FSI	Concurrent Micro 5	Vital IV/4w	6	1990	FAA LC		*Dual simulator
BAe 125-700	FSI	P-E 3240	Vital IV/4w	6	1979	FAA LC		
Canadair RJ	FSI	Harris Night Hawk	ChromaView	6	1998	LD standard		
Hawker 800	FSI	P-E 3260	Vital IV/4w	6	1991	FAA LC		
IAI Astra	FSI	P-E 3260	Vital IV/4w	6	1991	FAA LC		
IAI Westwind II	FSI	Concurrent	Vital VII	6	1994	FAA LC		
IAI Westwind I	FSI	PDP 11/55	SP1/2w	4	1980	FAA LA		
Wichita-Cessna								
Caravan	FSI		Vital VII	6				
Caravan I	FSI	P-E 3251XP	Vital IV	4	1990	FAA LB	CSS Available	
Centurion	FSI	P-E 3230	VDS-1000/2w	None	1989		FTD	
Cessna 400	FSI	PDP 11/55	SP1/2w	4		FAA LA		
Conquest I	FSI	PDP 11/55	SP1/2w	4		FAA LA		
Conquest II	FSI	PDP 11/55	SP1/2w			FAA LA		
Conquest II	FSI	PDP 11/55	N6000	4	1980	FAA LA		
Wichita, Kansas - Citation								
CitationJet	FSI	P-E 3262	Vital IV	6	1993	FAA LC		
CitationJet	FSI	Concurrent 3280	ChromaView	6	1997	FAA LC		
Citation I	FSI	PDP 11/55	N6000	4	1980	FAA LA		
Citation II	FSI	PDP 11/55	SP1	4	1981	FAA LB		
Citation II	FSI	P-E 3251XP	Vital IV	6	1987	FAA LC		
Citation S/II	FSI	P-E 3240	Vital IV	6	1986	FAA LC		
Citation Bravo	FSI	Harris Night Hawk	ChromaView	6	1998	FAA LD		
Citation III	FSI	P-E 3240	Vital IV/4w	6	1984	FAA LC		
Citation V	FSI	P-E 3251XP	Vital IV	6	1990	FAA LC		
Citation V Ultra	FSI	Concurrent 3280	Vital VIII	6	1997	FAA LD		

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
Citation V Ultra	FSI	Concurrent 3280	Vital VII	6	1995	FAA LD		
Citation Excel	FSI	Harris Night Hawk	ChromaView	6	1998	LD standard		
Citation VII/III	FSI	P-E 3262	Vital IV	6	1992	FAA LC		
Citation X	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard	L4 FTD	
Wichita, Kansas - Learjet								
Learjet 23/24/25	FSI	PDP 11/55	N6000	4	1978	FAA LA		
Learjet 35/36	FSI	PDP 11/55 Dual	SP1	4	1986	FAA LB		
Learjet 35/36	FSI	PDP 11/55 Dual	Vital IV	6	1985	FAA LC		
Learjet 55	FSI	P-E 3250XP	Vital IV	6	1986	FAA LC		
Wichita, Kansas - Raytheon								
Beech 1900D	FSI	Concurrent?	Vital VII/4w	6	1996	FAA LD		
Beech 1900D	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
Beechjet 400A	FSI	Concurrent Micro 5	Vital IV/4w	6	1992	FAA LC		
Beechjet 400A	FSI	Harris Night Hawk	ChromaView	6	1998	FAA LD		
King Air C90	FSI	P-E 3260	SP1	4	1980	NO		
Diamond I	FSI	P-E 3260	SP1	4	1987	FAA LA		
King Air 200B/UC-12B	FSI	P-E 3251XP	Vital IV	6	1987	FAA LC		
King Air 200C/UC-12	FSI	P-E 3251XP	Vital IV	6	1986	FAA LC		
King Air 200	FSI	Harris Night Hawk	ChromaView	6	1997	LD standard		
King Air 300	FSI	P-E 3251XP	Vital IV	6	1989	FAA LC		
King Air 350	FSI	P-E 3260	Vital IV	6	1992	FAA LC		
Hawker 800XP	FSI	Harris Night Hawk	ChromaView	6	1998	LD standard		
Premier I	FSI	Harris Night Hawk	ChromaView	6	1999	LD standard		
FLYTSIM TRAINING, High Wycombe, England +44 (149) 445 9545								
High Wycombe								
DC-9/15/32	CAE	XDS 930 modified	Image II/2w	3	1988			Ex British Midland
FRIENDSHIP SIMULATION, Beek, Netherlands +31 (43) 366 4545								
Hoofddorp								
B737-400	Link-Miles	MST	Image IV-500/150	6	1995	FAA LC	CBT (TRO)	
Fokker 70/100	CAE	Encore 32/97	Vital IV/6w	6	1993	JAA LC	CPT/CST (ASDL), CBT (TRO)	Ex KLM
Fokker 70/100	CAE	IBM 6000	MaxVue/150	6	1995	JAA LD	CPT/CST (ASDL), CBT (TRO)	
Maastricht								
B757/767-200ER/300ER	CAE	VAX 3800	Vital VII/225	6	1991	FAA LD	CBT (Wicat)	Owned by LTS/LTU
B767-200ER	CAE	Encore MultiSEL	SPX 500/150	6	1991	CAA L4	CBT (Wicat)	Owned by Kuwait Airlines
Fokker 50	CAE	Encore 32/97	Vital IV/4w	6	1988	FAA LC	CBT (TRO), CST (ASDL)	
Fokker 50	CAE	Encore 32/97	Vital VII/150	6	1991	FAA LC/CAA L3	CBT (TRO)	
Fokker F-27-200/500	Rediffusion	Encore 32/67	SP1/4w	6	1987	CAA L3	CPM, CBT	
GARUDA INDONESIA, Jakarta, Indonesia +62 (21) 231 1801								
Jakarta								
A300B4	T-CSF	Encore 32/77	Vital IV/4w	6	1982	CAA L2B		
B747-200	Rediffusion	Encore 32/77	SP1/4w	6	1983			
DC-9-30	A&M/ARI	PDP 11/84	Vital IV/2w	4	1990		CPT	Updated 1990
DC-10-30	ARI	Encore MultiSEL	Vital IV/4w	6	1989	FAA LC	CPT	
Fokker F-28-1000/4000	Rediffusion	Encore 32/77	SP1/4w	6	1983			
GULF AIR, Doha, Qatar +974 351325								
A320-200	T-CSF	Encore MultiSEL	Image IV-600	6	1992	FAA LD	TRO CBT	
A340-300	TTS	Harris Night Hawk	Image IV-600PT	6	1995	FAA LD, CAA L3	TRO CBT	
B-767-300ER	Rediffusion	Encore MultiSEL	SPX500/150	6	1990	FAA LD	TRO CBT	
L-1011-200	Rediffusion	Encore 32/77	SP1/4w	6	1983	FAA LB		
HELIKOPTER SERVICE, Forus, Norway +47 (4) 57 5 722								
Forus								
S-61N	Rediffusion	R2000A	SP1/4w	6	1979			
Stavanger, Norway								
SA330/AS332L	Rediffusion	Encore 32/77	SP1/W150	6	1984			
HUNTING AVIATION CARGO AIRLINES, Castle Donington, England +44 (133) 281 0081								
East Midlands Airport								
VC-9 Merchantman	AT Link	Analogue	OPDIS/2w	1*				*Pitch only
INTERNATIONAL AVIATION CONSULTANTS GROUP, Montreal, Canada +1 (514) 939 2288								
Vancouver								
B767-300	Rediffusion	Encore MultiSEL	SPX200T	6		FAA LC		At Canadian Airlines?
IBERIA, Madrid, Spain +34 (1) 747 8143								
A300B4	T-CSF	Encore 32/77	Vital IV/6w	6	1981	CAT 3	Teaching Machine (TMA)	
A320-200	T-CSF	Encore MultiSEL	Vital VII/150	6	1990	CAT 3	FBSD, CPT (Wicat)	
B727-200	Link	PDP 11/45	Vital III/2w	3	1973	CAT 3	CBT (Wicat)	
DC-9-30	CAE	XDS 930	Vital III/2w	3	1966	CAT 2	CPT, CBT (Wicat)	To be dismantled
DC-9-30	Link	PDP11/45	Vital IV/4w	6	1979	CAT 2	CPT, CBT (Wicat)	
MD-87	CAE	Encore MultiSEL	Vital VII/150	6	1990	CAT 3	CPT, CBT (Wicat)	
INDIAN AIRLINES, Hyderabad 500 011, India +91 (11) 388 951								
A300B2/B4	T-CSF	Encore 32/77	Vital IV/4w	6	1982			

CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
A320	CAE	Encore MultiSEL	Vital VII/150	6	1990	LD standard		
A320	CAE	Encore MultiSEL	Vital VII/150	6	1992	LD standard		
B737-200	Rediffusion	R2000	Vital IV/2w	3	1972			
B737-200	Rediffusion	Encore SCI-Clone	SP17/150	6	1987	FAA LD		
BAe 748	Rediffusion	R2000	None	3	1972			
IRAN AIR, Tehran, Iran +98 (21) 600 3830								
B707-300C	Link	PDP 11/45	NVS/2w	6	1978	CAO Iran		
B727-200	Link	PDP 11/45	NVS/2w	6	1978	CAO Iran		
IRAQI AIRWAYS, Baghdad, Iraq +964 (1) 888 5161								
B727-200	Rediffusion	R2000A	N2500/2w	3	1977			
B737-200	Rediffusion	R2000A	N2500/2w	4	1977			
JAMHIRIYA LIBYAN ARAB AIRLINES, Tripoli, Libya +218 2 136021								
B727-200	Rediffusion	Encore 32/77	SP2	6	1980			
JAPAN AIR COMMUTER, Kagoshima, Japan +81 (9) 9558 3794								
Saab 340B	CAE	IBM 6000	SPX500/180	6	1993	JCAB PII	CBT	
JAPAN AIRLINES, Tokyo 144, Japan +81 (3) 3747 3454								
Haneda								
B737-400	CAE	IBM 6000	Vital VII	None	1995	JCAB PIII	FMST	
B747-200	Rediffusion	Encore 32/77	SP1/4w	6	1975	JCAB PII		
B747-200	Rediffusion	R2000A	SP1/5w	6	1976	JCAB PII		Out of service
B747-200	Rediffusion	Encore 32/55	SP2/5w	6	1980	JCAB PII		
B747-200	Rediffusion	Encore 32/87	SP3T/150	6	1986	JCAB PII	MTS, CPT	
B747-300	CAE	IBM 6000	Vital VIII/225	6	1984	JCAB PIII		
B747-400	Rediffusion	Encore MultiSEL	SPX500/150	6	1989	JCAB PIII	FBS, FMST, ST	
B747-400	Rediffusion	Motorola	SPX550/200	6	1992	JCAB PIII		
B747-400	Rediffusion	Motorola	SPX550/200	6	1992	JCAB PIII		
B747-400	Rediffusion	Motorola	SPX550/200	6	1994	JCAB PIII		
B767-200	Rediffusion	Encore 32/87	SP3T/150	6	1985	JCAB PII	FMST (Xionix)	
B767-200	TTS	Power PC?	ESG3350/200	6	1998	JCAB PIII	767-300 MTS (CAE)	
B777-200	CAE	IBM 6000	MaxVue/200	6	1995	JCAB PII	FMTS	
B777-200	CAE	IBM 6000	MaxVue	None	1995	JCAB PII	FMTS	
DC-10-40	Rediffusion	Encore MultiSEL	SPX500/150	6	1989	JCAB PII		
MD-11	CAE	IBM 6000	Vital VII/225	6	1993	JCAB PIII	FMST + MTS (CAE)	
Napa								
King Air C90A/B	FSI	Concurrent Micro 5	Vital VII/M150	6	1992		L6 FTD	Operated by IASCO
JAPAN AIR SYSTEM, Tokyo, Japan +81 (3) 3747 6958								
Haneda								
A300-600R	CAE	VAX 3800 x 3	SPX500/200	6	1992	JCAB PIII	FMST (Xionix)	
A300B2	CAE	VAX 3800 x 2	SPX500	6	1992	JCAB PII		
B777-200	CAE	IBM 6000	MaxVue/210	6	1997	JCAB PII	FMST (CAE)	
MD-81	CAE	VAX 3800 x 3	SPX500/200	6	1992	JCAB PIII		
MD-81/87	CAE	Encore 32/9780	SP3T/6w	6	1987	JCAB PII	FBS	
MD-90-30	TTS	Motorola	ESIG3350/200	6	1996	JCAB PIII	FMST (TTS)	
Oita								
King Air B200	FSI	Concurrent Micro 5	SPX500HT/W180	6	1991			
JAPAN CIVIL AVIATION COLLEGE, Tokyo, Japan +81 (3) 3580 3111								
Miyazaki								
Beech A-36 Bonanza	FSI		VDS-1500/Prodas 50	None	1995	Level 5	CPT	FTD
Beech A-36 Bonanza	FSI		VDS-1500/Prodas 50	None	1995	Level 5	CPT	FTD
Sendia								
King Air C90	Mitsubishi		VDS-2000/Prodas 150	None	1995			FTD
JAPAN DEFENCE AGENCY, Tokyo								
Chitose AB								
B747-400	Rediffusion	Motorola	SPX550/200	6	1994			Operated by JASDF
JAPAN TRANSOCEAN AIR, Okinawa, Japan +81 (9) 8857 5532								
Haneda								
B737-400	CAE	IBM 6000	Vital VII/225	6	1994		FMST, CBT	Owned by JAL
JETSTREAM AIRCRAFT - AERO INTERNATIONAL (REGIONAL), Prestwick, Scotland +44 (129) 2 67 1022								
BAe 125-700	BAe	MicroVAX Gemini 280	None	2	1988			LOFT training only
BAe 125-800	Frasca	Intel MB2 386	Collimators	3	1990	CAA L2B		
BAe ATP	Reflectone	Encore MultiSEL	SPX200/150	6	1991	FAA LC, CAA L3		Also L4 FTD for Jetstream 41
JUGOSLOVENSKI AERO TRANSPORT, Belgrade, Yugoslavia +381 (11) 675 377								
DC-9-30	CAE	XDS 930	Vital IV/2w	3	1972			For sale
KELOWNA FLIGHTCRAFT, Kelowna, Canada +1 (250) 765 1481								
B727-200	CAE	Calder Digital	Vital IV/2w	6	1976	FAA LA		Ex CP, ex Alaska

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CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
KENYA AIRWAYS, Nairobi, Kenya +254 (2) 822 171								
B-707	Link	GP-4	Vital IV	3	1968			Ex NWA
KITTY HAWK (formerly AMERICAN INTERNATIONAL AIRWAYS), Ypsilanti, USA +1 (734) 44 3400								
Miami								
DC-8-61/70	CAE/ARI	Motorola 147	NB000/2w	3	1972	FAA LB		At Pan Am Academy
KLM FLIGHT ACADEMY, Paterswolde, Netherlands +31 (59) 079 8311								
Groningen								
Citation I	CAE	Encore 32/6780	Vital IV	6	1988	FAA LCI		Sold to CAE
KLM, Schiphol Airport, Netherlands +31 20 6491527								
A310-200	CAE	Encore 32/8780	Image II/6w	6	1983	Dutch CAA LC		For sale
B737-300	CAE	Encore 32/9780	Image II/6w	6	1987	Dutch CAA LC		
B737-400/300	CAE	IBM 6000	SPX500/150	6	1990	Dutch CAA LD		
B737-800	CAE	IBM 6000	MaxVue+	6	1998	JAA LC		Also for Transavia
B747-300	CAE	Encore 32/9780	Vital IV	6	1970			
B747-300	CAE	IBM 6000	Image II/6w	6	1981	Dutch CAA LC		Visual to be upgraded
B747-400	CAE	IBM 6000	SPX500/6w	6	1988	Dutch CAA LC		
B747-400	CAE	IBM 6000	SPX500/150	6	1991	Dutch CAA LC		
B767-300ER	CAE	IBM 6000	MaxVue	6	1995	Dutch CAA LD		
MD-11	CAE	IBM 6000	MaxVue	6	1993	Dutch CAA LD		
KOREAN AIR, Seoul, South Korea +82 (2) 755 2221								
Incheon								
A300-600	T-CSF	Encore 32/67	Vital IV/6w	6	1988	FAA LC		
A330	TTS	Power PC	ESIG3350/180	6	1998	LD standard		
B727-200	Link	PDP 11/55	DIG/3w	6	1990			Ex All Nippon
B747-200	CAE	VAX 11/780	Vital IV/4w	6	1983			
B747-400	CAE	Encore MultiSEL	SPX500/150	6	1990	FAA LD		
B747-400	CAE	IBM 6000	ESIG3350/180	6	1998	LD standard		
Fokker 100	CAE	VAX 4500	Vital VII/150	6	1994	kMoT L3		
MD-82	CAE	VAX 11/780	Vital IV/6w	6	1987			
Cheyenne V	FSI	Concurrent Micro 5	Vital VII/4w	6	1992	LC standard		
Citation II	FSI	P-E 3262	VDS-1000/2w	4	1993	FAA LC		
KUWAIT AIRWAYS, Kuwait City, Kuwait +965 472 2933								
A300-600/A310-300	CAE	Encore MultiSEL	SPX500/150	6	1990	CAA L4		
B747-200B	Link	PDP 11/55	DNVS/4w	6	1980	CAA L3		
Maastricht								
B767-200ER	CAE	Encore MultiSEL	SPX500/150	6	1991	CAA L4	MTS	At Friendship Simulation
LANCHILE, Santiago, Chile, +56 (2) 639 4411								
B737-200	TTS	Encore 32/7780	SPX500/10	6	1997			Ex Lufthansa, sold by TTS
LINHASA DE MOZAMBIQUE, Maputo, Mozambique, +1466071								
B737-200	Rediffusion	R2000	None	3	1970		CPT	
LUFTHANSA FLIGHT TRAINING, Frankfurt/Main, Germany, +49 (69) 696 2341								
Frankfurt								
A300-600/A310-300	CAE	Encore MultiSEL	SPX550/150	6	1991	LBA, FAA LD, CAA L3		
A320-200	CAE	Encore MultiSEL	SPX500/150	6	1989	LBA, DGAC, FAA LC		
A321-100	CAE	IBM 6000	SPX550/150	6	1997	LBA, FAA LD		
A340-200/300	CAE	IBM 6000	SPX550/150	6	1992	LBA, DGAC		
B737-3/4/500	CAE	Encore MultiSEL	SPX550/150	6	1990	LBA, FAA LD		
B737-300	CAE	Encore MultiSEL	SPX550/150	6	1988	LBA, FAA LD		
B747-200	TTS	Encore MultiSEL	SP2/4w	6	1979	LBA, FAA LC	CPT (Aerospatiale)	
B747-400	CAE	Encore MultiSEL	SPX500/150	6	1988	LBA, CAA L3		
B747-400	CAE	Encore MultiSEL	SPX500/150	6	1989	LBA		
B757/767-200/300ER	Rediffusion	Encore MultiSEL	SPX500/150	6	1990	LBA, DGAC		
Bremen								
A320-200	CAE	Encore MultiSEL	SPX500/150	6	1991	LBA, CAA L3, FAA LD		
B737-3/4/500	CAE	Encore MultiSEL	SPX550/150	6	1991	LBA, FAA LD		
B737-300ERIS	CAE	Encore MultiSEL	SPX550/150	6	1990	LBA, FAA LD		
Bonanza A36	FSI	Concurrent 3230	VDS-1000/50	None	1989	LBA, FAA L5		
Cheyenne IIIA	TTS	Encore 32/6780	SPX200T/4w	6	1990	LBA, FAA LB		
Cheyenne IIIA	TTS	Encore 32/6780	SPX200T/4w	6	1990	LBA		
Cheyenne IIIA	TTS	Encore 32/6780	SP1/4w	6	1987	LBA, FAA LB		
Cheyenne IIIA	TTS	Encore 32/6780	SP1/4w	6	1987	LBA, FAA LB		
Cheyenne IIIA	TTS	Encore 32/6780	SP1/4w	6	1987	LBA, FAA LB		
Phoenix								
Bonanza A36	FSI	Concurrent 3230	VDS-1000/50	None	1991	LBA, FAA L5		At ATCA
Bonanza A36	FSI	Concurrent 3230	VDS-1000/50	None	1991	LBA, FAA L5		At ATCA
LUFTHANSA SIMULATOR ZENTRUM BERLIN (LSZ), Berlin, Germany +49 (30) 8875 5774								
A300-600/A310-300	CAE	Encore MultiSEL	SPX550/150	6	1991	LBA, CAA L3		
B737-800	TTS	Motorola 604	SPX550/150	6	1997	LBA, FAA LD		

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LUFTHANSA ZFB, Berlin 10587, Germany +49 (30) 315 9040								
A340-200/300, A330-300	CAE	IBM 6000	SPX550/150	6	1992	LBA, DGAC, CAA L3		
MALAYSIA AIRLINES, Kuala Lumpur, Malaysia +60 (3) 740 2168								
A330-300	T-CSF	Harris Night Hawk	Image 600PT/150	6	1994			
B737-200	CAE	VAX 11/780	Vital IV/4w	6	1982			For sale
B737-400	Link	Intel 80386/387	Image 500/150	6	1991			Leased to Friendship
B737-400	Link-Miles	Harris Night Hawk	Image 600PT/150	6	1994			
B737-400/500	Link-Miles	Harris Night Hawk	Image 600PT/150	6	1993			
B747-400	Link-Miles	Intel 80386/387	Image 600PT/150	6	1990			
DC-10-30	CAE	VAX 11/780	Vital IV/4w	6	1982			
Fokker 50	SD Solcon	Encore SELpac	Image IV/150	6	1990			
MERPATI, Jakarta, Indonesia +62 (21) 424 3608								
CN-235	ASDL	Encore SELpac	Vital IV/4w	6	1993	LC standard		
F27-500F	Refifusion	R2000A	SP1T/4w	4	1993	NZ L4		Ex Air NZ
MEXICANA, Mexico City, Mexico +52 (5) 227 0260								
A320-200	T-CSF	Harris Night Hawk	ESIG3350/180	6	1993	LD standard		
B727-200	Link	GP-4	Vital IV/4w	3	1971	FAA LB		
B727-200	CAE	VAX 11/780	Vital IV/6w	6	1981	FAA LC		
MIAMI-DADE COMMUNITY COLLEGE, Miami, USA +1 (305) 237 5060								
B727-100/200	Link	GP-4	SP1/2w	3	1967	FAA LB		Marketed by Pan Am Academy
B747-100	Link	GP-4	DDP-324	6		FAA LA		For sale, in storage
MONARCH AIRWAYS, Bedford, England, +44 (158) 239 8100								
Luton Airport								
B757-200	CAE	VAX 3200	SPX200/150	6	1989	CAA L3; FAA LC		
NASA, Moffett Field, USA +1 (415) 604 6756								
B747-400	CAE	IBM 6000	ChromaView/180	6	1993	FAA LD		At Ames Research Center
NORTHWEST AEROSPACE TRAINING (NATCO), Egan, USA +1 (612) 726 2319								
Minneapolis-St Paul								
A320-200	T-CSF	Encore 32/97	SPX500/150	6	1990	FAA LD	CBT	
A320-200	Link/NATCO	Encore 32/67	SPX200CT/150	6	1990	FAA LC	CBT	
A320-200	Link/NATCO	Encore 32/67	SPX250CT	6	1997		CBT	Converted from FBS
A320-200	CAE	IBM 6000	ESIG3350/180	6	1998	LD standard		Bought jointly with KLM
B727-200	Link	PDP 11/45	Vital IV	6	1994	FAA LC		Ex Eastern
B727-200	Link	Encore 32/7780	SP3T	6	1984	FAA LD	CPT	
B727-200	Link	Encore 32/77	SP1	6	1983	FAA LC	CPT	
B747-200	CAE	T1980BB	Vital IV	6	1976	FAA LB		Moved to Egan
B747-200	Link	Encore 32/77	SP1	6	1982	FAA LC		
B747-200F	Link-Miles	Encore 32/77	DNVS	6	1997	FAA LC		Owned by Atlas Air, ex FedEx
B747-200	Link/NATCO	Encore 32/67	SPX200CT/150	6	1990	FAA LC		
B747-400	CAE	Encore MultiSEL	SPX500/150	6	1989	FAA LD	CBT	
B747-400	Link/NATCO	Encore 32/67	SPX200CT/150	6	1990	FAA LC	CBT	
B757-200	Link	Encore 32/77	SP3T	6	1985	FAA LD	CBT	
B757-200	CAE	Encore MultiSEL	SPX500/150	6	1990	FAA LC	FBS	Ex RC
B757-200	Link-Miles	Encore 32/67	SPX200CT	6	1990	FAA LC	FBS	
DC-10-30	Link-Miles	Xionix X-7/GP4	SP1T	6				Being prepared for FAA LC
DC-10-40	Link	GP-4/Encore 32/27	SP1	6	1973	FAA LC		
DC-9-10	Link	GP-4	N2500	3	1966	FAA LA		Ex RC
DC-9-30	Link	PDP 11/45	Vital IV	6	1975	FAA LA	CBT	Ex RC
DC-9-30	CAE	T1980A/B	Vital IV	6	1975	FAA LB	CPT	Ex RC
DC-9-30	Link/NATCO	Encore MultiSEL	SPX500		1990	FAA LD	CPT	
DC-9-30	Link/NATCO	Encore MultiSEL	SPX500/150	6	1990	FAA LD	CPT	
DC-9-30	NATCO/CAE	VAX 11/780	Vital IV	6			CPT	Being converted from MD-80
MD-80	CAE	VAX 11/780	Vital IV/4w	6	1983	FAA LC		
Saab 340B	CAE	IBM 6000						
Long Beach								
MD-82	Rediffusion	Encore 32/67	SPX200CT	6	1993	FAA LC		
MD-82/87	Rediffusion	MultiSEL	SPX200T/150	6	1994	FAA LC	FTD L4	Joint venture with Alaska
Vancouver								
B747-400	Link/NATCO	Encore 32/67	SPX200CT/150	6	1990	FAA LC	CBT	
OLYMPIC AIRWAYS, Athens, Greece +30 (1) 9362960								
Athens Airport								
A300B4	T-CSF	Encore 32/77	Vital IV/4w	6	1983	LB standard	A300 CSS	
B737-200	CAE	VAX 11/780	Vital IV/4w	6	1982	LB standard		
B747-100	Conductron	Belobox	Vistar 1/2w		1969	Greek CAA		Ex Lufthansa
Chania, Crete								
B737-400	T-CSF	Harris Night Hawk	Image 250	6	1994	LC standard	CBT	
OLYMPIC AVIATION, Thessalonica, Greece +30 (1) 936 2681								
ATR 42/72	FSI	Concurrent Micro 5	Vital VII/150	6	1993	LC standard		

CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
ORBIT FLIGHT TRAINING, Heathrow Airport, England +44 (133) 285 0737								
A320-200	T-CSF	Encore MultiSel	Image 600PT/180	6	1995	CAA L4, FAA LD		
A320-200	TTS	Power PC	ESIG3350/180	6	1998	LD standard		
A340-300	TTS	Power PC	TBD	6	1998	CAA L4, FAA LD		
B737-800	TTS	Power PC	ESIG3350/180	6	1999	LD standard		
B777-200	TTS	Motorola	Image 600PT/180	6	1996	CAA L4, FAA LD		
OXFORD AIR TRAINING SCHOOL, Oxford, England +44 (186) 584 4246								
Oxford Airport								
B737-100/200	Frasca	Dell	FVS 1000	3	1990			
PAKISTAN INTERNATIONAL AIRLINES, Karachi, Pakistan +92 (21) 457 2011								
A300B4	Link/ARI	PDP 11/45 (dual)	N6000/2w	6	1993	A	CSS, CBT for A310	Ex Continental
B707-320B	Link	GP-4	N6000/2w	3	1970	FAA LA		
B747-200	Link-Miles	PDP 11/55 (dual)	SP1/4w	6	1994	FAA LC	CSS	Ex Pan Am
PAN AM INTERNATIONAL FLIGHT ACADEMY, Miami, USA +1 (305) 874 6690								
A300B4	T-CSF	Encore 32/77	Vital IV	6	1995	FAA LC		Ex Pan Am
A320	TTS	Power PC	ESIG3350/180	6	1998	LD standard		Jointly owned by Orbit
B707-320B	Link	GP-4	VDS-1000/2w	3	1966	FAA LA		Ex Pan Am
B727-100	Link	GP-4	VDS-1000/2w	3	1967	FAA LA		
B727-200	Rediffusion	Encore 32/77	Vital IV/4w	6	1993	FAA LC	727 CPT	Ex USAir
B737-200	Rediffusion	R2000A	SP1	3	1995	FAA LA		Ex Continental
B737-200Adv	Rediffusion	Encore 32/67	SP1	6	1995			Ex Aerolineas Argentinas
B737-200Adv	Rediffusion	Encore RSX	SP2	6	1996	FAA LC		Ex Lufthansa, sold by Orbit
B737-3/4/500	Reflectone/AAI	Motorola	SP3T	6	1994	FAA LC		
B747-1/200	Link	Xionix X7	SP1	6	1971	FAA LC		Ex Pan Am
B767-200	Rediffusion	Motorola	SP2	6	1994	FAA LC		Ex Britannia
DC-8-60	CAE	Motorola	SP1	3	1995	FAA LB		
DC-8-70	Link	GP4	SP1	3	1994	FAA LB		Owned by Air Canada
DC-9-30/50	CAE	Sigma 3	Vital IV	6	1992			Ex Swiss Air
L-1011-100	Link	PDP 11/55	SP1	6	1980	FAA LB		Owned by ATA/LTU, Ex Pan Am
Learjet 30 series	ARI	Motorola	SP2	6	1994	FAA LC		Ex Pan Am
PHILIPPINE AIRLINES, Pasay City, Philippines +63 2832 5119								
B737-300ERS	Link-Miles	Harris Night Hawk 4800	Image IV-500/WAC	6	1993	LD standard	737 CBT	
PURDUE UNIVERSITY, West Lafayette, USA +1 (765) 494 5782								
B727-100	Link	GP-4	N6000/2w	3	1994	FAA LA		Ex American
B727-200	Link	Encore 32/77S	Image	6	1982	FAA LC		Ex NASA Ames
QANTAS AIRWAYS, Mascot, Australia +61 (2) 9691 7885								
Melbourne								
B737-300ERS	CAE	Encore MultiSEL	SP1	6	1986	ACAA L5	AVT	
B737-3/400ERS	CAE	Encore MultiSEL	Vital VII/150	6	1989	ACAA L5	AVT	
Mascot								
B747-200	Link	Encore 32/77	SP1T/4w	6	1981	ACAA L5		
B747-300	Link	Encore 32/77	SP1T/5w	6	1982	ACAA L5		
B747-400	CAE	VAX 3800	Image 600/200	6	1991	ACAA L5	FMST	
B747-400	Link	MST Intel	Image 600/200	6	1988	ACAA L5	FMST	
B747-400	Link	MST Intel	Image 600/200	6	1989	ACAA L5	FMST	
B767-200ER	Link	Encore 32/77	SP1T/6w	6	1985	ACAA L5	MTS	
B767-300ER	Link	MST Intel	Image 600/200	6	1990	ACAA L5		
Dash 8-100	CAE	IBM 6000	MaxVue	6	1986	ACAA L5		Owned by CAE Australia
QUADRANT SYSTEMS, Burgess Hill, England +44 (144) 424 6226								
B727-200	Link	PDP 11/45	DNVS	6	1993	CAA L2B		Ex Lufthansa, Ex Dan Air
B747-200/300	Link	Harris Night Hawk	Vital IV/4w	6	1992	CAA L3		Ex NATCO 747-100
RAYTHEON FLIGHT TRAINING (formerly HUGHES FLIGHT TRAINING), Crawley, England +44 (129) 3 54 3541								
Gatwick								
A320-200	Rediffusion	Encore SCI-Clone	SP1T/150	6	1988	CAA L3/FAA LC	AVT	
B737-200	Rediffusion	Encore 32/77	SP2/4w	6	1983	CAA L3	AVT	
B737-300ERS/EIS	Rediffusion	Encore SCI-Clone	SP1T	6	1987	CAA L3	CAT (Wicat)	
B737-300ERS/EIS	Rediffusion	Encore MultiSel	SPX200	6		CAA L3, FAA LC	CBT	Ex Delta
B747-200	Link	DEC 11/55	SP1	6		CAA L3	CBT	Ex Qantas
B757/767-200/300ER	Rediffusion	Encore MultiSEL	SPX200/150	6	1990	CAA L3		
Bae 125-700	QTE	Gemini	VDS-1000/2w	2	1990	CAA L2A		
DC-10-30/10	Rediffusion	Encore 32/77	SPX200/4w	6	1981	FAA LB, CAA L3	AVT, CBT	
MD-83ERS	Rediffusion	Encore SCI-Clone	SP1T/150	6	1989	CAA L3		
REFLECTONE TRAINING CENTER - DULLES, Sterling, USA +1 (703) 890 8900								
Bae 146-2/300	Reflectone	Encore MultiSEL 32/67	SPX200T/4w	6	1990	FAA LC	CPT	
Jetstream 31/32	Reflectone	Encore MultiSEL 32/67	SPX200T/4w	6	1990	FAA LC	CPT	
Jetstream 31/32	Reflectone	Encore MultiSEL 32/67	SPX200T/4w	6	1991	FAA LC	CPT, CBT	Ex American Eagle
Jetstream 41	Reflectone	Harris Night Hawk	VDS-2000/150	6	1995	FAA LC, CAA L3	CPT	
St Louis								
Jetstream 41	Reflectone	Harris Night Hawk	VDS-2000/150	6	1995	FAA LC	CPT	

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CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
REFLECTONE TRAINING CENTER - TAMPA, Tampa, USA +1 (813) 887 1680								
C-130/L-100-11	Reflectone	Encore MultiSEL	Vital IV	6	1990	FAA LB	L4 FTD, CBT	
C-130/L-100-11	Reflectone	Concurrent 8400	Vital IV	6	1992	FAA LB	L4 FTD, CBT	
ROYAL AIR MAROC, Casablanca, Morocco +21(2) 2912820								
B727-200	CAE	T1980B	Vital III/2w	6	1980			
B737-4/500	CAE	IBM 6000	Vital VII/150	6	1993	FAA LD	CBT	
ROYAL BRUNEI AIRLINES, Darussalam, Brunei +673 (2) 339 225								
B757/767	TTS	Power PC		6	1997	CAA L3		
ROYAL JORDANIAN AIRLINES, Amman, Jordan +962 (6) 893299								
Amman								
A310-300	T-CSF	Encore MultiSEL	SPX500/W150	6	1989	DGCA, FAA LD	CBT (VACBI)	
B707-300	Link	Mark I	N6000/3w	3	1977			Ex Qantas
B727-200	A&M	Harris 8024/4	N6000/3w	4	1975	FAA LB; CAA		Ex Qantas
L-1011-100	Rediffusion	Encore 32/77	SPX2007/4w	4	1976	CAA L3		Ex Cathay
Queen Alia International Airport								
A320-200	T-CSF	Encore MultiSEL	SPX500/150	6	1989	DGCA, FAA LD	CBT (VACBI)	
RWL FLIGHT TRAINING CENTRE, Dusseldorf / Moenchenglandbach, Germany +49 (21) 61 68900								
B737-3/4/500	CAE	VAX 3200	Vital VII/150	6	1990	FAA LD	AVT	
B737-7/800	CAE	IBM 6000	ESIG3350/180	6	1999	LD standard		
SABENA, Steenokkerzeed, Belgium +32 2 723-7510								
Brussels								
A320	TTS	Power PC	ESIG3350/180	6	1999	LD standard		
A340	TTS	Power PC	ESIG3350/180	6	1999	LD standard		
B737-200 Adv	A&M	PDP11/50	SP1/2w	4	1976			
B737-3/4/500	CAE	Encore MultiSEL	Vital V/4w	6	1989	FAA LC, CAA L3		
DC-10-30	LinkMiles	PDP11/45	SP1/6w	6	1976	LBA, Belgian CAA L3		
Auro RJ85	Reflectone	Harris Night Hawk	ESIG3350/180	6	1996	CAA L3		For Delta Air Transport
SAUDI ARABIAN AIRLINES, Jeddah, Saudi Arabia +966 (2) 686 4189								
A300-600	LinkMiles	Encore 32/77	SP3T/150	6	1985	Visual	CPT	
B737-200	Rediffusion	R2000A	N6000/4w	4	1977			
B747-100	LinkMiles	Encore 32/77	SP1/4w	6	1983		CPT, PTT	
L-1011-200	Rediffusion	Encore 32/55	SP1/4w	6	1980			
SCANDINAVIAN AIRLINES SYSTEM (SAS FLIGHT ACADEMY), Stockholm, Sweden +46 (8) 797 4009								
A320-200	AAI Microflite	Motorola	Image IV/4w	6	1992	FAA LD, CAA L3	CBT (Wicat)	
B737-3/500	Rediffusion	Motorola	SPX550/180	6	1992	LD standard	L4 FTD, CBT (Wicat)	Ex-Linjefflyg
B737-6/7/800	CAE	IBM 6000	MaxVue/180	6	1997	LD standard	L5 FTD	
B737-700	CAE	IBM 6000	MaxVue/180	6	1999	LD standard		
B767-300ER	CAE	VAX 3200 (3)	Image IV/200	6	1989	LD standard	CBT (Wicat) & L4 FTD	
DC-10-30/10	Link	Xionix X7	SP1T/6w	6	1975	LC standard	FTD, CBT (Wicat)	
DC-8-63/73	Link	GP-4	SP1T/4w	3	1967	LA standard		
DC-9-41	Link	Xionix X7	SP1T	6	1967	LC standard	L4 FTD, CBT (Wicat)	
DC-9-41	Link	Xionix X7	SP1T	6	1967	LC standard	L4 FTD, CBT (Wicat)	
MD-82/87ERIS	LinkMiles	MST	Image IV/6w	6	1988	LD standard	CBT (Wicat) & 2 L4 FTDs	
MD-82/87ERIS	LinkMiles	MST	Image IV/6w	6	1989	LD standard	CBT (Wicat)	
MD-82/87ERIS/Analogue	LinkMiles	MST	Image IV/6w	6	1991	LD standard		
Fokker F-28-1000/4000	CAE	Encore 32/6780	SP1/6w	6	1977		CBT (Wicat)	For sale, Ex Linjefflyg
Fokker F-28-1000/4000	Link	GP-4	SP1/6w	3	1978	STK	CBT (Wicat)	Ex Linjefflyg
Fokker 50	CAE	VAX 3200	Image IV/6w	6	1990	LC standard		
Saab 340A/B	GMI/ASDL	Encore 32/77 x 2	SP1T/4w	6	1984	LC standard	CBT (Wicat)	
Bell 412/212	CAE	IBM 6000	MaxVue/Bch	6	1998			
SENASA, Madrid, Spain +34 (1) 329 1032								
B757-200	PSI	Concurrent Micro 5	Vital VII/4w	6	1993	DGAC LD		For Iberia
Citation III/VII	PSI	Concurrent Micro 5	Vital IV/4w	6	1993	FAA LC		For Iberia
SIMCOM INTERNATIONAL, Orlando, USA +1 (407) 345 0511								
Pilatus PC-12	SimCom	586-33	SIS-100	None	1996	FAA L6		
SIMTEC, Braunschweig, Germany +49 (531) 350091								
Dornier 228	Simtec	VAX 4000	VDS-2000	6	1992			*with Letov
SIMUFLITE TRAINING INTERNATIONAL, Dallas/Fort Worth Airport, USA +1 (972) 456 8070								
Dallas/Fort Worth								
BaE 125-700	Link	Encore 32/77	Image III/4w	6	1985	FAA LC		
Challenger 601-3A/R	CAE	IBM 6000	MaxVue/150	6	1995		Avionics trainer	
Citation I/II/SII	Link	Encore 32/77	Image III/4w	6	1985	FAA LC		
Citation III/IV	Link	Encore 32/77	Image III/4w	6	1985	FAA LC		
Citation V	Simuflite	Encore/Harris	Vital IV/4w	6	1993	FAA LC		
Falcon 10	Link	Encore 32/77	Image III/4w	6	1985	FAA LC		
Falcon 20	Link	Encore 32/77	Image III/5w	6	1985	FAA LC, CAA L3		
Falcon 50	Link	Encore 32/77	Image III/5w	6	1985	FAA LC		

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Falcon 900B/EX	TBD							
Gulfstream II/IIIB	Link	Encore 32/77	Image III/4w	6	1985	FAA LC		
Gulfstream III	Link	Encore 32/77	Image III/4w	6	1984	FAA LC		
Gulfstream IV-SP	CAE	IBM 6000	MaxVue/150	6	1995		FMST	
Hawker 800/1000	Reflectone	Encore RSX	SPX250/150	6	1994	FAA LC		
King Air 200B	Link	Encore 32/77	Image III/4w	6	1985	FAA LC	C90/100 FTD	FTD for Quickturn programme
Learjet 24/25LR	Link	Encore 32/77	Image III/4w	6	1985	FAA LC		
Learjet 35/36LR	Link	Encore 32/77	Image III/4w	6	1984	FAA LC		
Learjet 55	Link	Encore 32/77	Image III/4w	6	1984	FAA LC		
Westwind II	Link	Encore 32/77	Image III/4w	6	1984	FAA LC		
Marietta C-130/L-100	Link	Perkin-Elmer	Image II	6	1984	FAA LA		Ex Lockheed
SIMULATOR TRAINING, Seattle, USA +1 (206) 241 1854								
B727-200	Conductron	DDP-124	Vital II/2w	3	1970	FAA LA	CPT	Ex PSA
B737-1/200	Conductron	DDP-124	Vital IV/4w	6	1968	FAA LA		Ex PI
SINGAPORE AIRLINES, Singapore +65 5417903								
A310-200	CAE	Encore 32/77	SP2/6w	6	1985			
A310-300	CAE	IBM 6000	Vital VII/150	6	1992	CAAS LD standard		
A340-300	CAE	IBM 6000		6	1995			
B747-300	Rediffusion	Encore 32/97	SP3T/150	6	1984	CAAS LC		
B747-400	CAE	IBM 6000	Vital VII/150	6	1992	CAAS LD standard		
B747-400	Rediffusion	Motorola	SPX550/150	6	1993			
B757-200	CAE	Encore MultiSEL	SPX550/150	6	1988	CAAS LC		
B777-200	CAE	IBM 6000	MaxVue	6	1997			
Learjet 31A	FSI	Harris Night Hawk	SPX550/150	6	1993	CAAS LD	CBT (Wicat)	
Learjet 45	FSI	Harris Night Hawk	ChromeView?	6	1998			
SOUTH AFRICAN AIRWAYS, Johannesburg, South Africa +27 (11) 356 1762								
Jan Smuts Airport								
A300B2K	Rediffusion	R2000A	SPX200/4w	6	1977			
A320-200	Rediffusion	Encore MultiSEL	SPX500/150	6	1992	CAA L3		
B737-200	Rediffusion	Encore MultiSEL	SP2/6w	6	1982	FAA LC		

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CIVIL SIMULATORS

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
B747-200B	Rediffusion	Encore 32/77	SP2/6w	6	1982	FAA LC		
B747-400	Rediffusion	Encore MultiSEL	SPX500/150	6	1992	CAA L3		
SOUTHWEST AIRLINES, Dallas, USA +1 (214) 792 1400								
B737-2/300	Rediffusion	Encore 32/8750	SP1/150	6	1984	FAA LC	CPT	Ex Orbit
B737-200	Link	Xionix X7	SP1	3	1986	FAA LA	CPT	Ex AA 707
B737-300	Rediffusion	Encore 32/9705	SP1T/150	6	1986	FAA LC	CPT	
B737-300	Reflectone	Harris Night Hawk	Vital VII/150	6	1994	FAA LC	CPT	
B737-700	TTS	Power PC	ESIG-3350/150	6	1998	LD standard	CBT	
SWISSAIR, Zurich, Switzerland +41 (1) 812 5615								
A321-100	Rediffusion	Motorola	ESIG3250	6	1994	JAA LD		
A321-100	Rediffusion	Motorola	ESIG3250	6	1994	JAA LD		
A330/A340	CAE	IBM 6000	MaxVue	6	1998	JAA LD		
B747-300	REPL	Encore 32/9780	Hivis IIIA/6w	6	1983	LC standard		
Fokker 100	CAE	Encore 32/97	Hivis IIIA/6w	6	1987	LC standard		Sold, still in use for Swissair
MD-11	CAE	Encore 32/9780	MaxVue A+	6	1990	FAA LD	CPT (Wicat) & FBS	
MD-11	CAE	Encore 32/9780	MaxVue A+	6	1990	FAA LD	CPT (Wicat) & FBS	
MD-82	CAE	Encore 32/97	Hivis IV/210	6	1991	FAA LC		
TACA INTERNATIONAL AIRLINES, San Salvador, El Salvador +503 279 1580								
B737-200	CAE	Ti980	Vital III/2w	6	1994		CPT	Ex Britannia
TAP AIR PORTUGAL, Lisbon, Portugal +351 (1) 841 5000								
A320	TTS	Power PC	ESIG3350/180	6	1998	LD standard		
B737-300EFIS	Rediffusion	Encore MultiSEL	SPX500/150	6	1989			
TAT EUROPEAN AIRLINES, Dinard, France +33 (99) 82 75 30								
Fokker F28-4000	Rediffusion/ASDL	Encore 32/67	SPX200T/4w	6	1990	FAA LC; DGAC		Ex-Nigerian
THAI AIRWAYS INTERNATIONAL, Bangkok, Thailand +66 (2) 513 0221								
A300-600	Link-Miles	Power PC	Image III/6w	6	1987	FAA LC	MTS	Computer upgraded
A300B4	T-CSF	Encore MultiSEL	SP1/4w	6	1980	FAA LA		
A330-300	TTS	Power PC	ESIG3350/180	6	1998	LD standard		
B737-400	Rediffusion	Motorola 88000	SPX550/150	6	1992	CAA L4		
B747-200	Link	Encore 32/77 (3)	SP1/4w	6	1980	FAA LA		
B747-400	Rediffusion	Motorola 88000	SPX550/150	6	1992	CAA L4	RMSGT (Wicat)	
B777	TTS	Power PC	ESIG3350/180	6	1998	LD standard		
THY TURKISH AIRLINES, Istanbul, Turkey +90 212 573 5188								
B737-400	TTS	Harris Night Hawk	Image 600PT/A180	6	1994	IQTG L2		
Avro RJ100	Reflectone	Harris Night Hawk	ESIG3350/180	6	1997	IQTG L2		
TRANS WORLD AIRLINES, Bridgeton, USA +1 (314) 895 6733								
New York Kennedy Airport								
B727-200	Link	GP4	N6000/2w	3	1969	FAA LB	CPT	
B747-100	Link	Belobox	N6000/2w	6	1969	FAA LB	CPT	Converted to L6 FTD
B747-200	Link	Encore 32/77	Image II/4w	6	1985	FAA LC	CBT & L6 FTD	
B767-200	Rediffusion	Encore 32/7780	Image IV/150	6	1981	FAA LC		
St Louis								
B767-200	Rediffusion	Encore 32/77	SP1/4w	6	1982	FAA LC	CPT	
L-1011-200/300	Rediffusion	Encore 32/77	SP1/4w	6	1983	FAA LC	CPT	
MD-82	Link	Encore 32/77	Image III/1	6	1988	FAA LD	CBT, FTD	
MD-83	Link	MultiSEL	SP2T/150	6	1998	FAA LC		Ex Delta, u/g by Reflectone
TRANSPRASIL LINHAS AEREAS, Sao Paulo, Brazil +55 (11) 240 7411								
B727-100	Link/GMI	Mark I	Vital II	3	1989			* De-activated
TRANSPORT CANADA, Gloucester, Canada +1 613-998-3742								
Gloucester								
King Air 90/100A	Singer Link	Analogue/Motorola VME	Vital IV	3	1975			
MacDonald Cartier International Airport								
Citation II	CAE	IBM 6000	MaxVue	6	1993	FAA LD	CBT, CPT x 2	
UNITED AIRLINES, Denver, U.S.A. +1 303-780-5920								
Denver								
A320-200	TTS	Motorola 88100	SPX550/150	6	1994	FAA LD	L5 FTD	
A320-200	TTS	Motorola	ESIG3350/150	6	1997	LD standard	RMAST (TTS)	
A320-200	TTS	Motorola	ESIG3350/150	6	1997	LD standard	RMAST (TTS)	
A320-200	TTS	Motorola	ESIG3350/150	6	1997	LD standard		
B727-100	Link	GP-4	Liberty200/2w	3	1967	FAA LB		Visual upgraded
B727-200A	Rediffusion	VAX 3800/R2000	SP1/4w	6	1970	FAA LC		
B727-200A	CAE	VAX 3800	SP3/4w	6	1982	FAA LD		
B727-200A	CAE	VAX 3800	SP1/4w	6	1981	FAA LC		
B737-200	Cond	DDP-124	Liberty200/3w	3	1968	FAA LA	CPT	Visual upgraded
B737-200	Cond	DDP-124/VAX 3200	SP3/4w	6	1968	FAA LC	CPT	
B737-200	CAE	VAX 8530	SP3/4w	6	1987	FAA LD	CPTs	
B737-300	CAE	VAX 8530	SP3/4w	6	1987	FAA LC	RMASTs, CBT	

Operator (location - telephone number) Type (Simulator location, if different)	Supplier	Computer	Visual/display	Motion axes	Entered service	Level	Associated devices	Remarks
B737-300	CAE	VAX 8530	SP3T/4w	6	1988	FAA LD	FMSTs	
B737-300	CAE	VAX 8500	SP1T/4w	6	1989	FAA LC	CBT, FMST	
B737-300	CAE	VAX 8530	SP3T/4w	6	1990	FAA LD	CBT, FMSTs	
B747-100	Link	VAX 4000-50	SP1/4w	6	1970	FAA LC	2 747-100 CPTs	
B747-200	Rediffusion	Motorola 68110	SPX250/4w	6	1992	FAA LC		Ex-Boeing
B747-400	CAE	VAX 4000-50	SPX500/150	6	1989	FAA LD	FMST (Xionix)	
B747-400	CAE	VAX 4000-500	SPX500/150	6	1993	FAA LD	FMST, CBT	
B747-400	CAE	IBM 6000	ESIG3350/150	6	1998	LD standard		
B747-400	CAE	IBM 6000	ESIG3350/150	6	1998	LD standard		
B757-200	CAE	VAX 4000-50	SPX250/4w	6	1990	FAA LD	CBT, FMST	
B757-200	CAE	VAX 4000-50	SPX250/4w	None	1990	FAA LD		
B757-200	CAE	IBM 6000	ESIG3350/150	6	1998	LD standard	2 L5 FTDs (CAE)	Plus DFMST (TTS)
B767-200	CAE	VAX 8530	SP1T/4w	6	1990	FAA LC		
B767-300ER	CAE	VAX 8550	SP1/4w	6	1982	FAA LC		
B777-200	TTS	Motorola	ESIG3350/150	6	1994	FAA LD	FBS	Visual upgraded
B777-200	TTS	Motorola	ESIG3350/150	6	1998	LD standard	DFMST (TTS)	
B777-200	TTS	Motorola	ESIG3350/150	6	1998	LD standard		
B777-200	TTS	Motorola	ESIG3350/150	6	1998	LD standard		
DC-10-10	Rediffusion	Sigma 5 - dual	SP1/4w	6	1971	FAA LC		
DC-10-10	Rediffusion	Sigma 5	N6000/2w	6	1976	FAA L6	FBS	
DC-10-10	CAE	VAX 3800	SP1/4w	6	1981	FAA LC		
DC-8-61	Link	GP-4	Liberty200/2w	3	1967	FAA LB	CPT	Visual upgraded
DC-8-71	Conductron	DDP-124/VAX 11-780	SP1/4w	6	1969	FAA LC	CPT	
UPS AIRLINES, Louisville, USA +1 (502) 359 8855								
B727-100	Link/ARI	GP-4	NVS/2w	3	1986	FAA LA		Ex Orion Air
B727-100QF	Rediffusion	Encore MultiSEL	SPX250	6	1991	FAA LD		
B757-200PF	Rediffusion	Encore MultiSEL	SPX500	6	1990	FAA LD	CBT, FTD	
B757-200PF	Rediffusion	Encore MultiSEL	SPX250	6	1995	FAA LD, CAA L3	CBT, FTD	
DC-8-71	Rediffusion	Encore MultiSEL	SPX250	6	1991	FAA LD		
DC-8-73	CAE/ARI	Sigma 3	Vital III/6000	3	1987	FAA LA		Ex Orion Air
US AIRWAYS, Pittsburgh, USA +1 (412) 472 7032								
A320	CAE	IBM 6000	MaxVue	6	1999	LD standard		Location TBA
A320	CAE	IBM 6000	MaxVue	6	1999	LD standard		Location TBA
A320	CAE	IBM 6000	MaxVue	6	1999	LD standard		Location TBA
Charlotte								
B737-200	CAE	VAX 11/780	Vital IV/4w	6	1982	FAA LC	CPT	Ex PI
B737-300	CAE	VAX 8350	Vital VII/4w	6	1988	FAA LD	L6 FTD, CBT (CAE)	Ex PI
B737-300	CAE	VAX 11/780	Vital IV/4w	6	1988	FAA LC	L6 FTD, CBT (CAE)	
Dash 8-100A	CAE	IBM 6000	Image IIT/6w	6	1992	FAA LC		
Fokker F-28-4000	REPL	Encore 32/77	Vital IV/4w	6	1984	FAA LC		Ex Reflectone; Ex PI
Pittsburgh								
B727-100	Link/USAir	GP-4	Image II/2w	3	1979	FAA LB		Ex PA 707
B727-200	Link/USAir	Encore 32/77	Image II/4w	6	1986	FAA LC	CPT (Link)	For sale
B737-200	GMI	Encore 32/77	Image II/4w	6	1985	FAA LC	CPT (GMI)	
B737-300	CAE	Encore 32/6780	Image IIT/4w	6	1988	FAA LC	FTD (CAE), CBT (CAE)	
B737-300	CAE	Encore 32/6780	Image IIT/4w	6	1988	FAA LC	FTD (CAE), CBT (CAE)	
B757-200	CAE	VAX 11/780	Vital IV/4w	6	1992	FAA LC	CPT (CAE), CBT	Ex EA
BAC One Eleven-2/400	Link	GP-4	DNVS/2w	3	1967	FAA LA	CPT (Link)	
DC-9-30	Rediffusion	DDP 124 PDP11/55	DNVS/2w	3	1974	FAA LB	CPT (GMI)	Ex Ozark
DC-9-30	Link	Encore 32/77	Image II/4w	6	1983	FAA LC	FTD (GMI)	
Fairchild FH-227B	Link	GP-4	DNVS/2w	3	1968	FAA LA		
Fokker 100	CAE	Encore 32/67	Image IIT/4w	6	1989	FAA LC	FTD (CAE)	
MD-80/82	CAE	VAX 11/785 & Encore 32/77	Vital V	6	1983	FAA LC	CBT, CPT (Microfite)	EX PSA
VARIG, Rio de Janeiro, Brazil +55 (21) 462 3344								
B707-320	Rediffusion	R2000A	2500/2w	4	1977			
B737-200	Rediffusion	R2000A	SP1T	3	1976		CPT (Burtek) AVT (Spiritus)	
B737-300ERS	Rediffusion	Encore SCI-Clone	SP3T/150	6	1988	FAA LC	AVT (Spiritus); L4 FMST (Xionix) & CBT (Wicat)	
B747-300	Rediffusion	Encore SCI-Clone	SP3T/150	6	1987	FAA LC	AVT (Spiritus)	
B767-200	Rediffusion *	Encore SCI-Clone	SP3T/150	6	1987	FAA LC	AVT (Spiritus)	
DC-10-30	Rediffusion	R2000A	N2500/2w	6	1976		CPT (Burtek) & CBT (Wicat)	
VASP, Sao Paulo, Brazil +55 (11) 532 3200								
B737-200	Cond	DDP-124	Vital III/4w	3	1968			Ex United, ex PSA
VIASA, Caracas, Venezuela +58 (2) 571 6221								
Buenos Aires								
B727-200	Rediffusion	Encore 32/77	SP1/4w	6	1981	FAA LB		Ex Aerolineas Argentinas
Caracas								
DC-10-30	CAE	VAX 11/780	Image IIT/4w	6	1981			Ex KLM
VIRGIN ATLANTIC AIRWAYS, Crawley, England +44 (1293) 744 680								
B747-200	Link	PDP 11/45 (dual)	SP1/4w	6	1976	CAA L3	FBS	At RFTL: Ex Qantas
ZAS AIRLINE of EGYPT, Cairo, Egypt +20 (2) 355 5485								
A300B4	T-CSF/ASDL	Encore 32/55	SP1/4w	6	1991			Ex Conair/FTC

Orbital aspirations

China is planning to launch a manned spacecraft in 1999

TIM FURNESS/LONDON

THE CHINESE Academy of Space Technology (CAST) has announced plans for a national manned spaceflight (see box), an unmanned lunar explorer and radical improvements to space applications technology, thus enabling China to compete more effectively in the international marketplace.

A space applications plan has been announced to develop indigenous high capacity satellites for mobile and direct broadcast communications, as well as other uses, starting with the Dong Fang Hong 4 series; and a range of new environmental, ocean monitoring and remote sensing satellites called Zi Yuan. The latest weather satellite, the Fengyun 1F3, will be launched in October.

A new series of improved unmanned recoverable satellites for microgravity processing

research is also being developed.

In addition, the proposal includes offering commercial piggyback small satellite flights on national launches; and the development of small low-cost satellites. Ground equipment, such as testing chambers, computer systems and laboratories will be upgraded.

New, uprated commercial satellite launchers will be required and boosters will be needed to carry payloads of up to 20,000kg to low Earth orbit. "Launch vehicles which can carry 10,000kg are big enough to launch manned craft, but we need a 20,000kg lift capacity for deep space exploration, including flights to the moon and planets," says CAST vice-president Xu Dazhe.

China says that it plans to launch a dual satellite system, called Xinguan, to provide additional information about the



China is developing a more powerful booster than the Long March 3B

sun and solar processes affecting the near Earth environment, in conjunction with other international spacecraft, such as the European Space Agency's planned Cluster 2 fleet. Indeed, China wishes to become more involved in international co-operation.

The country is also making greater efforts to reduce the amount of space debris left in orbit after a launch. Yuan Jie, a scientist at the Shanghai Academy of Space Technology, says that residual propellant on the upper stage of the Long March 4 booster will be vented to reduce the likelihood of the stage exploding in orbit.

About 25% of orbiting space debris has been caused by exploding rocket stages. The trajectory of the third stage of the Long March 3 system has also been altered to shorten its orbital lifetime. □

STEPS TO MANNED SPACEFLIGHT

TWO CHINESE astronauts are training for an orbital flight in 1999 to celebrate the 50th anniversary of the creation of the People's Republic of China. An unmanned test flight is expected later this year from China's Jiuquan base.

The crewed flight will make China the third nation to launch a national manned flight, after the former Soviet Union and the USA nearly 40 years ago. Yuri Gagarin flew into orbit and Alan Shepard made a suborbital flight in 1961. Space travellers from 23 other nations have since been launched by Russia and the USA.

China has enlisted the help of Russia to get its astronaut project off the ground. Chinese test pilots Wu Tse and Li Tsinglung have completed a course in cosmonaut training at the Yuri Gagarin Cosmonaut Training Centre, near Moscow.

As part of a \$1 million contract with Russia in 1997, a group of doctors attended the Gagarin centre to undergo training, so that they could develop a national training programme. One of the Chinese astronauts was to have flown in a Russian Soyuz TM craft to the Russian Mir space station,

but the flight has not materialised.

Although China plans to use an uprated version of its Long March 2E for the manned flight and to manufacture its own manned craft, it plans to buy Russian Soyuz manned spacecraft docking units, life support and other equipment. Indeed, the craft may well resemble the Russian Soyuz flight and service module.

The Chinese manned spacecraft will also be based on technology developed for the smaller FSW spacecraft and re-entry capsule, which has been used for years for unmanned military reconnaissance, remote sensing imaging and microgravity processing missions. The first FSW was launched and recovered in 1975.

The Long March 2E satellite launcher is capable of placing around 8,800kg into low Earth orbit, about the same weight as a Russian Soyuz spacecraft launched on the booster of the same name. The Long March 2E will also be equipped with extra redundancy and safety features, including a launch escape tower on top of the manned craft to allow it to be pulled free of the launcher should there be a major

failure during the initial launch phase.

The two-stage launcher and its four strap-on boosters are powered by nitrogen tetroxide and hydrazine, hypergolic propellants which ignite spontaneously on contact, like that of the Titan 2 launcher which carried the US Gemini two-man capsule in 1965-6. The LM2E first flew in 1992 and has had chequered record of ten launches with seven full successes.

Russia is also assisting in the development of a new Chinese heavy lift booster, capable of placing 20,000kg into low Earth orbit, a weight equivalent to that of one of the modules making up the Russian Mir space station. Russia may provide help with the production of the rocket engines. A new launch pad at Jiuquan is being built for the new heavy booster.

China plans eventually to launch its own space station. Copying Russian procedures as a stepping stone, China will probably form a "mini" space station by joining two manned craft together as the former Soviet Union did in 1969 when two Soyuz craft docked. The first Russian Salyut space station was then launched in 1971.



F M Dudine

■ SUNDSTRAND

Sundstrand Aerospace has named **F M Dudine** regional director, Asia-Pacific, based in Singapore, and **Guan Ming** regional manager for China, based in Beijing. Both appointments are in line with efforts to bring operations closer to customers.

■ SINGAPORE

Board member **Michael Fam** is to take over as chairman of Singapore Airlines when **S Dhanabalan** relinquishes the post to assume control of the country's DBS Bank. Mr Fam is also chairman of the Fraser & Neave Group.

■ BOEING CHINA

With the retirement of **Mike Zimmerman**, **Ray Bracy** has been appointed president of Boeing China. Bracy has been with the company for nine years, and he helped to guide the quality control initiative in the early 1990s and later headed the manufacturing business unit concept, which made significant efficiency gains.

■ BOEING EUROPE

Richard (Dick) James has been appointed president of Boeing Europe, assuming responsibility for commercial, military and space activities in the region. James had been working in the Asia-Pacific region as vice-president of commercial business development.

■ DELTA

Two veteran Delta Air Lines executives – **Robert Coggin**, marketing chief, and personnel director **Robert Adams** – will retire on 1 May. **Leo Mullin**, Delta's new president and chief executive, recently picked industry outsider **Warren Jensen** to replace **Thomas Roeck** as chief financial officer.

■ BAe

Richard Thompson has become commercial director FLA for British Aerospace Airbus, to be based at

Toulouse. The position opened up when **Andy Lewis** became director of sales support for the Eurofighter consortium, based at Warton, UK. Thompson was marketing director of Westinghouse Signals.

■ ROLLS-ROYCE

Richard Smallwood has rejoined Rolls-Royce from BMW Rolls-Royce, of Oberursel, Germany, as senior vice-president for customer business in Europe and in South and Central America, and as customer business director for British Airways. His responsibilities as business director on the BMW Rolls-Royce board of management have been assumed by chairman **Dr Klaus Nittinger**.

■ INNOTECH

David Miller has been appointed executive vice-president and chief operating officer of the Innotech-Execaire Aviation group, and now vice-president for sales and marketing, as reported in our issue of 8-14 April.



Bob Kievits

■ OGDEN

Bob Kievits has become managing director, Europe, for Ogden Aviation. He replaces **Jack Callaghan**, who assumes responsibility for Czech Ogden and its new cargo facility in Prague. Kievits joins from Royal Dutch Shell, and has spent the majority of his time in sales and marketing.



■ UK CAA SAFETY AWARD

Kevin Wright of Retford, UK, is the winner of the 1998 UK Civil Aviation Authority Safety Award for General Aviation. Joint second in the contest were **John Romain** of the Aircraft Restoration Company, Imperial War Museum, Duxford, and **Jack Wells**, vice-chairman of the Aircraft Owners and Pilots Association (UK). Wright, a maintenance engineer, pictured (above centre) between Romain (left) and Wells, rescued the pilot and passenger from a burning helicopter which had suffered a take-off accident at Gamston Airfield.



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E-mail: chowyer@iee.org.uk

Sixth Annual Middle East Aircraft Technology & Maintenance Conference

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ITEC '98

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28 April-2 May Pretoria, South Africa
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Fax: +27 (11) 442 8592

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1 May Elvington, Yorkshire, UK
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Fax: +44 (1904) 608246

Air Cargo Forum (ACF98)

3-6 May Paris, France
Contact: Arthur Weldy
Tel: +1 (412) 821 2121
Fax: +1 (412) 821 0560

Integrated Avionics

4-5 May Munich, Germany
7-8 May London, UK
Contact: HSA/AVINT, H Silver and Associates (UK), 2nd Floor, Africa House, 64-78 Kingsway, London WC2B 6BD, UK
Tel: +44 (171) 413 0936
Fax: +44 (171) 413 0937

Aeronautics and Space: Future Vision for Research and Industry in Europe

5 May Brussels, Belgium
Contact: M&M Conseil, 13 rue du 5 Septembre, 75002 Paris, France
Tel: +33 (1) 40 20 98 88
Fax: +33 (1) 40 20 98 89

Airlines of the Former Soviet Union

6 May London, UK
Contact: Charles Oman, Hon Secretary, The London Society of Air-Britain, Orchards, Mill Lane, Balcombe, Sussex RH17 6NP, UK
Tel: +44 (1444) 811317

Society of Experimental Test Pilots

1998 European Symposium
6-8 May Manchester, UK
Contact: Roger Beazley, DERA, Boscombe Down, Salisbury, Wiltshire SP4 0JF, UK
Tel: +44 (1980) 663586

Avoidance and awareness are the watchwords for CFIT

I would like to add to the debate on controlled flight into terrain (CFIT). I feel that the first emphasis must be on *avoidance*. Training programmes should attempt to use every tool available to improve situational awareness, and designers will soon provide a new one: the enhanced ground proximity warning system (EGPWS).

The second line of defence is to provide optimal terrain avoidance. The most efficient avoidance manoeuvre cannot be accomplished (without very regular training) by the standard airline pilot, when faced with a sudden requirement to fly around the edge of the flight envelope. This is especially so

when responding from low arousal levels after a long flight. Here technology has already helped, in the form of Airbus fly-by-wire envelope protections.

There is only one in-service control system which allows optimal pilot terrain avoidance with almost zero skill. A full backstick application on an Airbus fly-by-wire aircraft can be accomplished by a non-type-rated pilot, or even a non-pilot. At low speed, the spoilers will stow and TOGA will be automatically applied. Terrain avoidance will be optimised.

Some CFIT accidents have demonstrated that pilots failed to respond to multiple hard GPWS warnings before hitting

terrain. There may therefore be an additional case for future design to incorporate an auto-pull-up function following multiple EGPWS hard warnings, once this system is validated for reliability.

Even if the designers agree to take this route, we should still redouble our efforts to provide strong recurrent training for our airline pilots, emphasising situational awareness (particularly with regard to terrain), so that our superior pilot skills are never required for terrain avoidance.

JOHN BENT
MANAGER, FLIGHT TRAINING
Cathay Pacific Airways
Hong Kong

Here's how to keep the CAT in the bag

I refer to the letter from Capt A B Howes, "Clues to CAT" (*Flight International*, 4-10 March, P52).

When operating as a navigator on Boeing 707s over North Atlantic routes in the 1970s, I always kept a weather eye on the total air temperature gauge when in the area of forecast or reported clear air turbulence (CAT) at cruise altitude, as a normal operating procedure. It [temperature variation] invariably proved a reliable indicator of how significant the "chop" was going to be.

One wonders, therefore, why useful information like this was not investigated when one reads of new ways now being looked at to detect CAT, and when you print reports of inflight events arising from its effects.

VINCENT OLIVER
Polaris Aviation Consultancy
Cuddington, Cheshire, UK

Heathrow devotion is BAFFling

I fear the Business Aviation Fighting Force (BAFF), as outlined in your Comment (*Flight International*, 8-14 April, P5) is "missing the wood for the trees".

Watching Heathrow's arriving and departing "heavies", even a non-aviation person can see there is no room left in the sky for birds, let alone executive jets. I am sure users of such business aircraft, in their right corporate minds, wouldn't go near the place were it not for Heathrow's easy access to the centre of London – and that, I believe, is the key.

If the BAFF and others would only get away from the belief that Heathrow is the centre of the universe, they will see a number of viable alternative airfields surrounding London.

North Weald, for example, is just a short drive up the M11 from the City of London. Biggin Hill is actually closer to the City and equidistant from the West End with Gatwick, and from Southampton a high-speed rail link and motorway network can have a businessman, or woman, in London in just over the hour.

Yes, there are serious problems with each of these airports. Biggin Hill has made great strides in attracting business aircraft, but is hampered by the reluctance of authorities to invest in a decent public transport and road system.

The operators of Southampton Airport have declared their intention to increase scheduled commercial movements at the expense of business and GA

aircraft, even though its runway length makes it impossible to routinely and safely accept anything larger than a BAe146.

The BAFF may achieve greater success in establishing centres of business aviation by tackling such regional issues, rather than fighting for a lost cause.

BRIAN WARD
Stubbington, Hampshire

No accounting for public preference

Jean Pierson admits that the A3XX has not yet achieved a step change in operating economics (*Flight International*, 4-10 March), but Airbus has long refused to consider the mid-wing V-tail configuration which, I have argued in your columns and elsewhere, promises exactly this.

I have too much respect for Pierson and his fine team to cry "...not invented here", or to believe them ignorant of the powerful synergies. No, the culprits are the accountants who, fearful that the public might not accept this new shape of airliner, force European aviation into the graver danger that a mid-winged V-tailed Boeing could offer decisively better economics.

NOEL FALCONER
Stockport, Cheshire, UK

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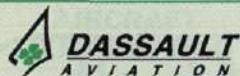


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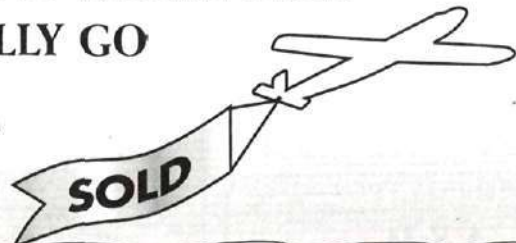
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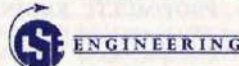
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