

Evidence of the Hijack of Malaysian Airways Flight MH370 using the Boeing-Honeywell Uninterruptable Autopilot

Introduction

The aim of this research document is to prove the technology, deployment and use of the Boeing-Honeywell Uninterruptable Autopilot (BHUAP) in the hijacking of Malaysian Airlines Flight 370 in the early hours of March the 8th 2014, whilst en-route from Kuala Lumpur in Malaysia to Beijing, China. **As Boeing has already admitted to such technology having been installed on its aircraft**, this paper will investigate the B777 flight systems and the avionics technology supplied by Honeywell and related companies to expose the history of the BHUAP and how it operates.

Using publically available information, the argument will take five principal forms:

Section 1

- Evidence by way of Media Reporting as to the existence and deployment of the Boeing-Honeywell Uninterruptable Autopilot and the Boeing and Honeywell Antihijack Patents

Section 2

- **Black Text** - Evidence by way of existing remote flight technology capable of the task, developed by Boeing, Honeywell and associated avionics and software companies
- **Blue Text** - Evidence by way of patents filed and approved to accomplish the task by Boeing, Honeywell and associated patent holders
- **Red Text** – Evidence by way of a combined analysis based on the patents and the as-installed technology aboard the B777-2H6ER with emphasis on how BHUAP works within these systems

Section 3

- Evidence by way of analysis of the flight path and system disruption of the B777-2H6ER flight MH370

To open, Honeywell filed for a patent in 2002 [US20030030581A1](#) (1) “Secure aircraft communications addressing and reporting system (ACARS)” - A method and apparatus that permit military aircraft operators to use the civilian Aircraft Addressing and Reporting System (ACARS) technology while ensuring data security. This invention relates to work done as part of the **Dual Use Science and Technology program under US Air Force Research Laboratory Agreement No. F33615-01-21808**.

The patent goes on to say “With the increase in automation, airlines, military, and civil aviation organizations are relying on ACARS for air traffic and operational control. **Unfortunately, automated information exchange between airborne and ground computers also increases the vulnerability of the system and may severely impact the safety of a flight or an air space.**”

“ACARS messages are transferred over open RF channels in human readable forms. Low cost, COTS equipment enables anyone to monitor and process ACARS messages. It is possible to determine aircraft type, condition, position, projected track, cargo content and operational details of the flight by analyzing ACARS messages. Aircraft operators would like to protect this information to maintain competitive advantage, **to ensure safety of flight and to reduce operational liability.**”

There was a clear concern by the US military about **unencrypted communication with modern aircraft computer systems**, not from a commercial point of view, but from something that could “severely impact the safety of a flight or an air space”. We will explore what that may have been.

Details of the Boeing 777 Servicing Flight MH370

On the 8th March 2014 Flight MH370 was serviced by a Boeing 777-2H6ER (ER stands for Extended Range and H6 is Malaysian Airlines designated customer code) with serial number 28420, registration 9M-MRO. (2) The 404th Boeing 777 produced since June 1997, it first flew on 14th May 2002, and was delivered new to Malaysia Airlines on 31st May 2002. (2) The aircraft was powered by two Rolls-Royce Trent 892 engines, and configured to carry 282 passengers and 10 crew. 9M-MRO had accumulated 53,460 hours and 7,525 cycles in service. On the night of the hijack there were 239 people on board.

Section 1 - Media Reports Regarding the BHUAP

Reporting on The Boeing Company

In response to Civil Case 3:07-cv-24 at District Court, District of North Dakota on 27 February, 2007 (Case entitled FIELD MCCONNELL v. ALPA and BOEING), **Boeing issued a statement to reporters documented on the 3rd March 2007 admitting to the existence of the Boeing Uninterruptable Autopilot.** This was extensively reported. For posterity Appendix 1 – London Evening Standard & The Daily Mail (3) (4) contains a dual article run on the 3rd March 2007 relating to **Boeing’s Uninterruptable Autopilot patent and Boeings statements confirming it.** The article opens with the lines “*The mechanism is designed to make it impossible to crash the aircraft into air or land targets - and enable the plane to be flown by remote control from the ground in the event of an emergency. Scientists at aircraft giant Boeing are testing the tamper-proof autopilot system which uses state-of-the-art computer and satellite technology*”.

The Boeing patent is [US7142971B2](#), (5) 19 Feb 2003 “System and method for automatically controlling a path of travel of a vehicle” where it is described as “*The method and system for automatically controlling a path of travel of a vehicle include engaging an automatic control system when the security of the on-board controls is jeopardized. Engagement may be automatic or manual from inside the vehicle or remotely via a communication link. Any on-board capability to supersede the automatic control system may then be disabled by disconnecting the on-board controls and/or providing uninterruptible power to the automatic control system via a path that does not include the on-board accessible power control element(s). The operation of the vehicle is then controlled via the processing element of the automatic control system. The control commands may be received from a remote location and/or from predetermined control commands that are stored on-board the vehicle.*”

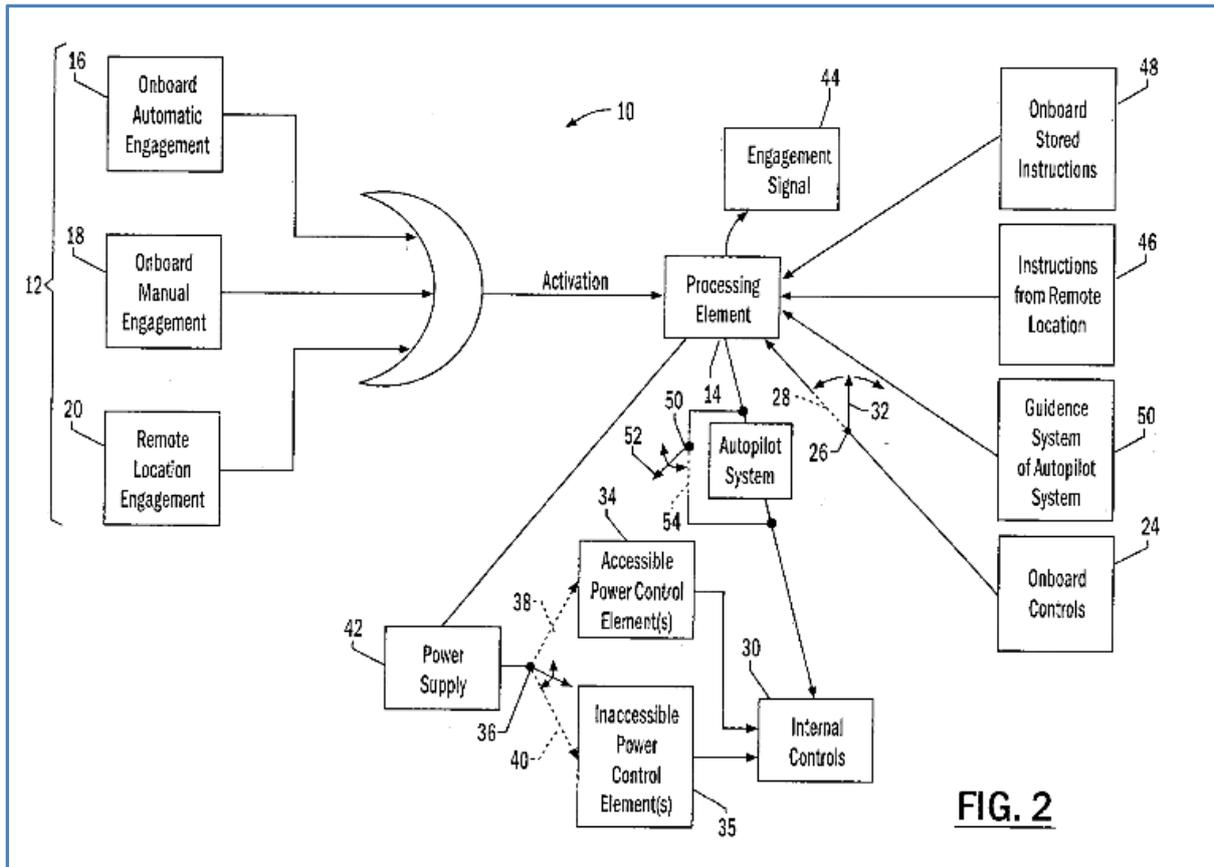


FIG. 2

Appendix 2 – Homeland Security News Wire (6) run on the 4th December 2006 and discusses the technology further: “Boeing’s is, of course, not the first autopilot technology in existence, but this one has been designed with counterterrorism first and foremost in mind. Not only is it “uninterruptible” — so that even a tortured pilot cannot turn it off — but it can be activated remotely via radio or satellite by government agencies. The system might even include sensors on the cockpit door that activate the autopilot of a certain amount of force is used against it. “There is a need for a technique that ensures the continuation of the desired path of travel of a vehicle by removing any type of human decision process that may be influenced by the circumstances of the situation, including threats or further violence on-board the vehicle,” the patent application explains. To make it fully independent, the system also has its own power supply, independent of the aircraft’s circuit breakers.”

Whilst reporting extensively on the disappearance of MH370, CNN’s Brian Todd discussed the idea during live coverage on the 29th March 2014 (7). During the coverage Todd remarked: “A lost signal, a vanished plane and on the ground a feeling of complete helplessness. But an idea has circulated to put auto pilot on passenger planes on remote control in stress situations. . In 2004 Boeing applied for a patent for a system referred to as uninterruptible autopilot.”

And later, “Has Boeing advanced this idea from ten years ago? Is the company still testing it out? Or has it scrapped the idea entirely? **We tried multiple times to get information from Boeing on this project. The company wouldn’t speak to us about it.**”

In Appendix 3 – Excerpt from “The Terror Conspiracy Revisited” (8), Jim Marrs writes about the Boeing Uninterruptable Autopilot **existing in 1995**:

“Former German Defense Minister Andreas von Bülow, in a January 13, 2002, interview with the newspaper Tagesspiegel, in speaking about the 9/11 attacks, noted, “There is also the theory of one British flight engineer [and] according to this, the steering of the planes was perhaps taken out of the pilots’ hands from outside.

The Americans had developed a method in the 1970s whereby they could rescue hijacked planes by intervening into the computer piloting [the electronic flight system]. This theory says this technique was abused in this case.” Von Bülow could well have knowledge of this technology as several researchers and websites have stated that Lufthansa, Germany’s national airline, was aware of the possibility of electronic capture and had quietly stripped the flight control systems out of its American-built jetliners in the early 1990s.

The British flight engineer Von Bülow mentioned is Joe Vials, a journalist, author, private investigator, and a former member of the Society of Licensed Aeronautical Engineers and Technologists based in London. “

Von Bülow was referring to the **23rd of October 1970**, Tool O K Incorporated patent [Autopilot system controlling entry of a craft into forbidden zones US 3749335 A \(9\)](#) – **“In combination with the autopilot system of an aircraft, an on board control system, inaccessible to the pilot, responds to ground transmitted or on board computed geographical position signals to restrict pilot heading or descent manoeuvres when the aircraft enters a forbidden geographical zone.”** The technology used to accomplish this patent was further enhanced as navigational aids and digital flight technology was perfected, resulting in the BHUAP.

In 2001, Joe Vials’ article “France, Russia, Germany Responsible for 9-11” [\(10\)](#) discussed the Boeing Uninterruptable Autopilot. Vials research has credibility as he was writing about it **some 5 years before** the patent was made public in 2006.

“During early 1995, Boeing sales experienced an unconnected but serious internal problem in Europe, though the details were never made public. The German flag carrier Lufthansa discovered that its new Boeing 747-400 aircraft had been fitted with flight directors [auto-pilots] that were vulnerable to American remote-control, ostensibly designed to “recover” hijacked aircraft whether the hijackers wanted to be recovered or not. Lufthansa was not informed about this “free extra” in advance, and was furious that its sovereign aircraft might be covertly “rescued” by America, without the knowledge or permission of the German Government.

In a mammoth operation rumoured to cost in excess of \$800 million, Lufthansa stripped every flight director out of every Boeing in its fleet, replacing them in total with German systems programmed by the Luftwaffe [German Air Force]. According to a member of the German internal security service in Frankfurt during October 1996, all Lufthansa aircraft had by that date been secured, rendering them invulnerable to remote flight director commands transmitted by any and all American authorities. Under the new intelligence protocols, Russia and France were made aware of these flight director risks.”

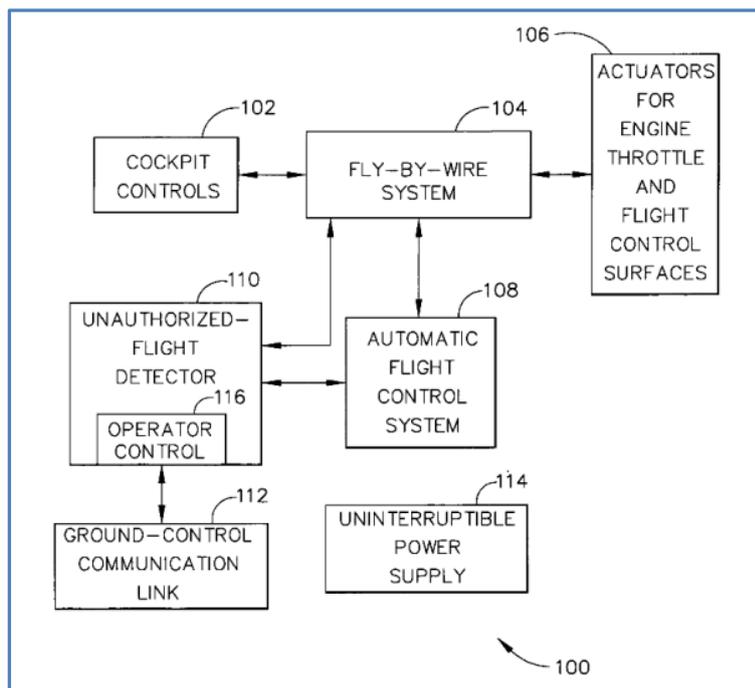
Reporting on Honeywell International

As early as **2005**, Boeing’s preferred avionics supplier, Honeywell, was reported by Stephen Trimble Appendix 4 – Flight International Magazine [\(11\)](#), to be talking to both Boeing and Airbus about fitting a device aimed at preventing a 9/11-style hijack.

Trimble reports “Honeywell’s marketing strategy for the “automatic” or “assisted” recovery system is focused on gaining acceptance with the Airbus A350 and the Boeing 787, with the former seen as the more natural candidate given Boeing’s philosophical objections to any system that overrides the pilot’s control of the aircraft.”

In fact, Honeywell was cited in Pilot Authority Denial patented technology as far back as 1970. The Tool O K Incorporated patent US 3749335A referred to in Von Bülow’s comments ‘American system designed to rescue hijacked jets’ was based on the Honeywell Regulator Company, 1956 Patent [US 2953329 A](#), (12) Automatic control apparatus for aircraft. A patent cannot cite another patent unless there is agreement between the two parties that the previously patented technology can be altered. Honeywell and Tool OK Incorporated would have discussed and agreed to this even prior to 1970.

On the 16th April 2003, Honeywell filed patent [US7475851B2](#) (13) “Method and apparatus for preventing an unauthorized flight of an aircraft” describing “A fly-by-wire (FBW) system (104) is coupled to cockpit controls (102) of an aircraft for controlling the aircraft, and an automatic flight control system (AFCS) (108) is coupled to the FBW system for maintaining the aircraft in stable flight. An unauthorized-flight detector (110) is coupled to the FBW system and coupled to the AFCS, and is arranged to carry out (306) a transfer of control of the FBW system from the cockpit controls to the AFCS, in response to a predetermined event.”



In a 2003 Wired News Report (14) also found in Appendix 5 – Wired News_it was reported:

“Airbus and Honeywell are close to perfecting technology that takes control of airplanes to prevent them from crashing into obstacles, The Wall Street Journal reports. When audible warnings from crash-avoidance systems are ignored, the system overrides actions by the pilot and takes evasive manoeuvres, the newspaper said.

The system would link crash-warning devices, already common on airliners, with cockpit computers that could automate flying to prevent collisions, executives from Honeywell (HON) said. Tests have

shown "promising results," but the idea of completely turning an airplane's controls over to a computer could make people nervous.

European airplane maker Airbus, owned by EADS (EAD) and Britain's BAE Systems, has been working on the project with Honeywell for years, although development sped up after the Sept. 11, 2001 hijacking attacks. The team may have beaten NASA, the Pentagon and Boeing to the finish line."

The quote from Airbus clearly reveals that **Pilot Authority Denial systems were ALREADY BEING DEVELOPED by Honeywell prior to 2001**, and as Vials claims, since the introduction of the Boeing-Honeywell AIMS-1 Flight Management System in 1995. Now it was Airbus' turn.

The Wall Street Journal article cited in the Wired News Report article can be found in Appendix 6 – The Wall Street Journal (2003). It goes further to explain a system very closely resembling BHUAP:

"Airbus, the big European jet maker, and Honeywell, an aerospace and industrial manufacturer in Morris Township, N.J., have been working on the so-called Auto-Avoid principle for years. That effort accelerated after the Sept. 11 attacks and is particularly timely in light of recent government warnings of possibly more suicide hijackings of planes. The National Aeronautics and Space Administration, the Pentagon and rival jet maker Boeing Co. are all pursuing their own research into crash-prevention devices, but none are believed to be as far along as Honeywell and Airbus." (15)

This report will later show that Boeing had in fact beaten Airbus in the implementation of the BHUAP by 8 years at the time that The Wall Street article was written.

"Taking that principle to a new level, the latest technology allows an aircraft's computers to instantly seize control when such audible warnings are ignored, or when a plane tries to enter computer-generated "no-fly zones" around skyscrapers, monuments and government buildings. The system would override pilot commands if necessary and, on its own, take evasive action. "If a pilot veers off course" substantially for any reason and fails to respond to repeated warnings, "the airplane will take over and fly" the correct path, says Robert Johnson, chief of Honeywell's aerospace unit."

This is exactly the BHUAP modus operandi that this report will allege took MH370, heard from the horse's mouth. This matches the 1970's patent involving Honeywell's Flight Management System (FMS) and matches the 2002 & 2003 patents applied for, and granted to Honeywell and Boeing. Embedded into Boeing in 1995 through the Honeywell FMS, and subsequently finding its way into Malaysian Airlines flight MH370.

"Eventually they [Pilots] may embrace the Auto-Avoid system, but "only if there is some way it can be turned off by the crew," said John Cox, air-safety chairman of the Air Line Pilots Association.

But allowing crew members to disable it would defeat one of the main purposes, to thwart hijackers. Since few other industry initiatives boast both safety and security components, the system is a natural for continued funding." (15)

Section 2 – Technology, Patents and As-Installed Systems on MH370

A Forward to the Boeing Honeywell Uninterruptable Autopilot (BHUAP)

As we strip down the 777 avionics architecture it is crucial to note that the B777 operates through a COMPLEX, DIGITALLY INTEGRATED FLIGHT MANAGEMENT SYSTEM. There are many contributors to the B777 avionics. The autopilot for example was made and programmed by Rockwell Collins, however the autopilot is only a slave to further control systems. **The Boeing Uninterruptable Autopilot IS ROOTED IN THE SOFTWARE CODING that governs how the Flight Management System operates, in particular the Unauthorized Flight Detector routines, not in one particular slave system such as the autopilot.**

To understand the “UNINTERRUPTABLE” is to understand how the SOFTWARE REMOVES OTHER SLAVE SYSTEMS to ISOLATE the autopilot from on-board Pilot Authority without rendering the aircraft vulnerable to system failure through loss of redundancy (ie. loss of safe autopilot navigation and control).

The Development of Boeing and Honeywell Technology that was Installed on MH370 at the Time of the Disappearance.

Despite Boeing’s 2007 admission as to their intention to install the Boeing Uninterruptable Autopilot on all civil aircraft by 2010, let us have a look at how long such technology has been in existence, so as to verify Joe Valis’ claims that this technology had been installed in Boeing aircraft through the Honeywell Flight Management System since 1995.

As Honeywell is the preferred avionics and flight management systems supplier to Boeing we will concentrate on the contributions that these industry leaders have made in the development of the necessary Remote Flight Technology specifically needed for the BHUAP.

1954 – Boeing Remote Control Unmanned Aerial Vehicles

Boeing was working with NASA and other companies and agencies after the WW2 to advance long-distance remote control flight technology. The Department of Defence had plans for a fleet of remotely piloted intercontinental bombers.

Importantly, one aim of the project was to create an effective method and means by which the flight of one separately power driven airplane may be controlled directly pilot in a separate airplane may accompany and control an aerodyne, such as a large airplane on a long distance bombing mission or the like without subjecting himself to the intense vulnerability usually encountered.

It is alleged that MH370 was under the influence of such technology (BHUAP) undertaken by an AWACS related to the Cope Tiger joint exercises being conducted in the Gulf of Thailand at the time.

Boeing’s patent for this technology was filed in 1954 as [US2883125 A](#) (16) conspicuously named “Composite Aircraft - This invention relates to a method and means for controlling aircraft flight, and more particularly the flight of a pilotless airplane... The guidance of aerodynes, such as pilotless airplanes by remote control through radio means and the like **has reached an advanced stage** but is not well suited for long distance flights...”.

1956 - Boeing-Honeywell Autopilots

The history of autopilots date back to World War 1, developed by Sperry Corporation in 1912 and patented in 1916 as [US 1415003 A](#) (17) Automatic pilot for aeroplanes. “The autopilot connected a

gyroscopic heading indicator and attitude indicator to hydraulically operated elevators and rudder... It permitted the aircraft to fly straight and level on a compass course without a pilot's attention, greatly reducing the pilot's workload.”

Eventually in 1986, Sperry Flight Systems was absorbed into Honeywell Inc however Honeywell's first autopilot patent was [US 2953329 A \(18\) Automatic control apparatus for aircraft](#), filed in 1956.

Honeywell is today's leading manufacturer of avionics equipment. *“Honeywell Aerospace began in 1914. Over nearly a century, through various acquisitions, mergers and name changes, Honeywell Aerospace combined legacy companies Sperry, Bendix, Garrett AiResearch, Pioneer, Lycoming, Grimes, King Radio (Company) and Allied Signal. Garrett Corporation also acquired Aero Engineering Inc., Aero Sales Engineering, Ltd. and Air Cruisers Company in 1954. Following the death of its founder John Cliff Garrett in 1963, Garrett Corporation merged with Signal Oil & Gas Company to avoid a hostile takeover by Curtiss-Wright, forming The Signal Companies. In 1982 Allied Corporation acquired Bendix Aerospace after coming in late in a protracted fight involving Bendix, Martin Marietta, and United Technologies. In 1985 The Signal Companies merged with Allied Corporation forming Allied-Signal Inc. Allied-Signal (later renamed to Honeywell International in 1999) now includes [what was (in 1986) called] Honeywell Inc., and in 1986 Honeywell Inc. acquired Sperry Aerospace for \$1.025 billion. Allied-Signal acquired the Lycoming Turbine Engine Division of Textron in 1994, and Grimes in 1997. Allied-Signal acquired Honeywell in 1999, and changed the name of the resulting company to Honeywell International.”* (19)

As you can imagine this has given Honeywell and subsequently Boeing a large pool of patents.

It is important to re-iterate here that BHUAP has two components, the hardware and the software. Both these components lie within the scope of each patent. The MH370 B777-200 contained an AFDS-770 Autopilot Flight Director System manufactured by Rockwell Collins. (20) The autopilot is a necessary component for BHUAP to operate however as previously stated it is a slave system to the software that directs aircraft navigation. We can therefore rule out the autopilot system as being individually capable of remote hijack. Honeywell worked closely with Boeing and additional programmer **Marconi Systems** to develop the B777 BHUAP software.

Software will be covered later however one can at this stage note: *“In addition to avionics, in 1970, Honeywell merged its computer business with General Electric's to form Honeywell Information Systems, which performed well in mainframe markets. In 1986, the personal computer emerged and the company formed Honeywell Bull, a global joint venture with Compagnie des Machines Bull of France and NEC Corporation of Japan. Its ownership level was gradually decreased until, in 1991, Honeywell was no longer in the computer business. **The company's digital computer knowledge was then applied to its traditional field of automation control, integrating sensors, and activators.**”* (19)

1958 - The Ring Laser Gyroscope

Sperry was manufacturing gyroscopes from around the turn of the century. The gyroscope is an integral part of any navigational and autopilot system. Honeywell invented and perfected the Ring Laser Gyroscope which uses fluctuations in the intensity of laser beams to determine acceleration on the three principal axes.



Honeywell states: “An early landmark commercial avionics technology was the **ring laser gyroscope (RLG)**, which was developed in 1958. Honeywell supported the “long and painful” development process, but was rewarded by the 1970s. Honeywell also developed the Laser Inertial Navigation system. Both RLG and the Laser Inertial System help navigation and automatic flight control systems measure altitude, position, velocity and rotation. By 1991, 45,000 RLG devices were sold” (19)

First patented in 1965, Honeywell’s RLG is an integral part of the B777 Air Data Internal Reference Unit. These units are integral to any modern autopilot system, providing accurate acceleration data for improved navigation and flight control.

Perfection of the RLG since 1991 enabled Honeywell to replace the QRS11 Gyrochip in its newer inertia systems facilitating the ability to export Flight Management Systems to a broader set of clients. The QRS11 is a military grade solid state gyro used mainly in missile applications and is subject to stringent US export restrictions.

1975 - Software and Programmability of Avionics Systems

Honeywell was working closely with NASA, contributing to both the hardware and **software** development necessary to facilitate the Glass Cockpit into Fly-by-Wire aircraft.

Ada 83 and Ada 95 Programming Language initiated by the Department of Defence in the latter 1970’s. “Ada 95 is a comprehensive high-level programming language especially suited for the professional development of large or critical programs for which correctness and robustness are major considerations. Ada 95 is a direct descendant of, and highly compatible with, Ada 83, which was originally sponsored by the U.S. Department of Defence for use in the **embedded system application area**. Ada 83 became an ANSI standard in 1983 and an ISO standard in 1987.” (21)

Honeywell worked with Marconi Systems in the early 1980’s to develop the FMS software for the Boeing 757 and 767, and with Reflectone Inc on the A310. Reflectone Inc later became CAE Inc, and Boeing now works directly with them to develop flight simulators for training purposes.

Whilst today programming languages have evolved further to incorporate the ARINC data protocol for fly-by-wire aircraft, the necessary functions and robustness necessary for FAA certification of the Honeywell Flight Management System using the Ada96 Language was obtained by 1984 which included accreditation of the software.

1980 - The Glass Cockpit Revolution in Avionics

“A glass cockpit is an aircraft cockpit that features electronic (digital) instrument displays, typically large LCD screens, rather than the traditional style of analogue dials and gauges. While a traditional cockpit relies on numerous mechanical gauges to display information, a glass cockpit uses several displays driven by flight management systems (programmable computers), that can be adjusted to display flight information as needed. This simplifies aircraft operation and navigation and allows pilots to focus only on the most pertinent information. They are also popular with airline companies as they usually eliminate the need for a flight engineer, saving costs.

As aircraft displays have modernized, the sensors that feed them have modernized as well. Traditional gyroscopic flight instruments have been replaced by electronic Attitude and Heading Reference Systems (AHRS) and Air Data Computers (ADCs), improving reliability and reducing cost and maintenance. GPS receivers are usually integrated into glass cockpits. In the latter 1970's, NASA conducted research with Honeywell, Boeing, McDonnell-Douglas and others on displays that could process the raw aircraft system and flight data into an integrated, easily understood picture of the flight situation, culminating in a series of flights demonstrating a full glass cockpit system. The success of the NASA-led glass cockpit work is reflected in the total acceptance of electronic flight displays beginning with the introduction of the MD-80 in 1979.

Early glass cockpits (found in the McDonnell Douglas MD-80/90, Boeing 737 Classic, 757 and 767-200/-300, and in the Airbus A300-600 and A310) used Electronic Flight Instrument Systems (EFIS) to display attitude and navigational information only, with traditional mechanical gauges retained for airspeed, altitude, vertical speed, and engine performance. Later glass cockpits, found in the Boeing 737NG, 747-400, 767-400, 777, A320 and later Airbuses, Ilyushin Il-96 and Tupolev Tu-204 have completely replaced the mechanical gauges and warning lights in previous generations of aircraft, although they still retain some analogue instruments as backups in case the EFIS displays malfunction.” (22)

By 1984 the FAA had approved Boeing-Honeywell's digital avionics and flight management systems for use in civil aircraft such as the Boeing 757, 767 and the Airbus A310, and in 1981 had authorised the reduction of the minimum flight crew number to 2, eliminating the flight engineer. Specifically, the Honeywell FMS certification test involved a 19 hour flight in a Boeing Seahawks 747 made in 1984 with the FMS programmed using NASA's ORACLS program developed at the Langley Research Facility. (23)

1980 - 1999 – Remote Control Technology: The Boeing Dark Star High Altitude Unmanned Aerial Vehicle

Using the knowledge gained **from the last 30 years of military research and development** with NASA under the Defence Advanced Research Projects Agency (24), **Boeing, Honeywell and Lockheed Martin** joined forces to compete against Northrop Grumman to develop an Unmanned Aerial Vehicle system for the US Defence Advanced Research Projects Agency (DARPA).

The concept of aircraft-based UAV's first became a reality in 1915 where they were used as aerial targets. Follow [this link](#) (25) for a fuller history of UAV's.

“In 1994, Boeing teamed with Lockheed Martin again to design and build a stealthy, unmanned reconnaissance plane called DarkStar for the U.S. Department of Defence Tier III Minus program. Boeing applied its expertise in unmanned aerial vehicles (UAV), **gained over three decades of UAV experience**, to develop the Dark Star's wings **and integrated avionics.**” (26) See [Wikipedia, Dark Star](#) (27)

On the 29th March, 1996 the Dark Star made its fully autonomous maiden flight. Boeing describes the Dark Star's technology:

“The DarkStar was **fully autonomous**: it could **take off, fly to its target, operate its sensors, transmit information, return and land without human intervention.**” (26) Wikipedia states: “Human operators, however, **could change the Dark Star's flight plan and sensor orientation through radio or satellite relay.**” (27)



It goes on to say: “Although purportedly terminated on January 28, 1999, it was reported in April 2003 that the RQ-3 [Dark Star] was still in development as a black project. The size and capabilities were reported to have increased somewhat. It was further alleged that the first such example had been used in the 2003 invasion of Iraq. There has been no independent confirmation.” (27)

Although the unstable airframe finished off Dark Star, the resulting BHUAP remote control software and avionics were successful. This facilitated a continuation of the black project and also saw the software incorporated into the Honeywell Pegasus Flight Management System in 1980, released in 1984, forming the FMS for the B757, B767 and the A320.

1980 – Boeing-Honeywell B757 & B767 Flight Management Systems

Digital fly-by-wire aircraft and the glass cockpit systems are essentially software driven. Drawing on their past experience in developing the flight management systems for the Apollo and Dark Star

programs, both Boeing and Honeywell were the main driving force behind the introduction of digital autopilot technology into the civil aviation sector. Honeywell's original flier for the first FMS to offer complete en-route optimisation of a flight path can be found in Appendix 7.

Honeywell's 1984 patent [EP0186965A1](#) (28) describes a "Digital fail operational automatic flight control system utilising redundant dissimilar data processing" which formed the basis of the Flight Management System, augmented with 1985 patent [US4787041A](#) (29) "Data control system for digital automatic flight control system channel with plural dissimilar data processing".

Honeywell's 1986 patent [US4760530A](#) (30) "Flight management system providing minimum total cost" describes "the invention relating to Flight Management Systems (FMS) providing minimum total cost flight profiles particularly with respect to accounting for arrival error cost functions."

Boeing's 1995 patent [US5842142A](#) (31) "Least time alternate destination planner" which is "An alternate destination planner for searching a navigation database in an aircraft and identifying a plurality of alternate destinations at which the aircraft can land in the event of an emergency. For each identified alternate destination, the alternate destination planner calculates an estimated time of arrival (ETA) and an amount of fuel remaining upon arrival at the destination. The calculation of the ETA and the remaining fuel is based on user-modifiable parameters of aircraft speed, aircraft altitude, wind direction and speed, outside air temperature, **and the type of routing the aircraft will follow from a diversion point to the alternate destination.** The plurality of alternate destinations are displayed to a pilot of the aircraft according to the ETA to each alternate destination, with the closest alternate destination by time listed first. The plurality of alternate destinations are also displayed to the pilot on a map of the surrounding region that is provided to the pilot on a navigation display. A pilot may select and divert to one of the plurality of alternate destinations using a minimal number of keystrokes on a control display unit."

BHUAP being built into the software as an "emergency situation" would hardly stretch the truth. This would invoke the Alternative Destination Planner to divert to an airfield that was capable of resolving a hijack incident and where commercial interests and the public were kept safe, such as a military base.

A fuller explanation of the Flight Management System is necessary here to explain the origins of some key BHUAP features, such as the introduction of digital avionics and flight route planning, satellite communications and satellite navigation.

In the Q2-2009 of Boeing's Aero Magazine, (32) Boeing sums up the development of the FMS as follows:

*"Performance Based Navigation is a concept used to describe navigation performance along a route, procedure, or airspace within the bounds of which the airplane must operate. For transport airplanes, it typically is specified in terms of required navigation performance (RNP). The PBN concept defines navigation performance in terms of accuracy, integrity, availability, continuity, and functionality. These operations provide a basis for **designing and implementing automated flight paths** that will facilitate airspace design, terminal area procedure design, traffic flow capacity, and improved access*

to runways (more information about PBN can be found in *AERO second-quarter 2008*). The PBN concept is made possible largely by advances in the capabilities of airplane FMS.”

Air Navigation Tools Leading Up to the FMS

In the 1940s, the introduction of a radio-magnetic indicator or dual-bearing distance-heading indicator facilitated the use of ground-based nav aids, including the very-high-frequency omnidirectional range (VOR) navigation system and distance measuring equipment (DME). VORs came into wide use in the 1950s and quickly became the preferred navigation radio aid for flying airways and instrument approaches. VOR and DME provided the framework for a permanent network of low-altitude victor airways (e.g., V-4) and high-altitude jet routes (e.g., J-2), which are still in place today.

Long-range navigation over remote and oceanic areas, where navigation radio transmitters did not exist, was originally accomplished by dead reckoning and celestial navigation. The introduction of the **inertial navigation system (INS)** on airplanes facilitated long-range capability by providing a continuous calculation and display of the airplane’s position. Flight crews could enter waypoints and the INS would calculate heading, distance, and estimated time of arrival to the respective waypoint.

Boeing’s initial entry into this arena was represented by the implementation of **the early Sperry (now Honeywell) automatic navigation systems on the 727, 707, and 747-100**. During this same time, Collins produced the AINS-70, an area navigation (RNAV) computer on the DC-10. Each of these steps reduced the amount of interpretation by the flight crew by presenting more specific indications of airplane positional and situational status. Even so, the reliance on the flight crew to manually interpret and integrate flight information **still provided opportunities for operational errors.** (32)

The First Integrated Flight Management Computer

When Boeing began work on the 767 airplane program in the late 1970s, the company created a flight deck technology group with engineers dedicated to the development of the flight management computer (FMC) and the control display unit (CDU). **Boeing merged previous designs of the performance management computer and the navigation computer into a single FMC that integrated many functions beyond navigation and performance operations.** The company used experience gained from **Boeing’s other research projects to develop advanced implementations of performance management functions and navigation into a single FMC.** The new FMC system was envisioned as the heart of an airplane’s flight planning and navigation function. (32)



Figure 2: 757/767 FMC CDU

One of the first implementations of an FMC CDU was designed for the 757 and 767 in the early 1980s.

*While Boeing [and Honeywell] was continuing work on new commercial airplane navigation systems for the new “glass” flight decks, a debate was under way among the airlines about the need for a dedicated flight engineer crewmember. In July 1981, an industry task force determined that two-crew operation was no less safe than three-crew operation. This decision would have a profound effect on the design of all Boeing commercial airplanes, including a short-notice implementation for the new 767. With one fewer crewmember, Boeing engineers **focused on a flight deck design that would reduce crew workload, simplify older piloting functions, and enhance flight deck efficiencies.***

*Then, as now, the navigation function was based on the IRS position and used ground-based nav aids (e.g., DMEs, VORs, localizers) to refine the IRS position and correct for IRS drift. **A navigation database (NDB) was included in the FMC’s memory and contained approximately 100 kilobytes of data consisting of nav aids, airways, approach procedures, and airports.** The NDB allowed flight crews to easily enter flight plans **from takeoff to landing and make real-time route changes in response to air traffic control (ATC) clearances.** The FMC also provided guidance to the flight plan route using the lateral navigation (LNAV) and vertical navigation (VNAV) functions. Initially, the FMC was equipped with LNAV only. VNAV was a new challenge and required a significant effort on the part of Boeing and Sperry (now Honeywell) engineers to make the vertical guidance component operational. (32)*

1980 to 1995 – Honeywell Flight Management System 1 and Fully Integrated Avionics

Honeywell describe the development of the same Flight Management System from their perspective in a 2014 article “[The Evolution of Flight Management](#)”. (33)

“The year: 1980. The mission: develop a new digital avionics system for pilots to plan and automatically fly a 3-dimensional flight trajectory optimized to provide the most efficient route possible. Success would have a number of industry-changing benefits:

- *Crew workload would be safely reduced to the point where air transport crew size could be reduced from 3 to 2*

- Aircraft position would be automatically calculated and would be more accurate than past systems
- Full flight trajectories would be flown automatically
- The system would understand the unique aerodynamic characteristics of the airframe and the engines so that it could minimize fuel burn or minimize time, or strike a pilot-defined balance between the two.

*It was a tall order, to be sure. The engineers at Sperry Flight Systems (a Honeywell legacy company) embarked upon this challenge with **two initial customers; Boeing and Airbus. The Boeing target platforms were the 757 and the 767, while for Airbus it was the A310.***

Providing solutions

*The new system, dubbed the “Flight Management System,” or FMS, became a major undertaking. The **hardware platform included a Honeywell-build digital processor card (the SDP-175), and this processor became the execution engine for the biggest software development program the company had ever undertaken.***

*A new user interface was required to allow the entry and display of FMS alphanumeric data, and the solution was the Control and Display Unit (CDU); **the first true computer terminal in an air transport aircraft.** The CDU proved to be such a benefit **that later versions were modified to allow other avionics systems to connect to the CDU and use its data entry and display capabilities,** and the CDU was then renamed “Multifunction Control and Display Unit,” or MCDU. The MCDU went from a monochrome display to colour on the A320 program. (33)*

Understanding new technology



As complicated as the FMS was, its capabilities can be summarized into four functions:

- *Flight Planning – defining where the airplane needs to fly*
- *Navigation – figuring out where the airplane is, along with its velocity*
- *Guidance – looking at where the airplane is supposed to be (flight plan), then using the current aircraft position and velocity to control the airplane to the flight plan*
- *Performance – calculate the optimum trajectory for the aircraft to fly and provide predictions for all the waypoints in the flight plan*

*The FMS included two databases: a **Navigation Database** and a **Performance Database**. The **Navigation Database** contained detailed information for possible flight plan waypoints, airports, departure and arrival procedures, and radio navigation aids, or “navaids.” The **Performance Database** was actually two databases: the aerodynamic model of the airframe and the engine model that gave detailed performance characteristics of the propulsion system. (33)*

The addition of a comprehensive navigational database would turn out to be an additional tool in the BHUAP arsenal. This would occur after 1995 when flight systems began to calculate their own flight paths independently of the pilots, who only needed to check the FMS generated flight route and either accept or amend it.

Improving operations

The FMS navigation function provided a major operational improvement to the crew. The function performed an automatic calculation of aircraft position by first using ground-based radio nav aids to calculate a radio position, then mixing this position with the aircraft position calculated by the Inertial Reference System.

*The mixing algorithm used each position solution to minimize the position error that is inherent in each individual position calculations, and thereby yielded an aircraft position solution that was more accurate than either radio or inertial position alone. **In addition, it didn't require any crew involvement. The FMS even automatically determined the best nav aids to use and tuned them automatically.** (33)*

Details can be found in patent [US6473675B2](#) (34) "Aircraft communication frequency nomination", described as "an aviation signal nominating device includes a position receiving component that receives position data indicating a position of the aircraft, an aviation signal receiving component that receives a plurality of aviation signals associated with an aviation facility, each aviation signal having a prescribed frequency, and a nominating component that nominates at least one but not all of the plurality of aviation signals as a nominated aviation signal likely to be of interest to a pilot based on the position of the aircraft."

Certification and continued evolution

*The initial FMS programs were **certified in 1984**. The FMS became a baseline system for all new air transport aircraft and was retrofitted on a number of platforms over time. The system also migrated to the business jet market. **In the late 1980s, the need to move data between the FMS and the ground** was satisfied with ACARS (Aircraft Communication Addressing and Reporting System). **The airline operations centre could now upload flight plans, along with wind and weather data, to the FMS.** . (33)*

The original 'mission' to develop a new digital avionics system to plan and automatically fly a 3-dimensional flight trajectory was the necessary foundation upon which the BHUAP could be constructed. The last major element still missing was the ability to navigate accurately enough to automatically land a CIVIL aircraft. This had already been accomplished by Boeing and Honeywell in the Dark Star UAV using military technology.

1990 – Honeywell perfects GPS Autoland System

George Lewison comments on the 1996 issue of Avionics Magazine: "Honeywell has for years been extremely interested in navigation utilizing the Global Positioning Navigation satellites. In the early 1980s Honeywell began development of a GPS receiver autonomous integrity monitoring algorithm called (RAIM). This Honeywell-developed algorithm allows for the automatic detection and exclusion of faulty satellite data from the GPS navigation solution without requirement for action by the crew.

In 1987, Honeywell developed the first integrated Inertial Reference and Global Positioning System in order to conduct testing of autoland systems for NASA. A Honeywell-equipped NASA Boeing 737 performed the first GPS guided automatic landing proving that DGPS landings were possible. In the fall of 1990, Honeywell and NASA made 34 Category III landings using the Honeywell IRS/DGPS integrated landing system." (35)

The test aircraft here used an Inertial Reference System containing the QRS11 Gyrochip.

1991 - The QRS11 Gyrochip

The QRS11 Gyrochip is a single-axis analogue solid-state quartz rate sensor. It's simply an output device that when voltage is applied, it will output the axis spatial acceleration the sensor detects as a DC voltage, **to be interpreted by a program**, and translated into real time acceleration. Further processing and monitoring over time can thus calculate the direction and speed at which the sensor is travelling.



Systron-Donner explains: *“The QRS11 is a compact, lightweight design, that features Quartz MEMS technology providing a solid-state gyro offering virtually unlimited life. The QRS11’s combination of high performance and long life makes it well suited for OEM’s and system integrators designing cost effective, high performance systems.*

*The QRS11 requires only DC voltage inputs to provide reliable, extremely accurate angular rate measurements with the benefit of no moving parts. With a hermetically sealed sensing element, the QRS11 has provided **reliable performance in aircraft, missile and space systems** across many demanding application environments.” (36)*

The QRS11 Gyrochip was classified as military grade hardware which Honeywell and Boeing (and many others) used in the ballistic missile and UAV navigation systems. Essentially QRS11 falls under the Missile Technology Control Regime and any export license granted to Boeing is subject to: <http://www.armscontrol.org/documents/mtcr> (Category II Items 9, 10, 11) all of which are under the Wassenaar Arrangement (37) of which Category 7 – Navigation and Avionics pertains to the QRS11.

Early Honeywell avionics systems may have used the QRS11 in the Air Data Inertial Reference Unit and the Secondary Attitude Air Data Reference Unit through their legacy company Systron Donner, before GPS became accurate enough for use in the USA (June 2000) and for transcontinental flight.

The B777-200 uses an advanced ring-laser gyro in the Air Data Inertial Reference Unit and the Secondary Attitude Air Data Reference Unit. It was not likely that the QRS11 was used in the B777-2H6ER.

As DGPS and ring-laser gyro technology has advanced, the QRS11 Gyrochip is no longer considered (since 2002) an essential item for the BHUAP. Prior to 2002 however it does indicate the inclusion of a military-grade inertial reference system into a civil aircraft, for example it was retrofitted along with

the Honeywell Digital Flight Data Acquisition Unit (38) to B737, B747, B757 and B767 aircraft, the Parts Manufacturer Approval being received on the 25th June, 2001. **Whilst the Flight Air Data Unit was essentially a system for the black-boxes, it does put the QRS11 at the scene where aircraft without the QRS11 in the ADIRU could be ‘upgraded’ and so make better use of the Honeywell AIMS-1 BHUAP software already programmed into it as per the 1970 patents, giving aircraft a means of accurate navigation for remote control flight.**

1992 Preserving America’s Military Advantage Through Dual-Use Technology

In the late 1980’s and early 1990’s, the Department of Defence was becoming increasingly aware that US defence technology was no longer superior to the technology available in the commercial sector. In a report to The Whitehouse in 1992 the Department of Defence made the following observations:

“...These new threats, if anything, increase the need for fast, flexible mobile forces equipped with the most advanced weapons systems.

Technology is the key. Since World War II, U.S. military superiority has been based on our technological advantage, as was plainly demonstrated in the Persian Gulf War. Technology will be even more important in the uncertain and unstable environment we now face. To maintain its technological advantage, the Department of Defence (DoD) must break down the barriers created over the last 30 years between the defence and civilian sectors. Because of DoD's overreliance on military specifications and because of the crush of a needlessly cumbersome procurement system, many commercial firms refuse to do business with the Department of Defence altogether, and those that do often wall off their defence production. DoD, as a result, has become reliant on an increasingly segregated defence industrial base.” (39)

1993 The Technology Reinvestment Project (TRP)

The TRP was unveiled by President Clinton in early 1993. The TRP awarded matching funds to industry-led projects, selected purely on the basis of merit, to develop new dual-use technologies that met defence needs. *“The program's success to date is encouraging. A key to its success is the emphasis on partnerships: the TRP has created unprecedented linkages for technology collaboration and business partnership among defence and commercial companies, small and large firms, and universities and laboratories. A second emphasis is cost-sharing. This cost-share ensures industries commitment to the project and lays the foundation for industry to assume the total cost of production development.”*

“Since October 1992 the Institute for Defence Analyses has assisted the Advanced Research Projects Agency (ARPA) with economic advice and recommendations regarding the Technology Reinvestment Project (TRP) under the task entitled "The Economic Impacts of Technology Investments." The purpose of the TRP is to promote integration of the commercial and military industrial bases to improve the affordability of weapons and systems while also contributing to the commercial competitiveness of U.S. industry through dual-use technology investments.” (40)

The mission of the TRP was to give the Department of Defence greater access to affordable, leading-edge technology by leveraging commercial know-how, investments and markets for military benefit.

TRP co-funded projects were of two types, the first being those that leveraged commercial technology to meet defence needs **and the second were projects termed ‘Transitioning Defence Technology’.** **The second type of project promoted the transitioning of defence technologies back to commercial**

applications, making the technology more affordable and accessible to the military (such as Honeywell selling Air Data Inertial Reference Unit containing the military grade QRS11).

As both Boeing and Honeywell were actively researching and producing UAV technology for the Department of Defence it stands to reason that the BHUAP hardware and software came from these programs. Both Boeing and Honeywell are not in the business of wasting money developing civil and military hardware independently, especially when the relaxing of Dual-Use technology laws permitted them to on-sell co-funded military technology to the commercial sector.

To be specific, the cost of the hardware and software routines developed for DoD programs such as Dark Star (which was initially rejected by DARPA), could legally be recouped by including such hardware and software in future aircraft and avionics systems.

This in itself was not BHUAP. That came later when the technology was exploited. However it does provide a legitimate pathway that such BHUAP technology could pass into civil aircraft systems.

One such way was a 1995 competition announced on 21st October 1994. \$415 million in matching funds would go towards 12 dual-use focus areas. Two of these areas were:

- Microelectromechanical systems (MEMS) applications – Demonstration and insertion of MEMS technology into defence and commercial applications (eg. inertial sensors)
- Affordable controls technologies – development of affordable, advanced digital electronics and control technologies for enhanced military systems and industrial automation”

Clearly the Honeywell DGPS ADIRU augmented by the QRS11 fits the first category and development of the full-flight from take-off to landing Honeywell AIMS-2 (covered in the next two sub-sections) fits the bill for the second.

Coinciding with this were new 1994 FAA Minimum Aviation System Performance Standards governing Required Navigational Performance of BOTH civil and military aircraft. Military aircraft were not equipped to use DGPS and could not integrate into the civil aviation network or ILS (Instrument Landing Systems) easily, and did not meet the new FAA standards. Civil aircraft could not be used by the airforce to land on military airstrips in the reciprocal spirit of dual-use technology as the ILS (Instrument Landing Systems) used by the military were different from those in the civil sector.

The spin-off from DoD funding both the QRS11 equipped ADIRU and the DGPS augmented JPALS (Joint Precision Approach Landing System), was that military aircraft could navigate and land in civil airspace as now required by FAA introduced law, the cost of which was supplemented by Rockwell Collins developing the JPALS and Boeing-Honeywell providing both civil and military aircraft with QRS11 augmented ADIRU navigation including built-in DGPS.

Boeing and Honeywell had a close relationship with the Department of Defence where for 40 years prior they had jointly developed space, missile and unmanned aerial vehicle navigation and flight control systems, mostly programmed in Ada-95. Boeing and Honeywell's intention was to reuse the intellectual property they had developed over decades rather than start something completely new and from scratch, which makes perfect and legitimate sense from a corporate and financial point of view

The regulatory conditions were right for military accessible remote-flight hardware and software systems to find their way into civil aircraft.

1995 Honeywell's Differential GPS Satellite Landing System

George Lewison comments on the 1996 issue of Avionics Magazine: *“In January of 1995, Honeywell and Pelorus Navigation Systems Inc. of Calgary, Canada, joined forces to develop and manufacture a Differential GPS (DGPS) Ground Station to be called the Satellite Landing System. The ground station equipment is available in two configurations, the SLS-1000 and the SLS- 2000. Both systems are comprised of three major subsystems: 1) Ground Reference Station 2) Remote Satellite Measurement Units 3) VHF Data Link Transmitter*

*The Teaming of Honeywell and Pelorus Navigation Systems of Canada was a good choice as Pelorus had an extensive background in installation and training for approach aid technology. With this type of background, the **Honeywell team participated in Boeing's Category III-b flight test evaluation program in July and August of 1995.** NASA supplied the 757 aircraft and flight test facility. Boeing supplied the pilots, ground crew, maintenance, flight test personnel and performed the aircraft modifications for the flight tests.*

*The flight tests were accomplished at NASA's Wallops Island, Virginia, flight test facility. **A total of 75 Category III-b automatic landings were accomplished during this phase of flight testing. The Honeywell DGPS landing system replaced the standard ILS instrument landing system for these test flights.** The DGPS landing system provided equivalent lateral and vertical guidance signals to the aircraft's autopilot. The autopilot used the DGPS to guide the aircraft to a landing and then continued to use the DGPS signals to provide lateral guidance to keep the aircraft centered on the runway during roll out.*

*Preliminary performance data of these flight tests showed that the Honeywell DGPS landing system **achieved the predicted system accuracy of one to two meters.** The analysis of these results have been used to help create the requirements for the impending certification of the DGPS precision landing system.” (35)*

1995 – Honeywell Flight Management System 2 and Fully Integrated Avionics

In the 1990s, the global positioning system (GPS) prompted further modification to the navigation function, which provided even greater position accuracy. This accuracy could enable closer aircraft spacing in oceanic airspace, which would allow the flying of more efficient flight plans. The FMS used ACARS datalink via satellite to send position information to Air Traffic Control (ATC) and ATC would send clearances back to the aircraft. This capability, called FANS (Future Area Navigation System), is a baseline function on most long haul aircraft today.

Honeywell writes in their article “The Evolution of Flight Management” (33) *“The transition from MCDU (Multifunction Control Display Unit) textual flight planning to graphical flight planning over the last decade was a big one. **Pilots make flight plan changes on the cockpit map display using a cursor control device.** This has been a very well-received human factors improvement.*

In the late 1980s and 1990s, the airline industry requested the capability of direct routing from one location to another, without the need to follow airways based upon ground-based nav aids. Modern FMS equipped with a multi-sensor navigation algorithm for airplane position determination using VOR, DME, localizer, and IRS data made this possible, and RNAV was transformed from concept to operational reality. (35)

But oceanic operations and flight over remote areas — where multi-sensor updating of the FMC could not occur with accuracy better than the drift of IRS systems — made RNAV operations difficult. Operations in these areas of the world were increasing during the 1990s, and there was pressure on avionics suppliers, airplane manufacturers, and regulatory agencies to find a way to support precise navigation in remote and oceanic areas. As a result, the concept of a future air navigation system (FANS) was conceived in the early 1990s (see AERO second-quarter 1998).

*Subsequently, Boeing and Honeywell introduced the first FANS 1-capable FMC. At the heart of the system was a new, more capable FMC that **implemented several new operations**:*

- ***Airline operational communications — Digital communication of data (data link) such as text messaging, weather data, and flight plans directly from the airline operations facility to the FMC.***
- *Controller-pilot data link communications — Digital communication between ATC and the airplane in the form of **predefined messages**.*
- ***Automatic dependent surveillance** — Information about position and intent generated from an ATC request.*
- ***Global positioning system (GPS)** — Incorporation of satellite navigation functions in the FMS for the **primary means of navigation**.*
- *Air traffic services facilities notification — ATC communication protocol initialization.*
- *RNP — A statement of the navigation performance necessary for operation within a defined airspace.*
- *Required time of arrival — Enablement of airplane performance adjustments to meet specified waypoints at set times, when possible.” (35)*

The digital data communications link provides an airline operator to directly upload new software and alternate flight plans directly to the Flight Control Computer from a remotely based facility (such as Boeing HQ or an AWACS).

*“Although each feature was individually significant, the three primary enablers for FANS operations were RNP, GPS, and data link. RNP defined the confines of the lateral route, and the FMC provided guidance to reliably remain on the route centreline. The FMC’s RNP function also provided alerting to the flight crew when this containment might not be assured. **GPS was originally a military navigation sensor that was allowed for commercial use with some limitations.** Integrated as the primary FMC position update sensor, GPS provided exceptionally precise position accuracy compared to ground-based sensors and enabled the FMC’s capability for precise navigation and path tracking. GPS remains the primary sensor for the current generation FMCs. Data link provided a reliable method of digital communication between the airplane and the air traffic controller. A comprehensive list of preformatted messages was implemented to provide for efficient traffic separation referred to as controller-pilot data link communications.*

Concurrent with the FANS 1 FMC, Alaska Airlines teamed with Boeing, Smiths Aerospace (now GE Aviation), and the FAA to develop procedures that would provide reliable access to airports that are surrounded by difficult terrain. By virtue of the surrounding rough terrain, the Juneau, Alaska, airport became the prime candidate for the certification effort. Because the approach to runway (RW)

26 was the most challenging air corridor to Juneau, it was selected as the most rigorous test to prove the real performance capability of RNP ([see fig. 3](#)).

In 1995, Alaska Airlines successfully demonstrated its ability to safely fly airplanes to RW 26 using RNP and soon began commercial operations using RNP, which was a first for commercial aviation.

Figure 3: Juneau, Alaska: Site of initial RNP certification efforts

RNP enabled an approach to runway 26 and access to Juneau that in some weather conditions was not otherwise practical.



RNP: ENABLER OF PBN

The concept of a reliable and repeatable defined path with containment limits was not new. Early conceptual work was done at the Massachusetts Institute of Technology in the 1970s, but the modern FMC, with its position accuracy and guidance algorithms, made reliable path maintenance practical.

The first demonstration of the FMC's terminal area precision came at Eagle, Colorado, in the mid-1980s. A team comprising American Airlines, the FAA, and Sperry (now Honeywell) applied RNP-like principles to approach and departure procedures to the terrain-challenged runway. Following simulator trials, the procedures were successfully flown into Eagle and subsequently approved by the FAA. The result: reliable approach and departure procedures that provide improved access to Eagle.

Although Eagle demonstrated the FMC's capability to execute precisely designed terminal area procedures, in the mid-1980s, it would take another 10 years until RNP equipment was available for airline operators. The FMC's navigation position accuracy enhanced with GPS and lateral and vertical guidance algorithms, the development of the vertical error budget, and additions to crew alerting enabled RNP and its future applications. " (35)

1995 to 2000 – The Aircraft Information Management System: Honeywell AIMS-1

The original AIMS system was the first integrated modular avionics system for the air transport sector and is still the most highly integrated one, consolidating the processing for 10 different aircraft systems. Inside the cabinets, the units are broadly differentiated by module type—such as core processing and I/O.

AIMS-1 core processing modules (CPMs) come in four basic flavours. Each type has a common set of processing resources—processor, instruction memory, bus interfaces and power—and some unique circuit card assemblies (CCAs), or plug-in modules. The CPMs include:

- *CPM/Basic, which does not have a special-function CCA.*
- *CPM/Comm, with interfaces to the airplane fibre optic LAN (local area network), the A717 interface to the flight data recorder, and an RS-422 interface to the quick access recorder.*
- *CPM/GG (graphic generator), with the core processor and a graphic generation CCA, which connects to the flight deck display units.*
- *And CPM/ACMF (aircraft condition monitoring function), with an additional memory CCA that stores ACMF data.*

*Because the AIMS architecture uses generic building blocks, a need existed for **multiple software applications** to be able to share common hardware resources, without corrupting each other's data. This led to the development of **Honeywell's Apex operating system**—with its time and space partitioning—which became the foundation for the ARINC 653 operating system spec. Under Apex, for example, the central maintenance function (Level D of DO-178B), flight deck communications (Level C) and DCG (Level A) can share the same processing hardware **yet still be developed and verified independently** [developed here means 'produced'].*

*Another achievement was deferred maintenance through fault tolerance. Boeing required a continued, 10-day dispatch rate of up to 99.9 percent in the face of any failure, assuming a full-up system at the beginning of that period, recalls Gust Tsikalas, Honeywell product line director. With AIMS this was performed largely in software, by carrying extra copies of the applications, rather than many different processor modules. Honeywell's deterministic SAFEBus backplane technology allowed the company to prove that "**another copy of a software application could be running and ready to go, so that, [if needed, it] could come on line without a hiccup,**" Tsikalas says. **A backup software function can transition into a primary function within two backplane clock cycles, a matter of nanoseconds.** (35)*

With the patented inclusion of an AIMS system called the Unauthorized Flight Detector, a backup Flight Management System we have called the BHUAP (or Boeing have called the Boeing Uninterruptable Autopilot) could be brought on line whereby control is removed from the Primary Flight Control Computers used by the pilot to control the aircraft. Control would then by default pass to the Autopilot via an external, uplinked control source. The uplinked control source could be either a remote pilot or an uploaded back-up flight route. This is documented in both Boeing and Honeywell's Autoflight patents.

The Honeywell Flight Management Systems On-board MH370

The Flightdeck

The standard Boeing 777 avionics and communication systems are documented in Philip Birtles' "[Boeing 777 – Jetliner for a New Century](#)" (41)

*"The flightdeck and its systems are an essential part of the aircraft, and the 777 has a number of advanced features. **The brains of the aircraft are the integrated management system (AIMS) and the integrated air-data inertial reference system (ADIRS)**, which are both supplied by Honeywell. The AIMS provides **central processing and input/output hardware to perform flight management**, display symbology generation, **central maintenance, aircraft condition monitoring, digital communications management and data conversion.***

*The autopilot, **maintenance access terminal** and the standby instruments have all been developed by Rockwell-Collins. The Triplex-redundant autopilot has been especially developed for the 777 and as the aircraft has **fly-by-wire controls**, a back-drive system was developed to move the control yoke in response to autopilot commands. The **AIMS maintenance terminal** has a thin (20x20cm), full colour liquid crystal display, with a key board and disc loaders, **used to programme up to 50 on-board systems, using a fibre-optic avionics network.***

The Primary Flight Control Computers (PFCC) were developed by GEC Avionics in Britain. The first fly-by-wire computers were delivered to Boeing for installation in the 777 iron bird test-rig, and operated as required. Each 777 has three PFCCs, which drive 12 power control units (PCUs) on the major control surfaces via four actuator control electronics (ACE) boxes. The PCUs are supplied by Teijin Seiki of Japan which teamed with Lear Astronics to produce the ACEs."

*The AIMS cabinets are not readily accessible. A patent that will be discussed later subsequently located the Flight Control Computers into the AIMS architecture. As AIMS, the autopilot, Navigational Computer and Flight Control Computer were then directly connected to the Actuator Control Electronics system, and had their own independent power supply; **AIMS could now coordinate all flight control functions without the need of a cockpit.***

Pilot Flight Control Computer

*"The pilot's control inputs pass to three **primary flight-control computers (PFCCs)**. These GEC-Marconi produced PFCCs use flight-control laws developed by Boeing to protect the integrity of the aircraft, but ensure that the pilot can over-ride them and maintain ultimate control. The flight-control laws of the Boeing 777 are governed by speed stability, which means that when the control column is displaced, it will return to its previous position, giving the pilot an indication of where the aircraft is going. The 777 is therefore trimmed to a set speed and any changes from this speed will cause the pitch to change." (41)*

2000 - The Honeywell Air Data Inertial Reference Unit 10MCU-IRS/ADAIRS

*"The **Honeywell air-data inertial reference system is a key part of the aircraft avionics systems.** This fault-tolerant, skewed axis **laser-gyro inertial unit** provides inertial information and air data to such a high level of redundancy that the airline may not even be aware that there is a failure. A **secondary attitude air-data reference unit provides a back-up data source.**" (41)*

The Digital Autonomous Terminal Access Communication (DATEC)

The triply redundant DATEC bus, also known as the ARINC 629 bus is used for all communication between all computing systems for flight control functions. It was designed by Boeing based on the ARINC 629 protocol. All busses are physically and electrically isolated. (21)

Aircraft Communications Addressing and Reporting System (ACARS)

In 1978 ARINC (Aeronautical Radio Incorporated) was the company that first introduced the **Aircraft Information and Reporting System (ACARS)**, a **datalink system** that **enables ground stations** (airports, **aircraft maintenance bases**, **air traffic control** etc.) and commercial aircraft to communicate with **digital data**, due to the datalink system being integrated with aircraft systems via a **Communications Management Unit (CMU)**. (21)

From the ARINC website: (42) *“The data link revolution in aviation communications began over 30 years ago when ARINC first introduced the Aircraft Communications Addressing and Reporting System (ACARS®). Today, over 300 airlines and 15,000 aircraft around the world rely on ACARS® and the GLOBALinkSM infrastructure for these critical communications...*

As the largest aeronautical data link provider in the world...VHF data link extends throughout all of North and Central America as well as most of Europe and Asia ... Inmarsat satellite service expands VHF capabilities to include real-time reporting of flight and weather information...

Being the company that started it all and the company that is still the industry leader simply makes ARINC the one to trust for data link communications.”

2000 - Major Modifications to the Aircraft Information Management System (AIMS)

“The Honeywell Aircraft Information Management System (AIMS) is the "brains" of Boeing 777 aircraft. It uses four ARINC 629 data buses to transfer information with all other aircraft systems.” (21)

Honeywell’s patent [US6317659B1](#) (43) “Layered subsystem architecture for a flight management system” describes “An improved aircraft flight management system (FMS) based on a layered subsystem architecture, residing on a computing platform and including an operator interface subsystem, a communications subsystem, a flight management subsystem...”

Continuing on, “Although no other entity in the system needs to be aware of the data link per se, subsystems that reside above the Data Link Management subsystem clearly know of its existence and can use that knowledge as required. **Generally, flight crews do not appreciate automatic changes such as modification of the flight plan. Since the flight crew has ultimate responsibility for the safe operation of the aircraft, they should have the final say regarding any commands that can affect their trajectory. Therefore, when an uplink is received, the crew should manually accept the proposed change.** Since this can be accomplished via the CDU, the CDU Management processing must access the Data Link Management subsystem to collect the pertinent information.”

A simple software change that can automatically accept on behalf of an incapacitated crew in an emergency situation means that the aircraft flight plan can be modified from an off-board source and flown automatically. An emergency situation would be invoked when BHUAP disables Pilot Authority. Flight change commands **can be uplinked with a conditional status**, such as ‘If variable “cockpit emergency” is true, then “flight plan change authority” = automatic-accept. There are patents for this in Boeing and Honeywell’s Air Traffic Network technology for the Future Airtraffic Network System (FANS).

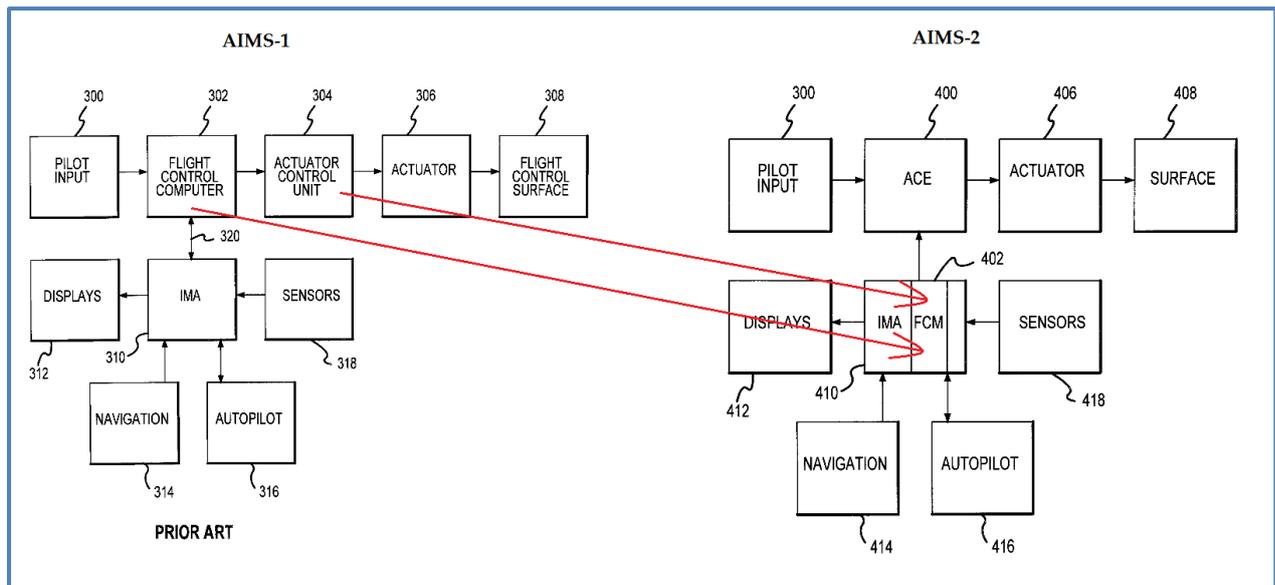
Follow Boeing's 2004 patent [WO2006001851A2](#) (44) "Systems and methods for handling aircraft information received from an off-board source" where "The present invention is directed toward systems and methods for handling aircraft information **received from an off-board source**. A method in accordance with one embodiment of the invention includes **receiving from a source off-board an aircraft in instruction for a change in a characteristic of the aircraft during operation**. The method can further include automatically determining whether or not at least a portion of the instruction is to be implemented once a condition is met. If at least a portion of the instruction is to be implemented once a condition is met, **the method further includes automatically carrying out a first course of action. If implementation of at least a portion of the instruction is not predicated upon fulfilling a condition, the method can include automatically carrying out a second course of action different than the first course of action.**"

In June 2003, Charlotte Adams writes:

*"In the Boeing 777's first major avionics upgrade since its introduction in 1995, the distinctive twin-engine widebody jet will sport a leaner, yet more capable integrated avionics system. **Starting with the 777-200ER, new production aircraft also will receive new primary flight computers, electrical load management systems, air supply and cabin pressure controllers, cabin pressure outflow valves and proximity sensing electronics units.**"*
(45)

Honeywell's patent [WO2002006115A9](#) (46) entitled "Flight control modules merged into the integrated modular avionics" describes *"In an aircraft using fly-by-wire technology, the **flight control functions have been integrated into the integrated modular avionics** ("IMA"). The new flight control module ("FCM") resides on the same data bus as the other modules in the IMA and receives power from the same power supply. In addition, **the FCM is also connected to a separate power supply to add redundancy to the system**. Several benefits arise from this configuration of an FCM. There is no longer a separate chassis needed for the flight control functions, thus resulting in a reduction in weight. In addition, **the FCM now has access to all of the data on the IMA bus**, instead of a limited amount of data over an ARINC 629 bus. **The FCM provides augmentation signals to the actuator control electronics ("ACE") to aid in the flying of the aircraft. In the event of a failure of the FCM, the ACE still provides enough control to fly the airplane.**"*

The present invention incorporates a flight control module into the avionics of an airplane. The flight control module is coupled to an actuator control electronics system which operates a hydraulic actuator coupled to a flight control surface. The flight control module provides augmentation information to the actuator control electronics system. However, in the actuator control electronics system is also capable of operating based solely from inputs provided by a pilot through a control stick, without any such augmentation from the flight control module in a "direct mode."



“At the heart of the upgrade is **Honeywell’s Airplane Information Management System (AIMS), IMA (integrated modular avionics in the patent)** which integrates processing for the following avionics functions:

- **Flight management computing,**
- **Navigation,**
- **Flight deck communications,**
- **Primary displays computing,**
- **Digital flight data acquisition,**
- **Quick access recorder,**
- **Aircraft condition monitoring**
- **Thrust management computing,**
- **Central maintenance computing and**
- **Data conversion gateway.**

The basic AIMS architecture includes two cabinets, each populated with **line replaceable modules**. The original system greatly reduced avionics cost and weight by decreasing the number of standalone black boxes, **each with its own power supply, processing and input/output (I/O)**. A special function-qualified to the **DO-178B, Level A, software specification**—is the **data conversion gateway (DCG)**, which transfers bus signals between the various types of links, reducing the number of bus wires and interface cards. Signals from the various digital buses, analog lines and discrete connections **enter the system once** (apart from deliberate redundancies) **and are distributed to the different AIMS-hosted avionics functions** over the **SAFEbus (ARINC 659) deterministic backplane**. **Additional copies of the data** are transmitted to other airplane line replaceable units over various transmission mediums, including discrete, **ARINC 429 and ARINC 629 formats.**” (32)

Honeywell AIMS-2 – 2000 Onwards

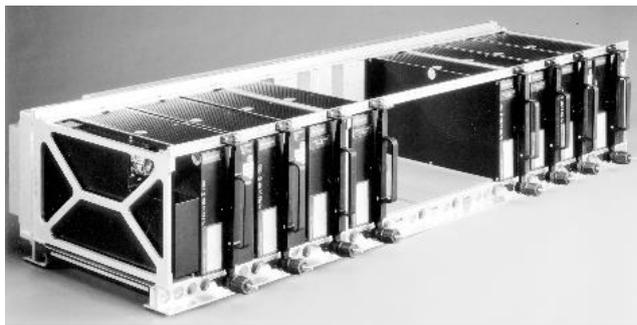
Anticipated growth in avionics features and parts obsolescence issues drove the need for an AIMS upgrade, says Dan Murray, Boeing’s 777 systems and equipment manager. It has gotten difficult and expensive to obtain parts for the original 100-megabit/sec (Mbit/sec) Fibre Distributed Data Interface (FDDI) local area network. Called Planenet, the fibre optic LAN—used on the ground—carries traffic between AIMS and both the maintenance access terminal (MAT) and the portable MAT, and is used in

software data loading. **With AIMS-2, Boeing replaced the FDDI LAN with 10-Mbit/sec Ethernet 10BaseT.**

Data loading is far faster with AIMS-2. It now takes only 17 minutes to load the AIMS operating software, compared with five hours before. The navigation database, which has to be updated every 28 days, can be loaded in less than five minutes, as opposed to an hour. One of the reasons for this is improved components, such as electrically erasable flash memories that can be more rapidly loaded. **Another factor is that AIMS now handles the loading protocol.**

Boeing also has replaced the 2-Mbit/sec ARINC 629 AIMS intercabinet bus with a point-to-point Ethernet 10BaseT line, enabling a five-fold increase in throughput. (ARINC 629 is still used for the airplane flight control buses and systems buses.) According to **Honeywell**, the AIMS-2 design also is more reliable, lighter-weight, lower in cost of ownership, less power-hungry and higher in I/O count. Throughput and memory capacity have been more than doubled, for example, compared with AIMS-1.

The new design also makes hardware and software upgrades easier, according to Tsikalas. A key enabler is the more than 10-fold reduction in the amount of low-level, board-specific software, i.e. firmware. The functions that this board-resident software provided—such as built-in test and hardware initialization—are now performed by **"non-resident boot software" that is loadable in the field.** (32)



Software

The 777 is Boeing's first truly digital aircraft **has more than 2.6 million lines of software code incorporated in the avionics and cabin entertainment system**, compared to only 400,000 lines in the Boeing 747-400. Out of the total, **around 615,000 lines are dedicated to the Honeywell-produced Aircraft Information Management System (AIMS).**

The Boeing 777 was programmed using the **Ada-95 Programming Language**. Ada 83 and Ada 95 Programming Language initiated by the Department of Defence in the latter 1970's. "Ada 95 is a comprehensive high-level programming language especially suited for the professional development of large or critical programs for which correctness and robustness are major considerations. Ada 95 is a direct descendant of, and highly compatible with, Ada 83, which was originally sponsored by the U.S. Department of Defence for use in the embedded system application area. Ada 83 became an ANSI standard in 1983 and an ISO standard in 1987." (21) The Avionics Handbook Ch26.

Software company AdaIC explains further in their article "[Boeing Flies on 99% Ada](#)":

"Working Together" is the project name Boeing chose when it first entertained the idea of producing its 777 jet plane. The then-Seattle-based avionics company intended for the 10,000 people involved in the jetliner project to accept the company's policy of openness and non-competitiveness among both internal divisions and external suppliers. Management asserted that "working together" was the way

to achieve the highest possible quality in every part of the system, from the secondary hydraulic brake to the auto-pilot system.

One challenge to the "Working Together" model was **Boeing's insistence that the software be written in the Ada programming language**. According to Brian Pflug, engineering avionics software manager at Boeing's Commercial Airplane Group, **most companies disliked the idea of a standard language at all, and then seriously objected to Ada as too immature**. In addition, one supplier was already six months into the development of their part of the project and had used another language.

Honeywell approached the request by **conducting an extensive study into the benefits of Ada versus the C programming language**. When the results were in, **Honeywell agreed with the decision to use Ada**: the study concluded that Ada's built-in safety features would translate into less time, expense, and concern devoted to debugging the software.

Once committed to Ada, each company's first task was to find a compiler of good quality for the specific job at hand.

Honeywell was to develop the cockpit's primary flight controls in two projects, the Boeing 777's Airplane Information Management System and its Air Data/Inertial Reference System. For these projects, Honeywell purchased DDC-I, Inc.'s Ada Compiler System, using it as the front-end source for Honeywell's symbolic debugger. The two companies worked together for a year and a half to build the compiler's final debugger and the entire back-end, targeted to an Advanced Micro Devices (AMD) 29050 microprocessor. According to a recent telephone interview with Jeff Greeson, **Honeywell's project leader for the 777 project's engineering, the companies "were able to build into the compiler a lot of optimization features specific to our hardware."** (47)

Philip Butrlas again: "In comparison, Honeywell's Airplane Information Management System (AIMS) project consists of the largest central computer on the jetliner; it runs 613,000 new lines of code taking up 15,656 kilobytes (KB) of disk space and 4,854 KB of random-access memory (RAM)."

"Honeywell's massive effort on the 777 **involved over 550 software developers**. The company built the AIMS computer as a custom platform based on the AMD 29050 processor. It was unique among aviation systems for integrating the other computers' functions; in other systems, each function resides in a different box [the central maintenance had its own box with its own input/output (I/O), its own central processing unit (CPU), etc.]. **AIMS combines all these functions and shares the CPU and I/O among them**: it uses the same signals for flight management and for displays, so that the data comes in only once instead of twice; one input circuit provides data to all of the functions; each of the functions gets a piece of the CPU, as in a mainframe computer, where systems use part of the CPU but not all of it; and every function is guaranteed its time slot.

Another innovation is that the disk drive can read files formatted for the Microsoft Disk Operating System, **which provides maintenance with access to the terminal communications**. The mechanics can transfer files for data loading over the airplane bus, because **Honeywell built the program to accept new data and to change the software**. In fact, most of the equipment on the airplane has that ability, only a few classic systems do not (such as the ground-proximity warning system, which has proven sufficiently trustworthy and not in need of change). (45)

The Central Maintenance Computer

Gregg Bartley from Boeing explains: "The main interface to the Primary Flight Control System for the line mechanic is the Central Maintenance Computer (CMC) **function of AIMS**. The CMC uses the

*Maintenance Access Terminal (MAT) as its primary display **and control**. The role of the CMC in the maintenance of the Primary Flight Control System is to identify failures present in the system and to assist in their repair. The two features utilized by the CMC that accomplish these tasks are maintenance messages and ground maintenance tests.*

Maintenance messages describe to the mechanic, in simplified English, what failures are present in the system and the components possibly at fault. The ground maintenance tests exercise the system, test for active and latent failures, and confirm any repair action taken. They are also used to unlatch any EICAS and Maintenance Messages that may have become latched due to failures.

The PFCs are able to be loaded with new software through the Data Loader function on the MAT. This allows the PFCs to be updated to a new software configuration without having to take them out of service.” (45)

With the addition of Swift Broadband over the Inmarsat Network, the data loader is no longer necessary as **the Central Maintenance Computer and the Primary Flight Computer can be accessed through the WiFi (Swift) network.**

BHUAP software routines can be initiated and updated flight plans can be loaded into the appropriate database through the CMF in FANS (Future Aircraft Navigation System) enabled aircraft, in Boeing’s case any aircraft running the Pegasus FMS (1984), AIMS-1 (1995) or AIMS-2 (2002) software.

See Boeing’s 1989 patent [US5270931A](#) (48) – “Software controlled aircraft component configuration system” and [follow patents](#) that build on the technology.

See Honeywell’s 2000 patent [US6438468B1](#) (49) “Systems and methods for delivering data updates to an aircraft” – “Systems and methods for providing data updates to a vehicle component (such as a navigation database on an aircraft) make use of a system server, a vehicle server, and an administrative program.”

Also see Boeing’s 2007 patent [US8185609B2](#) (50) “Method and apparatus for processing commands in an aircraft network” – “..processing the received set of commands by the on-board electronic distribution system and forwarding the set of crated aircraft software parts located on the aircraft data processing system to a set of target data processing systems on the aircraft.” (Flight Systems software update)

Furthermore, since 1999 software could directly control the electrical breakers on any flight control system through the CMF and the solid state power controller. BHUAP electrical isolation of the cockpit and hence Pilot Authority is a programmed response of the Unauthorized Flight Detector.

Patent [US6470224B1](#) (51) “Configurable aircraft power system” whereby “An aircraft power system includes a secondary power distribution assembly (SPDA), a programmable solid state power controller (SSPC) disposed within the SPDA and a non-volatile memory disposed within the SPDA and adapted to store configuration information for the programmable SSPC. The configuration information stored by the non-volatile memory may include the name and current rating of the SSPC and whether that SSPC is enabled or disabled.”

“The present invention relates generally to aircraft power systems and, more particularly, to a configurable aircraft secondary power system, **the components of which a user can enable, disable and rename.**”

The Data Communications Management Function

From the Digital Avionics Systems Conference 1995, R. Kerr (Air Transport Systems Division, Honeywell Inc) “*The integrated avionics architecture of the Boeing 777 airplane, where several functions normally housed in separate computer units are implemented within a single avionics cabinet, presented some unique opportunities and challenges for the implementation of the data link functionality. The Data Communications Management Function (DCMF) is responsible for the communications routing protocols, both for the ACARS air-ground communications and the onboard, fibre optic avionics network. The Flight Deck Communications Function (FDCF) implements the crew interface to the data Link function using a Cursor Control Device (CCD) and Multi-Function Display (MFD) in addition to the conventional Control and Display Unit (CDU) and printer. FDCF is also responsible for the implementation of the customer unique Aeronautical Operational Control (AOC) applications which may be tailor-made and loaded into the system by the airline customer using a ground-based tool.*” (52)

OOOI Ping Times

In 1999 Harris Corporation filed patent [US6154636A](#) “System and method of providing OOOI times of an aircraft” (53). The patent describes “A method for determining the Out, Off, On, and In (OOOI) times for commercial air transport aircraft, based on parametric data routinely sampled and presented in a multiplexed data stream to the Flight Data Recorder. In a preferred embodiment, this method is used in conjunction with a system capable of recording, analyzing, and automatically forwarding recorded flight data. "Out" means out of the gate, "Off" means off the ground, "On" means on the ground, and "In" means in at the gate. Greenwich Mean Time (GMT), brake pressure, magnetic heading, ground speed, flight number and flight leg, engine start/stop, and air/ground switch are currently available parameters that are sampled and presented to the Flight Data Recorder in a multiplexed data stream. These parameters are used by this method in various combinations to determine the OOOI times for a given flight. "Out" and "Off" times can be determined through analysis of these parameters and downloaded immediately after takeoff over a RF Link to a ground station. "On" time can likewise be determined through analysis of these parameters and downloaded immediately after landing over a RF Link to a ground station. "In" time can be determined from analysis of these parameters and downloaded while the aircraft is parked at the gate. These parameters can also be recorded and forwarded at the end of the flight to an analysis station where the OOOI times are subsequently computed on a different computing platform.”

These four changes in flight phase are transmitted through the ACARS system to the Airline Carrier and to the Airline Manufacturer as well as the Engine Manufacturer. The data transfer forms the principal way that the Airline and Manufacturers track one complete cycle in the service of an aircraft. Aircraft have a limited number of cycles before major inspections **MUST** be conducted, and also each aircraft type has a maximum number of cycles over its life of service before the aircraft must be decommissioned. **In the case of MH370, Honeywell’s Communications Management Unit determines the best way for OOOI information to be transmitted, depending on the availability of sub-networks such as VHF or HF ACARS or the SATCOM system. Details of this can be found in Honeywell’s patent for the Gatelink System, [US8107412B2](#).** (54)

Malaysian Airlines Communications

SITA has confirmed it supplies Malaysia Airlines with communications via VHF radio and **Inmarsat** satellites for its fleet's Aircraft Communications Addressing and Reporting System (ACARS), ATC voice and datalink and the FMS datalink. This is made possible through Inmarsat's Aero H service, a high-gain satellite link.

From a March 2009 Honeywell Press Release:

PHOENIX, March 12, 2009 -- Honeywell (NYSE: HON) announced today that it has provided upgraded satellite communications equipment to Malaysia Airlines to allow passengers to use mobile phones and personal digital assistants (PDAs) while on selected Malaysia Airlines flights as part of a pilot program through mid-2009.

*Malaysia Airlines Boeing 777 aircraft are **already outfitted with Honeywell's SATCOM communications systems** to provide passenger and crew instant digital voice and data communications, as well as flight deck connectivity with air traffic control. Recent routine maintenance checks provided an opportunity to implement the new lightweight data services capability, for cost-effective and seamless connectivity. The European Aviation Safety Agency and the Malaysian Department of Civil Aviation provided aviation safety approvals."*

"Honeywell's HD710 High Speed Data SATCOM unit replaces the High Power Amplifier (HPA) with a unit that contains both the HPA and a high-speed data unit. Currently, the unit will have two Swift64 High-Speed Data Channels, each channel with a capacity of 64Kbits/second. The same system is planned to be upgraded in the future to two Swift Broadband Channels with a total capacity of 864Kbits/second." (55)

This upgrade would include the **Gatelink System and Communications Management Unit** described above.

The Honeywell HD710 High Speed Data SATCOM Unit

Honeywell named it the MCS-7100 (HD-710) Multi-channel Inmarsat Satcom. (56)



"Key Benefits - Honeywell MCS-7100 Series allows for on-line connections at speeds of 64Kbps/channel to 432 Kbps/channel, when using either Swift64 or SwiftBroadband. Our SATCOM systems have become renowned for providing world-class voice, data and fax communications. SATCOM provides the communications element of the emerging CNS/ATM environment being developed and implemented by the world's air traffic authorities. All of Honeywell's SATCOM systems maintain Level D certification.

The SwiftBroadband connection allows you an always on connection [the hourly pings] with convenient access to:

- *E-mail - use your own laptop and e-mail application without any modifications, for full access to private or corporate e-mail accounts.*
- *Internet - get the latest news and information by browsing your favourite web sites.*
- *Corporate network- transfer files to or from your corporate network using the Inmarsat satellite data link networks. [BHUAP Gateway]*
- *Video conference - conduct a live video conference while flying anywhere Inmarsat provides service.” (56)*

Honeywell’s patent filed 8th August 2007, [US20090041041A1](#) (57) “Aircraft data link network routing” stating “A method for routing aircraft data link messages over a **plurality of communications networks** is disclosed. The method assigns at least one data link message routing service for an aircraft having a first message processing application **based on prescribed criteria**, the prescribed criteria comprising preferred networks of the plurality of communications networks. As a first preferred communications network becomes available, the method selects a first message route from the assigned routing service and transmits each of the data link messages on the first message route while the first message route satisfies the prescribed criteria. When the prescribed criteria changes over a **plurality of flight phases** of the aircraft, the method reassigns the at least one data link message route to continue data link message transmissions to and from the aircraft based on the latest prescribed criteria.”

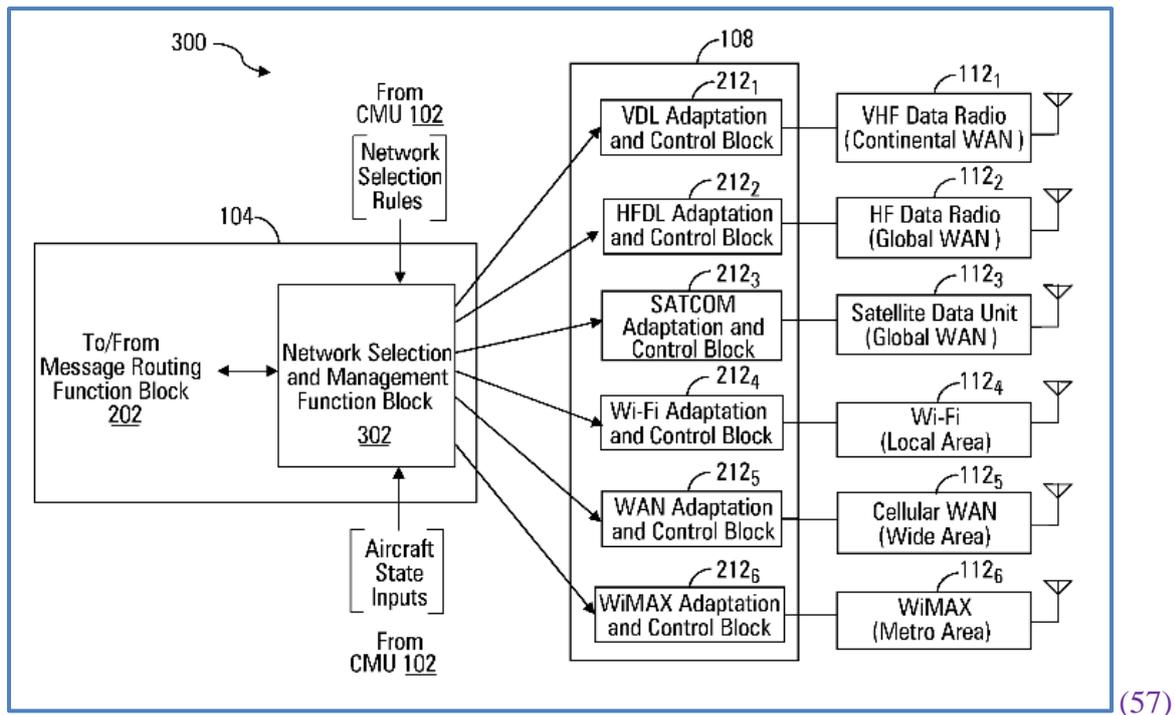
The patent states that the **prescribed criteria** governing network selection is primarily based on flight phase.

“Flight phase measurements are already in common use in aircraft communication. A specific flight phase is often used to trigger certain communications messages. For example, many aircraft maintenance systems send their reports over an air-ground data link network when an aircraft is on final approach or immediately after touch-down. In addition, air-ground data links send information between an aircraft and air traffic control services when the aircraft is too far from an air traffic control tower to make voice radio communication and radar possible. For example, aircraft data link systems are used for long-distance flights operating over any substantial land and water routes.”

It is also most likely that Honeywell’s 2009 upgrade of the MAS fleet included the [Mark II CMU](#) (58) (Communications Management Unit) and the [ATSU Datalink](#). (59) These give direct access to the AIMS CPU..

BHUAP Gateway refers to the Satcoms systems interface with the Inmarsat Global Network where-by the aircraft acquire a network IP address for point-to-point data communications via an IP router. With flash override authority or an aircraft specific encryption key the system can be accessed externally, such as for ATC/military initiation of BHUAP, or simply through access granted by a carrier’s or manufacturer’s aviation maintenance network.

Furthermore, within the AIMS’ Communication Management Unit (CMU) **software code** referred to as the “**message selection and management function block**” decides on how information is routed. **BHUAP would certainly be flagged as a type of “phase of flight”** and thus have dedicated software as to the communication protocols to be used during BHUAP application.



The Boeing-Honeywell Uninterruptable Autopilot

We would contend that what is referred to as the Unauthorized Flight Detector in the patents lies within the software of the Line Replaceable Units making up the Honeywell AIMS system at the heart of the Boeing 777, and it is programmed with the routines that monitor for the circumstances on which to initiate the Boeing Honeywell Uninterruptable Autopilot.

The circumstances surrounding BHUAP initiation would include:

- ATC initiation upon the divergence of an aircraft's flight path from the ATN as-filed flight route without ATC clearance or aircraft contact
- Aircraft transponder set to squawk 7700 – Hijack Alert
- Remote initiation via electronic means aboard a suitable aircraft such as an AWACS
- Remote hack of an aircraft's SATCOM, ACARS or transponder links via digital override authority
- Remote hack of Airline Operator or Manufacturer's SATCOM or ACARS link to the Central Maintenance Computer.

The essence of an Interruptible Autopilot patent is to sever links between the fly-by-wire system and the pilot control system, and transfer flight control to the autopilot under direction from either the Flight Management System (in particular the Airdata Information Management System (AIMS) or via an external RF link to a ground-based facility (also controlled by the AIMS).

In Honeywell's 1995 – 2002 AIMS-1, the link between the Primary Flight Control Computers (PFC, which receive pilot commands) and the AIMS system is severed via software electronics control. The AIMS controls the PFC's which are linked through the Actuator Control Electronics (ACE_ system to the control surfaces.

In Honeywell's 2002 – present AIMS-2, the Primary Flight Control Computers are located within the AIMS system and are linked to a back-up power bus. The cockpit electronics are severed, and the AIMS directly controls the surface actuators through its own Flight Control Computers command of the ACE system.

As discussed before, the AIMS system is a once-in once-out management system at the heart of the Boeing 777. It controls the autopilot, the RF link, the Air Data Inertial Reference Unit, AND the feedback loop to the Primary Flight Control Computers plus the cockpit instrumentation. **This is all done through programmed software. BHUAP can turn off everything in the cockpit and AIMS will still function normally, either through executing a pre-programmed flight plan or by opening an RF data link to an external source to receive direct Flight Management Computer instruction or an uplinked back-up flight route.**

MH370 BHUAP V.2002 versus 9/11 BHUAP V.1995

With the AIMS-2 upgrade in 2002 the Flight Control Computers were located within the integrated avionics of the AIMS system, allowing the direct control of the AIMS over the ACE's and hence the control surfaces. Additionally the advancement in SATCOM and ACARS data-link systems giving aircraft an IP address have simplified the technology required to access the AIMS and initiate the Unauthorized Flight Detector routines with additional access to the Central Maintenance Computer.

Back in 1995 the easiest way to initiate BHUAP was to employ a Mode-S Transponder to interface with the aircraft's transponder. The transponders used in the US then had access to WAAS & LAAS (Wide and Local Area Augmentation System) used to error-correct the GPS signal for civil aircraft, and also access to the JPALS (Joint Precision Approach Landing System) used to error-correct GPS for military aircraft. These transponders were developed under Department of Defence Dual-Use Technology Reinvestment Programs, with the aim that civil aircraft could be called upon to complete Cat-3C landings at military airstrips, and also military aircraft could perform Cat-3C landings at civilian airstrips.

The mode of entry from an external source to the antennae of MH370 is beyond the scope of this documents' authors. The hijackers of MH370 are unlikely to have used the Mode-S transponder as Malaysian Airlines has not yet agreed to the terms of the Wassenaar Agreement, Boeing would not necessarily have sold them, and Honeywell in 2009 would not necessarily have upgraded the 9M-MRO with the likes of an [H-764 ACE](#). (60)

Section 3 – Analysis of The flight path and System Disruption of the B777-2H6ER Flight MH370 with reference to BHUAP

Prelude – The Method and Opportunity

It is no secret that the financial power in the world belongs to the banks. The banks are controlled through the Livery Companies of the City of London (an entity completely separate by law to any sovereign state) which have intimate ties to Israel (particularly a select few who follow the Talmudic Law), the Vatican and the Crown. The entire world's wealth can be traced back to these three sources.

It is also well documented that the financial squeeze placed on Governments over the past 60 years has “forced” (some would say extorted) Governments to **outsource critical defense and security arrangements to private companies**, the biggest of which is Serco / G4S.

Serco now controls the US Defense Red Switch Network, over 70 ATC contracts worldwide (including training of Malaysian ATC), nuclear weapons contracts, detention centers, US Defense, Australian Defense, UK Defense, Canadian Defense, many prisons and prisoner tagging and tracking, the State Department's Security Incident Management Analysis System, the World Time Atomic Clock. They are intimately associated with Inmarsat contracts, FAA contracts, CONAIR, and many administration and support roles for fixed military bases (including Diego Garcia) and mobile military deployment for the US, Canada, the UK, Australia, New Zealand, plus other regions into which the company has recently expanded.

This is a lot of power in the hands of a private company whose banker shareholders are directly linked to the City of London, Israel and the Crown. For example, 5% of Serco stock is held by Lloyds Banking Group, which itself is 40% owned by The Commissioners of her Majesty's Treasury. For evidence of institutional shareholders, see [here](#). (61)

The BHUAP was instigated by Kristine Marcy (CONAIR 1995) with federal help from Bill and Hilary Clinton (documented in Section 2), and incorporated into Serco's arsenal by David Emerson (former MDA Director) and Maureen Baginski (former NSA director, FBI, now Serco Director) for use on 911 (62) (63)

Serco, the City of London and Israel / the Vatican continue to use the BHUAP for extortion.

MH370 Hijack and the Motive

The flight departed from Kuala Lumpur International Airport on 8 March 2014 at 00:41 MYT (16:41 UTC, 7 March) and was scheduled to land at Beijing Capital International Airport at 06:30 MYT (22:30 UTC, 7 March).

Malaysia Airlines released the names and nationalities of the 227 passengers and 12 crew members, based on the flight manifest, later modified to include two Iranian passengers travelling on stolen passports. Of the 227 passengers, 152 were Chinese citizens, including a group of 19 artists with six family members and four staff returning from a calligraphy exhibition of their work in Kuala Lumpur; 38 passengers were Malaysian. The remaining passengers were from 13 different countries. **Twenty passengers, 12 of whom were from Malaysia and 8 from China, were employees of Freescale Semiconductor. (64)**

MH370 climbed to its assigned cruise altitude of 35,000 feet (11,000 m) and was travelling at 471 knots (872 km/h; 542 mph) true airspeed. The aircraft's last Aircraft Communications Addressing and Reporting System (ACARS) message and final automated position report was sent at 01:07 MYT. The final contact with air traffic control (ATC) occurred at 01:19 MYT, when one of the aircraft's pilots responded to a send-off by Lumpur area ATC to Ho Chi Minh City area ATC with "Good night Malaysian Three Seven Zero".

At this point there is a deviation from radio protocol where-by Malaysian ATC instructs MH370 to "...contact Ho Chi Minh 120 decimal nine..." which is normally REPEATED by the pilot as a matter of course. MH370 only responds with "Good night, Malaysian three seven zero." From the recording it is clear that the pilot has made the transmission through his accent and verbal mannerism however you can detect that there is a hint of stress the voice of Malaysian ATC. The MH370 PILOT DOES NOT REPEAT the instruction "...contact Ho Chi Minh 120 decimal nine..." which is a clear deviation from protocol. The audio can be found [here](#). (65)

As an example, study the official transcript below: (66)

12:25:53 (MAS 370) Delivery MAS 370, good morning.
12:26:02 (ATC) MAS 370 standby and Malaysia Six is cleared to Frankfurt via AGOSA Alpha Departure six thousand feet squawk two one zero six [squawk refers to a transponder code assigned to a departing flight by air traffic controllers].
12:26:19 (ATC) ... MAS 370 request level.
12:26:21 (MAS 370) MAS 370, we are ready. Requesting flight level three five zero to Beijing.
12:26:39 (ATC) MAS 370 is cleared to Beijing via PIBOS A departure six thousand feet squawk two one five seven.
12:26:45 (MAS 370) Beijing PIBOS A six thousand squawk two one five seven, MAS 370. Thank you.
12:26:53 (ATC) MAS 370, welcome over to ground.
12:26:55 (MAS 370) Good day.
12:27:27 (MAS 370) Ground MAS 370 good morning, charlie one requesting push and start.
12:27:34 (ATC) MAS 370 Lumpur Ground, morning, push back and start approved runway 32 right exit via Sierra four.
12:27:40 (MAS 370) Push back and start approved 32 right exit via Sierra four POB 239 Mike Romeo Oscar.
12:27:45 (ATC) Copied.
12:32:13 (MAS 370) MAS 377 request taxi.
12:32:26 (ATC) MAS 37..... (garbled) ... standard route. Hold short Bravo.
12:32:30 (MAS 370) Ground, MAS 370. You are unreadable. Say again.
12:32:38 (ATC) MAS 370 taxi to holding point Alfa 11 Runway 32 right via standard route. Hold short of Bravo.
12:32:42 (MAS 370) Alfa 11 standard route, hold short Bravo MAS 370.
12:35:53 (ATC) MAS 370 Tower.
12:36:19 (ATC) (garbled) ... Tower ... (garbled)
(MAS 370) 1188 MAS 370, thank you.
12:36:30 (MAS 370) Tower MAS 370, morning.
12:36:38 (ATC) MAS 370, good morning. Lumpur Tower. Holding point... (garbled)... 10 32 Right.
12:36:50 (MAS 370) Alfa 10 MAS 370.
12:38:43 (ATC) 370 line up 32 Right Alfa 10.
(MAS 370) Line up 32 Right Alfa 10 MAS370.
12:40:38 (ATC) 370 32 Right, cleared for take-off. Good night.
(MAS 370) 32 Right, cleared for take-off MAS 370. Thank you. Bye.

The plane takes off at 12:41 am, and by 12:46 am passes from ground ATC to outbound radar control.

12:42:05 (MAS 370) Departure Malaysian three seven zero.

12:42:10 (ATC) Malaysian three seven zero selamat pagi [good morning] identified. Climb flight level one eight zero cancel SID turn right direct to IGARI.

12:42:48 (MAS 370) OK level one eight zero direct IGARI Malaysian one err three seven zero

12:42:52 (ATC) Malaysian three seven zero contact Lumpur Radar one three two six. Good night.

(MAS 370) Night one three two six. Malaysian three seven zero.

12:46:51 (MAS 370) Lumpur Control, Malaysian three seven zero.

12:46:51 (ATC) Malaysian three seven zero, Lumpur Radar, good morning. Climb flight level two five zero.

12:46:54 (MAS 370) Morning, level two five zero, Malaysian three seven zero.

12:50:06 (ATC) Malaysian three seven zero, climb flight level three five zero.

12:50:09 (MAS 370) Flight level three five zero, Malaysian three seven zero.

01:01:14 (MAS 370) Malaysian three seven zero, maintaining level three five zero.

01:01:19 (ATC) Malaysian three seven zero.

The last transmission by the plane's Aircraft Communications Addressing and Reporting System (ACARS), which relays key information on the plane's mechanical condition every 30 minutes, takes place at 1:07am.

01:07:55 (MAS 370) Malaysian... three seven zero maintaining level three five zero.

01:08:00 (ATC) Malaysian three seven zero.

01:19:24 (ATC) Malaysian three seven zero contact Ho Chi Minh 120 decimal nine. Good night.

01:19:29 (MAS 370) Good night, Malaysian three seven zero.

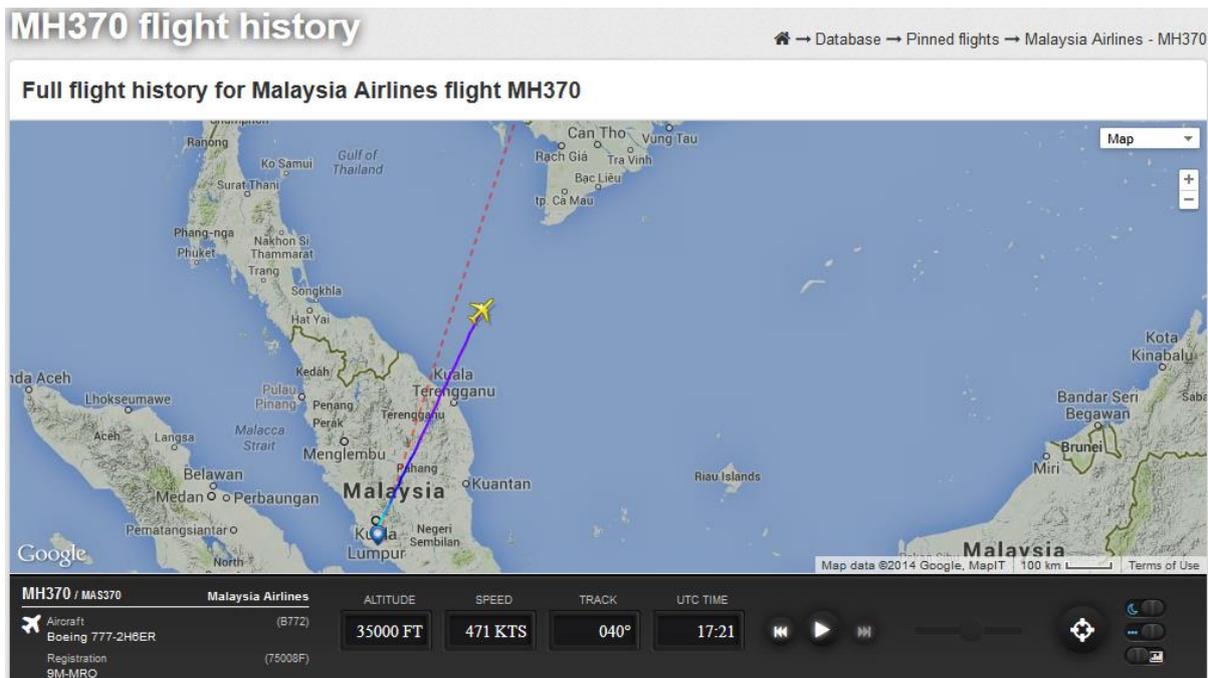
Initially, Malaysian Authorities had reported that the words spoken by the Co-pilot were just "All right, good night." On the 1st April Malaysia's CAA corrected the record that the words were in fact spoken by the pilot and they were "Good night, Malaysian three seven zero."

It is also noted that the Malaysian Ground Control segment of the audio recording was reconstructed after the fact and blended poorly into the recorded transcript. **THIS IS IN CLEAR BREACH OF INTERNATIONAL LAW** which requires the ATC audio recording to occur within the control room and at the relevant controller's panel.

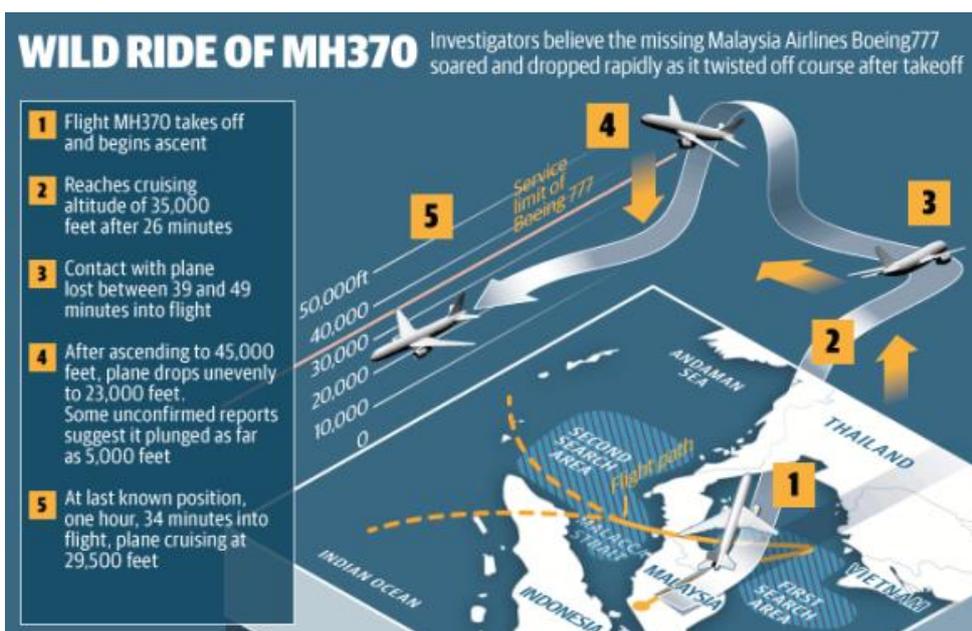
The aircraft's last known position from secondary radar was on 8 March at 01:21 MYT past the navigational waypoint IGARI in the Gulf of Thailand, heading towards the BITOD intersection, after turning to heading 040, altitude 35,000 ft at 471 kts.

flight_id	snapshot_id	latitude	longitude	altitude	speed	heading	squawk	radar_id
47716903	2014-03-07 17:21:03	6.97	103.63	35000	471	40	8535	696
47716903	2014-03-07 17:20:35	6.93	103.59	35000	471	40	8535	696
47716903	2014-03-07 17:20:18	6.90314	103.57	35000	472	28	8535	696
47716903	2014-03-07 17:19:28	6.8	103.52	35000	474	25	8535	696
47716903	2014-03-07 17:19:17	6.78333	103.512	35000	473	25	8535	696
47716903	2014-03-07 17:18:39	6.68	103.46	35000	473	25	8535	696
47716903	2014-03-07 17:17:39	6.58	103.41	35000	473	25	8535	696
47716903	2014-03-07 17:17:04	6.5197	103.386	35000	473	25	8535	696
47716903	2014-03-07 17:16:02	6.39583	103.328	35000	472	25	8535	696
47716903	2014-03-07 17:15:01	6.27365	103.27	35000	472	25	8535	696

All official versions ignore the fact that MH370 turned right over IGARI towards BITOD intersection, last bearing 040, as can be seen on the Flight Radar website. (67) Whilst this turn is routine for that flight, the failure of officials to disclose the turn should raise suspicions that the information as received by the public has gone through a layer of filtering where some facts have been left out or have been deemed insignificant. Considering officials have no knowledge or are covering up the use of the BHUAP, and that no-one in an official capacity claims to understand where MH370 went, NO FILTERING OF THE FACTS SHOULD HAVE TAKEN PLACE, regardless of how insignificant they may be.



At 01:07:48 MYT the aircraft deviated from the planned flight route, making a left hand turn to a bearing roughly of 250 to 260 whilst ascending to 45,000 ft, then variably dropping to 29,500 ft. This data was obtained from Malaysia's military primary radar.



The Serco – Malaysian ATC – BHUAP Hit 1

At the BITOD intersection, BHUAP was initiated, most likely via the Mode-S transponder. It is at this point where no country has jurisdiction over the flight, it is essentially ISOLATED.

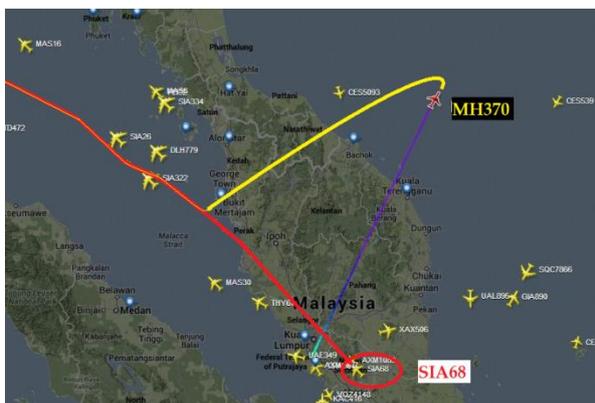
In late 1996, a laptop and a Mode-S Transponder was used by a Dalfort Aviation Services Engineer on a Grenough Airlines Boeing 757 to initiate the BHUAP system and take Uninterruptible control of the autopilot during an autopilot return to service flight test (weight off wheels and autopilot receiving simulated air data). The witness, an Avionics Technician named Wayne Anderson, was aware that the means by which the aircraft was being controlled did not appear on the type wiring diagrams. (68) This is because BHUAP is embedded into the AIMS software and is not an extra ‘wired in’ system.

Wayne Anderson explained that the engineer was able to change autopilot settings such as heading, speed and altitude simply by uplinking new values to the Flight Management System at will, the aircraft’s autopilot system received the new settings and took action to accomplish them. (68)

We would contend that this erratic flight trajectory was aimed at simulating an in-flight emergency of some sort, such as a cockpit struggle or a gyroscope failure. However as primary radar tracking can show, the remainder of the flight was orderly once heading towards a waypoint called VAMPI in the Strait of Malacca. (64) Evidence of this has come about through a leaked Defense Red Switch Network communique between Michelle Obama (born as a male; Michael LaVaughn Robinson in Chicago, Illinois on January 17th, 1964) (69) and a Serco agent Subang, Malaysia authorizing the pre-planned abduction of MH370. (70)

Serco hijacked MH370 at 01:07:48 MYT. The Mode S BHUAP completely cuts off all SATCOM communications as the SATCOM unit is not necessary when BHUAP is receiving instructions through the Transponder. Between 01:07:48 and 02:03:41 Inmarsat had absolutely no communication with MH370, and nor with ACARS.

It is possible at this point that MH370’s flight was timed to fall in behind Singapore Airlines flight SIA68. This would enable MH370 to fly into Europe undetected. MH370’s Tactical Collision Avoidance System (TCAS) requires the transponder to augment forward radar to be aware of hazards entering the aircrafts flight trajectory. SIA68 would not be aware of MH370 as it fell in behind. MH370 TCAS would have identified SIA68 via forward radar and maintained a close but safe distance (verified by TCAS patents).



Why would SIA68 be used to shield MH370 from primary radar and what would be the European connection?

Firstly, we know that Malaysian officials will not release Page 1 of the MH370 cargo manifest. We can have an educated guess that of all the items in the cargo hold, the most important may have been belonging to Freescale Semiconductors, who were actively researching stealth technology at the time. This cannot be confirmed until Page 1 of the manifest is released in full. **HOWEVER, IF THE INTENT WAS TO ABDUCT THE AIRCRAFT AND KEEP IT HIDDEN ON A NORTHERLY TRACK OVER THE MIDDLE EAST BY HIDING IN SIA68 RADAR SHADOW, STEALING CARGO OR THE 20 FREESCALE SCIENTISTS IS THE MOST LIKELY MOTIVE. WE CANNOT RULE OUT ANOTHER MOTIVE WHICH MAY HAVE BEEN TO USE MH370 TO CONDUCT A 911 STYLE ATTACK SOMEWHERE WITHIN ASIA, THE PETRONAS TOWERS FOR EXAMPLE.**

In either case, the precedence of Israel, Serco and the US Government using BHUAP was established during 911. Serco controlled ATC in both cases, stood to gain economically in both cases through extortion, insurance fraud and via the wars that followed. THEREIN LAYS METHOD, MOTIVE AND OPPORTUNITY.

It has been proven beyond doubt that the attacks of September 11, 2001 involved the droning of 3 out of 4 commercial aircraft in order to remove them from their flight paths. The similarities to MH370 are striking. On 9/11, the 3 airlines flights all ceased radio and transponder communication, yet maintained ACARS pings long after they are meant to have hit the World Trade Centre and the Pentagon. In MH370's case, Honeywell's CMU realized the ACARS was turned off and so used the SATCOM system to communicate data pings with the Inmarsat satellite.

On 9/11, the aircraft were also tracked by primary radar, which was covered up by officials and ATC. This is because the BHUAP was initiated; the aircraft were flown to remote locations over the ocean, where they were destroyed. (71)

Also of a similarity to the disappearance of MH370 was the misinformation and layered filtering of the official story in the days immediately after the events.

The European connection occurs through an Israeli-American Company called GA Telesis who secretly took delivery of an identical B777-2H6ER in 2013, construction number 28416, MAS registration 9M-MRI, new registration N105GT. The aircraft was flown from America to Tel Aviv on the 4th of November 2013 and photographed. (72)



(73)

N105GT GA Telesis Boeing 777-2H6(ER) - cn 28416 / ln 155

Airframe Details	
Construction Number (MSN)	28416
Line Number	155
Aircraft Type	Boeing 777-2H6(ER)
First Flight	25. Jul 1998
Age	16 Years
Airframe Status	Stored

 [Send in corrections](#)

Operator History

Reg	Aircraft Type	Airline	Engines	Config	Delivered	Remark
9M-MRI	Boeing 777-2H6(ER)	Malaysia Airlines	2x RR Trent 892	C35Y247	20. Oct 1998	Leased from ALAFCO wfu 08. Apr 2013 std at LDE 04. Oct 2013
N105GT	Boeing 777-2H6(ER)	GA Telesis	2x RR Trent 892		21. Oct 2013	std at TLV 04. Nov 2013

Suspicion of the Israeli connection came shortly after the disappearance of MH370 when top Israeli security ‘experts’ pointed the finger squarely at Iran, citing MH370 was to be used in a 911 style terrorist attack. The Times of Israel reported “Ex-El Al expert: Iran likely involved in MH370”. “Isaac Yeffet, who served as head of global security for Israel’s national carrier in the 1980s and now works as an aviation security consultant in New Jersey, said investigators were correct in homing in on the two fake-passport carrying Iranian passengers on the doomed flight, and they have wasted valuable time by exploring other leads.”

The article went on to say “We are talking about a captain who is 53 years old, who has worked for Malaysia Airlines for 30 years, and suddenly he became a terrorist? He wanted to commit suicide? If he committed suicide, where is the debris?” (74)

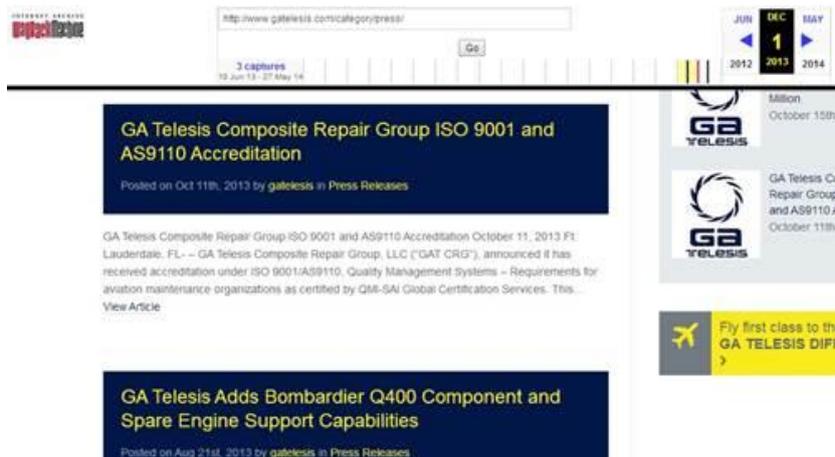
Yeffet was correct. ISRAEL WAS NOT EXPECTING DEBRIS.

AFTER the facts about the “Tel Aviv Twin” had been reported widely in the alternative media, GA Telesis faked a press release (backdated to 4th October 2013) admitting to the purchase of the aircraft, its transportation to Tel Aviv, and its plans to scrap the airframe. An internet publisher named Bollyn came across the faked release when comparing the current GA Telesis press release page to an archived copy months earlier.

Evidence of this has come about through a leaked Defense Red Switch Network communique between Michelle Obama (born as a male; Michael LaVaughn Robinson in Chicago, Illinois on January 17th, 1964) (69) and a Serco agent Subang, Malaysia authorizing the pre-planned abduction of MH370 and the later use of the Tel Aviv Twin by Israel in a False Flag Event.

Original (Google Archive) Page:

Source: web.archive.org/web/20131201071225/http://www.gatelesis.com/category/press/



Note that there is no press release between the two depicted above, being the 11th of October and the 21st of August 2013. Recently, a release backdated to the 4th of October was inserted between them.

Current GA Telesis Page: source: <http://www.gatelesis.com/category/press/page/2/>



The AWACS Cope Tiger - BHUAP Hit 2

At 02:25:27, the Cope Tiger AWACS used Flash Override authority to electronically disengage BHUAP. This is supported by a Log-In request from MH370's SATCOM unit.

Inmarsat have themselves said that this behavior is highly unusual. The AIMS reset (AIMS is where the BHUAP resides) allows time for the AWACS to control MH370 whilst seeking further instruction. By 18:28:14 UTC, communication is lost again save for some basic Inmarsat handshakes.

If one were to propose that the original intent of the abduction was for Serco to steal the Freescale technology, it would be of benefit to have a plan to destroy the evidence (MH370 airframe). Since both Israel and Serco (and including elements at the top of the US Administration and Department of Defense) have been linked to the attacks on 911, it would be a natural conclusion to draw that those same elements were plotting another multi-aircraft style attack that could be blamed on Iranian terrorists to facilitate another US-led war in the Middle East to continue Israel's war on Muslims and subsequent financial dominance.

Cope Tiger is an annual military exercise conducted around Thailand. In 2014 the USAF stated "Aviation and ground units from the U.S. Air Force, the Royal Thai Air Force, Navy and Army, and the Republic of Singapore Air Force is participating in the Cope Tiger 2014 Field Training Exercise (FTX) in Thailand March 10-21.

CT14 is an annual, multilateral, aerial large force exercise conducted in the Asia-Pacific region. It takes place at Korat Royal Thai Air Force base in Thailand. More than 760 personnel will participate in the exercise, including approximately 160 U.S. service members and 600 service members from Thailand and Singapore.

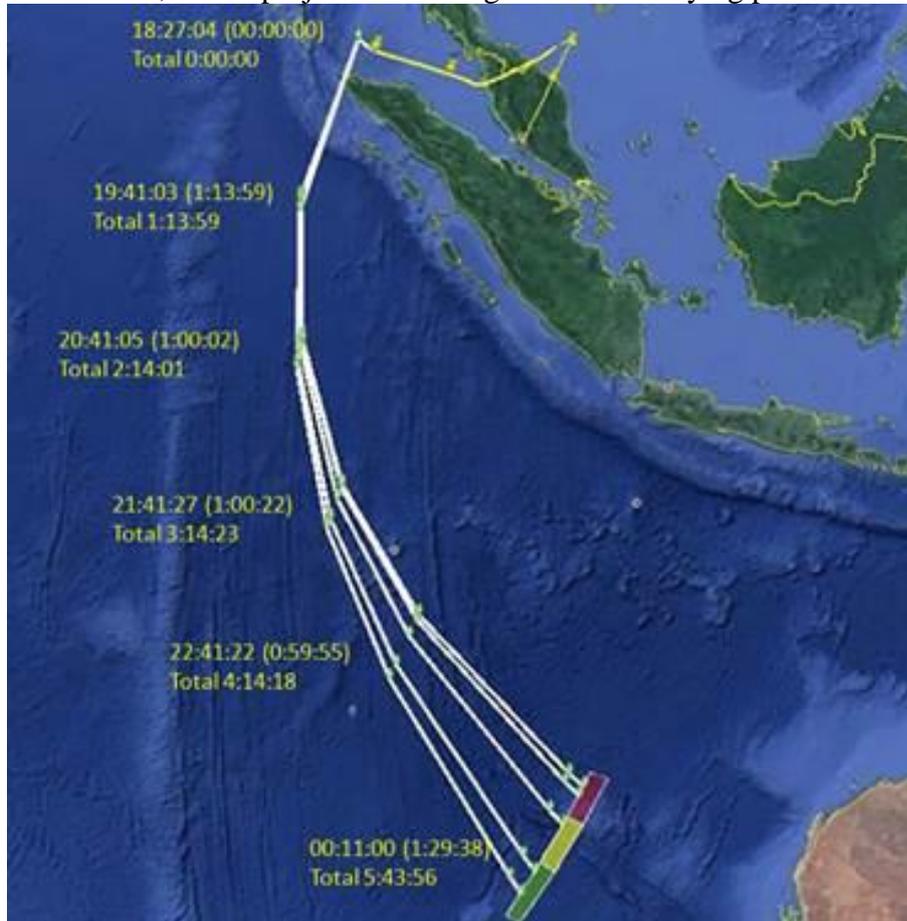
The FTX will involve a combined total of 76 aircraft and 42 air defense units, including 10 U.S. F-15C/D aircraft, and 15 F-16s, six JAS-39s, six F-5s, five ALPHA JETs, six L-39s, one C-130, one BELL 412, and one UH-1H from the Royal Thai Air Force. The Republic of Singapore Air Force will deploy eight F-16s, six F-15SGs, six F-5s, one G550, one KC-135, and two AS332 to the exercise.

The exercise enhances combined readiness and interoperability, reinforces the U.S. commitment to the Asia-Pacific region, and demonstrates U.S. capability to project combined and joint forces strategically in a multilateral environment." (75)

The flight path of MH370 would have taken it right past the Cope Tiger military exercise. There can be no doubt that the US knew that MH370 had been abducted, either through prior knowledge, via monitoring radio communications (such as the emergency aviation channel used to attempt contact with the flight), ATC communications or their own radar.

At the top of the Andaman Sea, at 02:25:27 MYT, MH370 took an unexpected Northerly turn, heading for Thailand and Cope Tiger, under the control of an AWACS. This track was short lived, only lasting until 02:28:14 MYT when communication is lost again. **If we were to presume that an AWACS or similar electronically equipped aircraft from Cope Tiger were to use the Defense Red Switch Network Flash Override facility to reset the B777 AIMS and initiate a second BHUAP abduction, we would see a similar LOG-ON REQUEST AS OBSERVED BY INMARSAT AT 02:25 MYT as the SATCOM system was reset. The Northerly track would coincide with the waiting time required for US Command to get instruction on where to send MH370 to land via BHUAP.**

SATCOM to communicate via Honeywell’s Communication Management Unit which selects the SATCOM service over ACARS (as ACARS had been turned off during BHUAP operation). **The black boxes are still collecting data (required in a hijack situation), which is why the OOOI system is still operational.** If we were to implicate Inmarsat in a cover-up, which we are, the timing within the original data can be faked to reproduce a Southerly track. **1st April 2014** – the final ping locations are released to the public: The 7th radial has gone to be replaced by an Easterly turn counter to the satellite radial and also counter to the curvature of the Earth, which projects as a straight line when flying parallel to latitude.

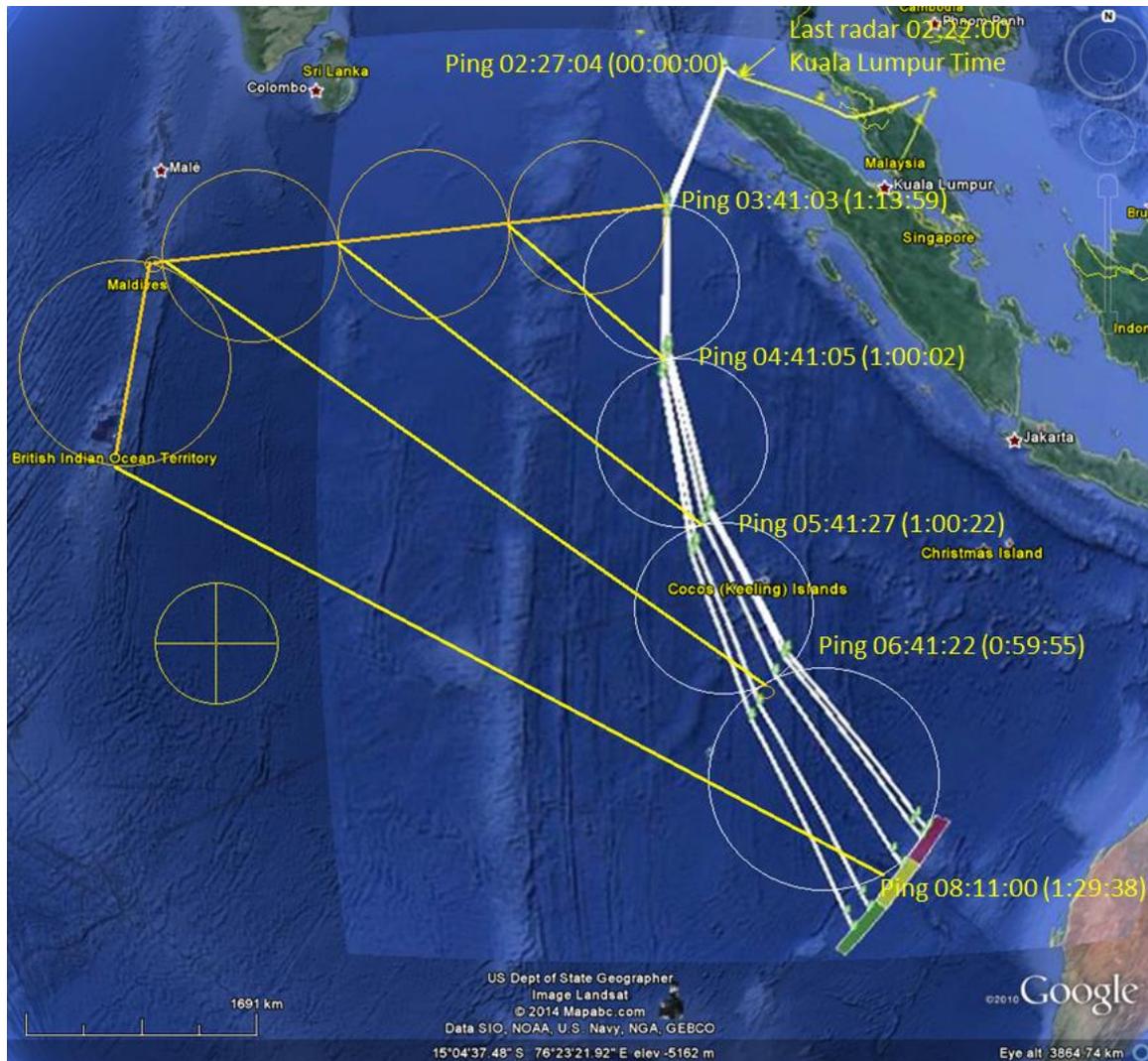


Notice the routine hourly pings from West of Singapore (T+1:13:59) until the second last ping. SATCOM recognises the plane is in cruise and just maintains hourly contact. The ping at T+0:0:0 is not the first ping of the trip, however that’s what we’re calling T+0, and it’s the last routine ping before the OOOI system recognised the aircraft in cruise after the AWACS AIMS reset.

The last ping is delayed because between T+4:14 and T+5:43 the aircraft was descending. As it is not in cruise, SATCOM doesn’t routinely ping every hour if there is a change in flight phase. REMEMBER, all other systems communicating with the ACARS and SATCOM are off, so the SATCOM is just using its own software to trigger an hourly handshake or the OOOI (triggered by a system connected to the black boxes which are still powered).

So, under the assumption that the speed of light hasn’t changed, the as-sent ping times were not manipulated, and let’s also assume that the average speed of the plane in cruise was 330kts (611 kph as an average used by the investigating team), then an alternate flight path

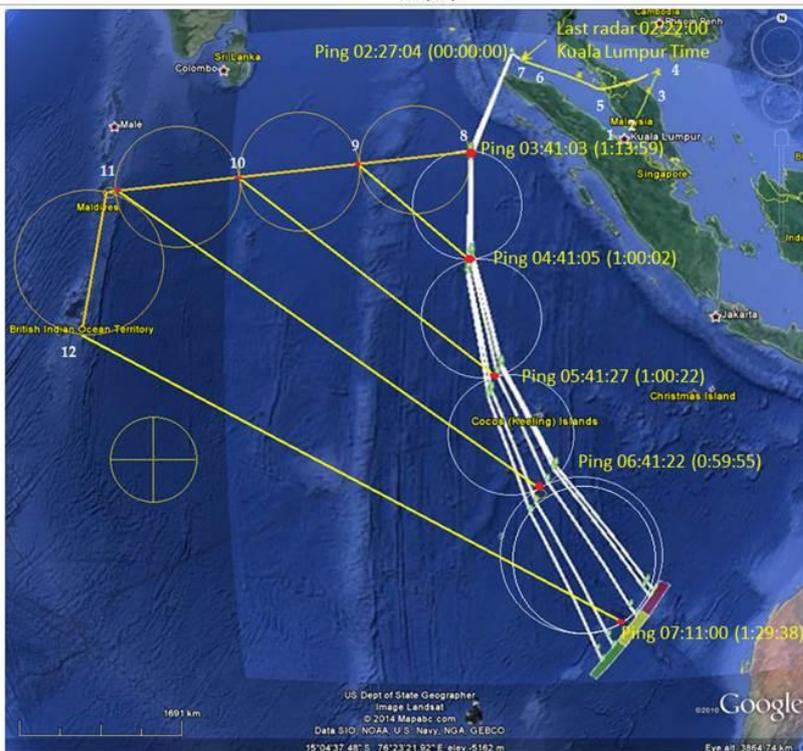
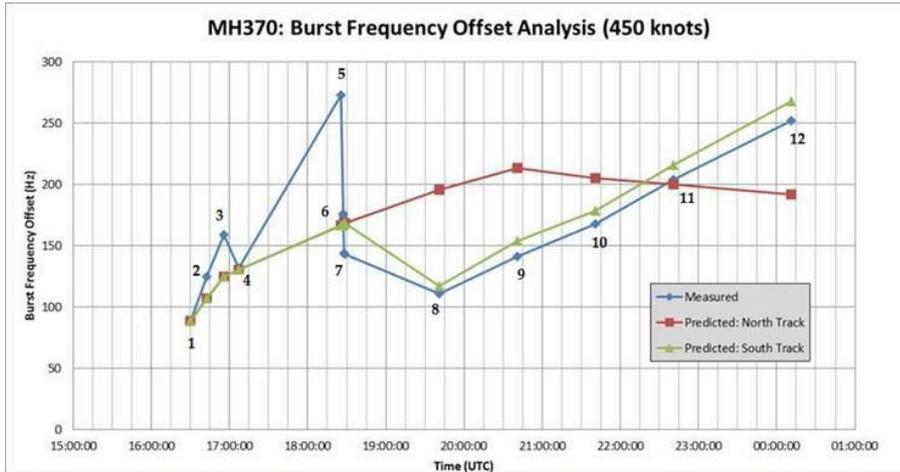
can be suggested that matches the observed ping habits of the SATCOM system (which the official version ignores) and makes it to Diego Garcia in time for the final On ground ping. Incidentally, it ties in with the time that MH370 was seen in the Maldives too, around 6:45am Malaysian time. **The ping times below ARE IN KUALA LUMPUR TIME AND THE SEGMENT LENGTHS MATCH EXACTLY.**



Inmarsat’s further calculations using the known speed of MH370 can create enough of a Doppler-shift in the SATCOM ping as-received frequency that they could calculate the direction the aircraft was travelling relative to the satellite, and that it was not travelling directly down the 45 degree radial as previously claimed.

They claimed this was the first time anyone had done this calculation in this way, calling it novel. Called Frequency Burst Analysis, this technique is not new or novel, which is why it has a name in Inmarsat’s 2009 patent on the subject.

The frequency burst is the difference between the expected frequency and the as-arrived frequency. The burst analysis, according to Inmarsat’s patents, has to be corrected by the satellite system to resolve the digital data encoded within it, so it automatically corrects for satellite position and motion. Inmarsat published the Frequency Burst Off-set which we have juxtaposed above the two projected flight tracks. A positive FBO correlates with MH370 flying towards the satellite above FJDG.



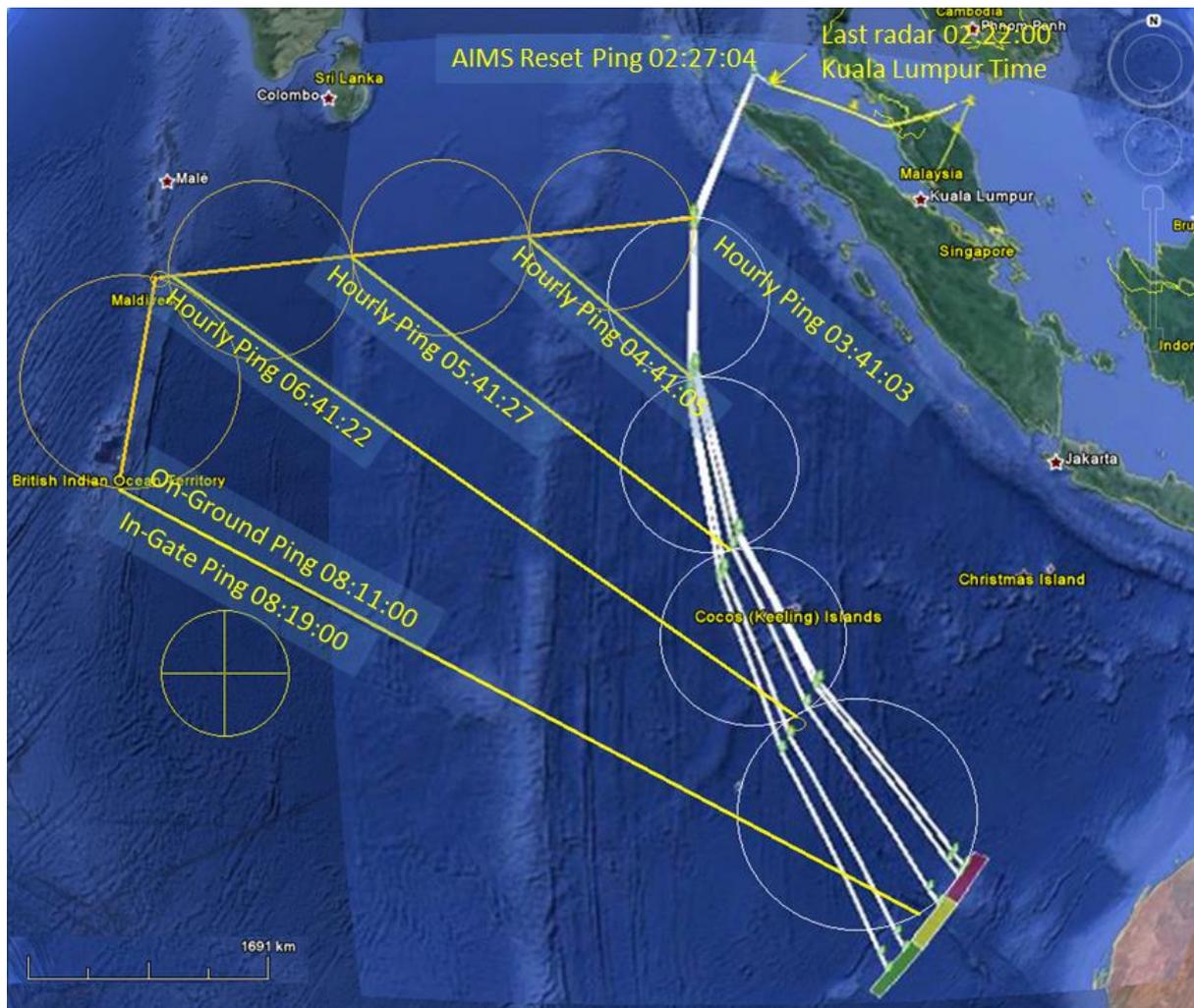
The first thing to notice is that the Burst Off-set is always positive, and second they do not show which satellite recorded the earliest pings (Points 1 to 7 weren't necessarily the same satellite that is over Diego Garcia as claimed by Inmarsat). We can see 3 things from the graph. 1 – Inmarsat has polished the data so that we cannot back-calculate it. 2 – The MH370 SATCOM system had a consistent frequency error in the transmitter around 90 Hz greater than the frequency it was meant to transmit on, or the satellite had a frequency error consistently 90 Hz lower than the frequency it is meant to receive on. 3 – MH370 WAS CONSISTENTLY TRAVELLING TOWARDS DIEGO GARCIA as the last burst offsets are increasing.

THE INMARSAT DATA, AS PRESENTED BY THEM IN THE GRAPH ABOVE, SUPPORTS A FLIGHT ROUTE TOWARDS DIEGO GARCIA, NOT PARALLEL OR AWAY FROM IT. THIS IS COMPLETELY BESIDE THE FACT THAT WE BELIEVE THEIR TIME DATA HAS BEEN ALTERED TO 'FLY THE PLANE SOUTH'. Even if you swapped the polarity of the burst offset between points 8 and 12 to a negative, this would

then be at odds with MH370 confirmed flying towards Diego Garcia between points 4 and 5, which again confirm that trajectory according to the data. **Even given the odd error that can occur with assumptions, a Westerly flight track still has a better fit with the burst-offset data than a track to the South.**

It is duly noted by the authors that Inmarsat has officially redacted their frequency burst offset calculations after the publication of the above images on the internet and separately through public pressure for them to reveal the methods used for scrutiny.

Sadly, after almost 4 months, Inmarsat has finally revealed that the last ping, received at 08:19 MYT was “an unusual LOG-ON request”. AT 08:11 THE SATCOM SYSTEM PINGED TO SEND AN “ON-GROUND” FLIGHT MODE CHANGE as MH370 landed at FJDG and the weight of the aircraft armed the squat switches in the landing gear. AT 08:19, JUST 8 MINUTES LATER, THE “IN-GATE” PING INITIATED BY THE PARK-BREAK BEING APPLIED AND THE 1 & 2 FUEL-FLOW SWITCHES BEING TRIPPED caused the SWIFT system to attempt a routine LOG-IN via the SATCOM system, as happens at any airport gate.



The last cruel twist, FJDG administration is run by Serco. It is possible that the AWACS hit by the USAF in Cope Tiger was anticipated and needed by the perpetrators, giving them plausible deniability, whilst the US was then goaded into a cover-up as they had initially used the BHUAP during 911. Serco, KNOWN FOR EXTORTION, could then extort the US further as getting rid of MH370 and the remaining passengers had to be accomplished by the US military. If not, then the US's involvement in 911 will be revealed.

Serco could then take the cargo or Freescale employees and not have to clean up the mess. Israel could then use the Tel Aviv Twin to conduct a terrorist attack, pretending 9M-MRI was MH370. The US has long been humiliated by Serco and Israel (and the City of London Livery Companies). We would contend that this is a continuation of that as Israel draws the US into another war in the Middle East whilst having a second swipe at Malaysian Islamists.

The Continued Search

It is anticipated that MH370 would be dumped by ship somewhere inside the Serco-trained, Australian-led search zone possibly to be found later. The aircraft cannot be powered up without Malaysia, Rolls Royce, Boeing or Inmarsat receiving an inexplicable SATCOM or ACARS ping. (76)

Another scenario might see yet another crashed jetliner with bodies on board from MH370, MH17 for example.

Appendix 1 – London Evening Standard & the Daily Mail

New autopilot will make another 9/11 impossible Published: 03 March 2007



A hijack-proof piloting system for airliners is being developed to prevent terrorists repeating the 9/11 outrages.

The mechanism is designed to make it impossible to crash the aircraft into air or land targets - and enable the plane to be flown by remote control from the ground in the event of an emergency.

Scientists at aircraft giant Boeing are testing the tamper-proof autopilot system which uses state-of-the-art computer and satellite technology.

It will be activated by the pilot flicking a simple switch or by pressure sensors fitted to the cockpit door that will respond to any excessive force as terrorists try to break into the flight deck.

Once triggered, no one on board will be able to deactivate the system. Currently, all autopilots are manually switched on and off at the discretion of pilots.

The so-called 'uninterruptible autopilot system' - patented secretly by Boeing in the US last week - will connect ground controllers and security services with the aircraft using radio waves and global satellite positioning systems.

After it has been activated, the aircraft will be capable of remote digital control from the ground, enabling operators to fly it like a sophisticated model plane, manoeuvring it vertically and laterally. A threatened airliner could be flown to a secure military base or a commercial airport, where it would touch down using existing landing aids known as 'autoland function'.

After it had landed, the aircraft's built-in autobrake would bring the plane safely to a halt on the runway.

Boeing insiders say the new anti-hijack kit could be fitted to airliners all over the world, including those in the UK, within the next three years.

The latest move to combat airline terrorists follows The Mail on Sunday's disclosure three weeks ago that scientists in Britain and Germany are developing a passenger-monitoring device. This will use tiny cameras linked to specialist computers to record every twitch, blink, facial expression or suspicious movement made on board flights in order to identify potential terrorists.

A Boeing spokesman said: "We are constantly studying ways we can enhance the safety, security and efficiency of the world's airline fleet.

"There is a need in the industry for a technique that conclusively prevents unauthorised persons gaining access to the controls and threatening the safety of passengers. Once this system is initiated, no one on board is capable of controlling the flight, making it useless for anyone to threaten violence in order to gain control."

Appendix 2 – Homeland Security News Wire

Boeing wins patent on uninterruptible autopilot system Published 4 December 2006

New technology can be activated by the pilots, government agencies, even on-board sensors; not even a tortured pilot can give up control; dedicated electrical circuits ensure the system's total independence

Although airplane cockpit door locks are now standard, worries remain about terrorists taking control of a plane a la 9/11, perhaps by extorting the pilots into opening the door against their better judgement. Elsewhere in today's issue we report on a new Raytheon contract to develop software that uses type of craft, location, and fuel capacity to determine the safest route for a hijacked or otherwise compromised aircraft. This is a great idea, one that must have Chicago, Illinois-based Boeing excited — not out of envy but because it improves the value of its recently awarded patent for a system that, once activated, takes control of the airplane away from the pilots and flies it to a predetermined landing position. Put the Raytheon and the Boeing systems together — now that's a good idea.

Boeing's is, of course, not the first autopilot technology in existence, but this one has been designed with counterterrorism first and foremost in mind. Not only is it "uninterruptible" — so that even a tortured pilot cannot turn it off — but it can be activated remotely via radio or satellite by government agencies. The system might even include sensors on the cockpit door that activate the autopilot if a certain amount of force is used against it. "There is a need for a technique that ensures the continuation of the desired path of travel of a vehicle by removing any type of human decision process that may be influenced by the circumstances of the situation, including threats or further violence on-board the vehicle," the patent application explains. To make it fully independent, the system also has its own power supply, independent of the aircraft's circuit breakers.

Appendix 3 – Excerpt from Jim Marrs’ book “The Terror Conspiracy Revisited”

The Global Hawk program is managed by DARPA for the Defense Airborne Reconnaissance Office. The primary contractor is Teledyne Ryan Aeronautical and the principal suppliers are Raytheon Systems, Allison Engine Co., Boeing North American, and L3 Com. So what does this unmanned flight system have to do with September 11?

Former German Defense Minister Andreas von Bülow, in a **January 13, 2002**, interview with the newspaper *Tagesspiegel*, in speaking about the 9/11 attacks, noted, “There is also the theory of one British flight engineer [and] according to this, the steering of the planes was perhaps taken out of the pilots’ hands from outside. The Americans had developed a method in the 1970s whereby they could rescue hijacked planes by intervening into the computer piloting [the electronic flight system]. This theory says this technique was abused in this case.” Von Bülow could well have knowledge of this technology as several researchers and websites have stated that **Lufthansa**, Germany’s national airline, was aware of the possibility of electronic capture and had quietly stripped the flight control systems out of its American-built jetliners in the early 1990s.

The British flight engineer Von Bülow mentioned is Joe Vials, a journalist, author, private investigator, and a former member of the Society of Licensed Aeronautical Engineers and Technologists based in London. In an article published on several websites, Vials claimed, “[T]wo American multinationals collaborated with the Defense Advanced Research Projects Agency (DARPA) on a project designed to facilitate the remote recovery of hijacked American aircraft. Brilliant both in concept and operation, ‘Home Run’ [Vials’ designation, not its real code name] allowed specialist ground controllers to listen in to cockpit conversations on the target aircraft, then take absolute control of its computerized flight control system by remote means.” wrote Vials in late 2001.

“From that point onwards, regardless of the wishes of the hijackers or flight deck crew, the hijacked aircraft could be recovered and landed automatically at an airport of choice, with no more difficulty than flying a radio-controlled model airplane. The engineers had no idea that almost thirty years after its initial design, Home Run’s top-secret computer codes would be broken [or passed to unauthorized personnel] and the system used to facilitate direct ground control of four aircraft used in the high-profile attacks in New York and Washington on 11 September 2001.”

After news of Global Hawk and its remote-controlled capability was first released, there was speculation that UAV technology might be used to thwart airline hijackings. Once a hijacking took place, the Global Hawk flight technology would be triggered and the electronically captured plane flown to a landing at a safe location regardless of the actions of the flight crew or the hijackers.

The seemingly outlandish suggestion that remote-controlled planes were crashed into American targets is backed by several intriguing facts, beginning with a little-noticed item in the September 28, 2001, edition of the *New York Times* in which President Bush announced his plans to protect air passengers. Along with the usual proposals, such as strengthening cockpit doors and transponders that cannot be turned off, he mentioned “new technology, probably far in the future, allowing air traffic controllers to land distressed planes by remote control.” Apparently, Bush was familiar with the Global Hawk technology but chose to present it as technology not yet available.

One aviation authority who did speak out on remote control was Robert Ayling, former CEO of British Airways who was quoted in *The Economist* in 2001 suggesting “aircraft could be commandeered from the ground and controlled remotely in the event of a hijack.”

Appendix 4 – Flight International Magazine

Recovery system will override pilot Published 20 September 2005

Source: **FLIGHT**
INTERNATIONAL

00:00 20 Sep 2005

Honeywell talking to Airbus and Boeing about fitting device aimed at preventing 9/11-style hijack

Honeywell is in talks with Airbus and Boeing about installing a recovery system that uses the automatic flight control system in fly-by-wire airliners to override pilots who set a course that would enter restricted airspace or intentionally collide with buildings.

Honeywell's marketing strategy for the "automatic" or "assisted" recovery system is focused on gaining acceptance with the Airbus A350 and the Boeing 787, with the former seen as the more natural candidate given Boeing's philosophical objections to any system that overrides the pilot's control of the aircraft.

A retrofit option for existing fly-by-wire airliners is deemed unlikely because of the high costs of development and certification.

Flight tests of the system were conducted in April this year with a United Airlines A319 in airspace near Monterrey, California. Honeywell says the tests demonstrated that the automatic flight controls could be reprogrammed to assume control of the airliner, rather than simply give the pilot a warning. The system also has been tested in flight aboard Honeywell's Beech King Air testbed.

The automatic recovery system is essentially an upgrade to Honeywell's enhanced ground proximity warning system (EGPWS), which uses a worldwide terrain database to alert pilots to obstacles such as mountains. Automatic recovery would require adding "virtual keep-out areas", such as restricted airspace above the White House, into flight computers equipped with the EGPWS terrain database.

The system would give the pilot a warning as the aircraft enters a buffer zone around restricted airspace or certain prominent buildings. If the pilot fails to respond to the warning, the flight controls would override the pilot's commands and steer the aircraft out of the danger zone.

STEPHEN TRIMBLE/WASHINGTON DC

Appendix 5 – Wired News

Flying Safety Put on Auto-Pilot

Wired News Report 08.12.03

Airbus and Honeywell are close to perfecting technology that takes control of airplanes to prevent them from crashing into obstacles, *The Wall Street Journal* reports. When audible warnings from crash-avoidance systems are ignored, the system overrides actions by the pilot and takes evasive manoeuvres, the newspaper said.

The system would link crash-warning devices, already common on airliners, with cockpit computers that could automate flying to prevent collisions, executives from Honeywell (HON) said. Tests have shown "promising results," but the idea of completely turning an airplane's controls over to a computer could make people nervous.

European airplane maker Airbus, owned by EADS (EAD) and Britain's BAE Systems, has been working on the project with Honeywell for years, although development sped up after the Sept. 11, 2001 hijacking attacks. The team may have beaten NASA, the Pentagon and Boeing to the finish line.

A prototype of the system, which could keep planes from crashing into mountains and prevent the use of aircraft as weapons, has been tested on a limited scope on small aircraft, the report said.

Appendix 6 – The Wall Street Journal

Airbus, Honeywell Devise Anticrash System for Jets

By

Andy Pasztor Staff Reporter of THE WALL STREET JOURNAL

Updated Aug. 12, 2003 12:01 a.m. ET

Nearly two years after the Sept. 11, 2001, terrorist attacks, Airbus and Honeywell International Inc. have devised a cockpit-automation system that would take control of jetliners to keep them from flying into natural or man-made obstacles.

By linking existing onboard crash-warning devices with advanced cockpit computers, the technology pushes the envelope to prevent hijackers from using airliners as weapons. It also would preclude accidental collisions with mountains or the ground, the most frequent cause of commercial-aircraft fatalities.

A prototype has had limited testing on small aircraft and shown promising results, though the concept remains highly controversial. The challenge is to convince regulators that it can work reliably in large aircraft, a task that could keep the system from being installed for years. Furthermore, the idea is sure to stir debate among pilots and the flying public, who are bound to be sceptical about fully turning an airplane's controls over to a computer.

Airbus, the big European jet maker, and Honeywell, an aerospace and industrial manufacturer in Morris Township, N.J., have been working on the so-called Auto-Avoid principle for years. That effort accelerated after the Sept. 11 attacks and is particularly timely in light of recent government warnings of possibly more suicide hijackings of planes. The National Aeronautics and Space Administration, the Pentagon and rival jet maker Boeing Co. are all pursuing their own research into crash-prevention devices, but none are believed to be as far along as Honeywell and Airbus.

Implementation of such technology would mark a Holy Grail for the aviation industry, as it would represent a foolproof means of preventing air crashes that aren't caused by mechanical failures. Every year, a dozen or more perfectly functioning passenger planes smash into mountains, barely avoid obstacles such as radio towers, or end up slamming into the ground because cockpit crews simply lost track of their position.

The new system also is intended to prevent deliberate disasters, as occurred on Sept. 11. In another closely followed incident, an EgyptAir jet with 214 people aboard crashed into the Atlantic south of Nantucket Island in 1999 after its autopilot was disengaged and engines turned off. Investigators concluded that a co-pilot purposely put the aircraft into a steep dive.

Pilots flying today's sophisticated jetliners routinely use autopilots to climb, navigate and land planes -- with minimal intervention by anyone in the cockpit. And Honeywell already sells "enhanced ground-proximity warning" devices specifically intended to alert pilots if their aircraft is headed toward the ground. The final alerts include a synthetic human voice loudly repeating the message: "Terrain! Pull up! Pull up!"

Taking that principle to a new level, the latest technology allows an aircraft's computers to instantly seize control when such audible warnings are ignored, or when a plane tries to enter computer-generated "no-fly zones" around skyscrapers, monuments and government buildings. The system would override pilot commands if necessary and, on its own, take evasive action. "If a pilot veers off course" substantially for any reason and fails to respond to repeated warnings, "the airplane will take over and fly" the correct path, says Robert Johnson, chief of Honeywell's aerospace unit.

Using a laptop computer in the cabin of a specially equipped twin-engine King Air turboprop, Honeywell has conducted some flight tests to demonstrate crash-avoidance manoeuvres. The results have been promising enough to gain credibility in the industry, prompting Honeywell to hold preliminary discussions with various carriers, regulators and pilot representatives. For widespread acceptance, though, proponents will have to demonstrate that the automatic safeguards will kick in only in an emergency and won't react to false warnings.

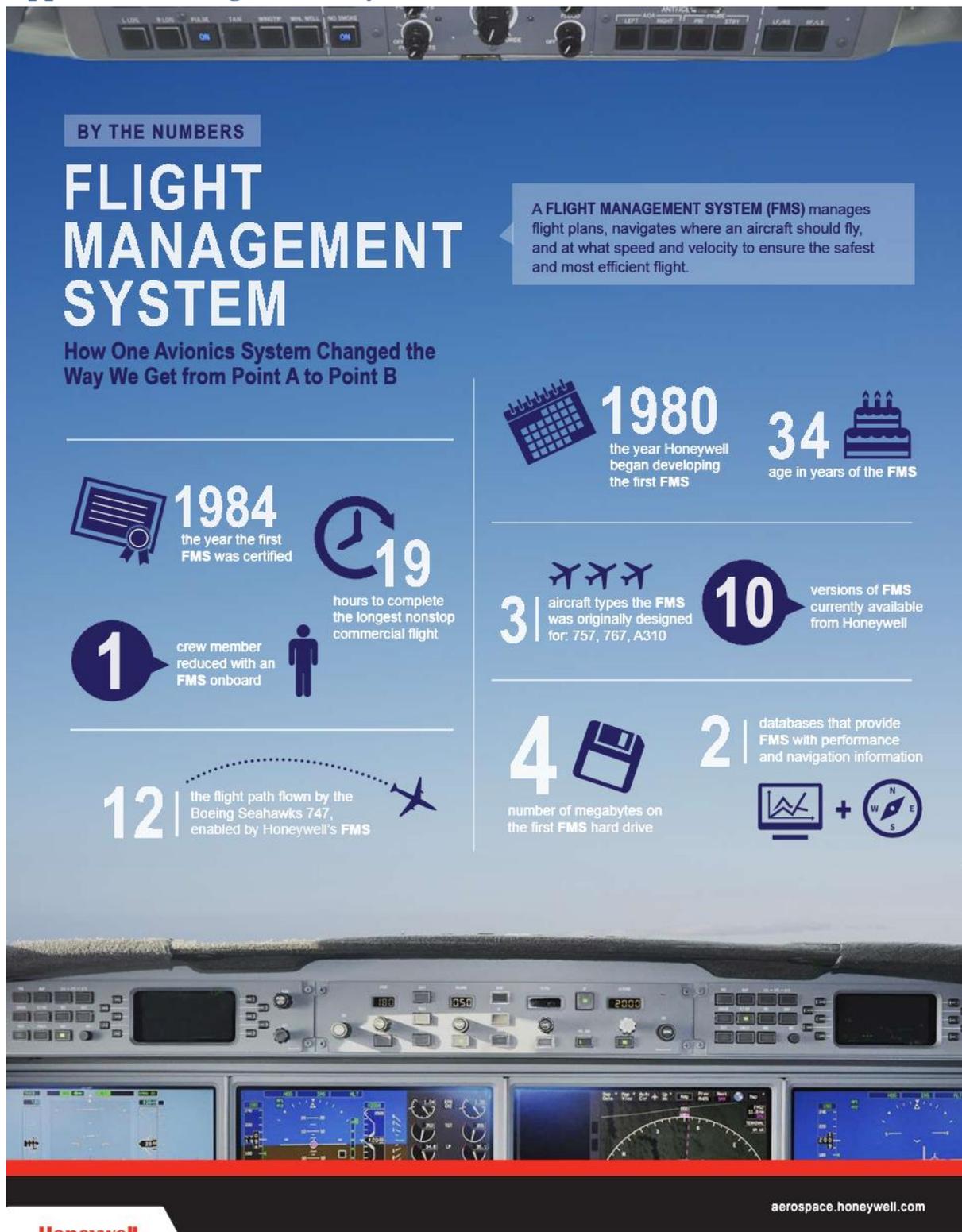
There also are questions about how sudden diversions from flight paths would be coordinated with air-traffic controllers, particularly in crowded skies over urban areas. (When Honeywell simulated an airborne emergency around Washington, D.C., recently, its test plane weaved in and out of airspace reserved for two different airports.)

"We have been working hard on this for three years," but still "haven't found a way to be able to satisfy regulators" about reliability issues, says Robert Lafontan, chief engineer for the Airbus A380 "superjumbo," which is destined to be the largest jetliner ever built. But he is optimistic the system may be phased in during later production of A380 models, which are slated to begin service by 2006.

Pilots oppose giving up ultimate decision-making authority. Eventually they may embrace the Auto-Avoid system, but "only if there is some way it can be turned off by the crew," said John Cox, air-safety chairman of the Air Line Pilots Association.

But allowing crew members to disable it would defeat one of the main purposes, to thwart hijackers. Since few other industry initiatives boast both safety and security components, the system is a natural for continued funding.

Appendix 7 – Original Honeywell FMS Flier



BY THE NUMBERS

FLIGHT MANAGEMENT SYSTEM

How One Avionics System Changed the Way We Get from Point A to Point B

A **FLIGHT MANAGEMENT SYSTEM (FMS)** manages flight plans, navigates where an aircraft should fly, and at what speed and velocity to ensure the safest and most efficient flight.

- 1980** the year Honeywell began developing the first FMS
- 34** age in years of the FMS
- 1984** the year the first FMS was certified
- 19** hours to complete the longest nonstop commercial flight
- 1** crew member reduced with an FMS onboard
- 3** aircraft types the FMS was originally designed for: 757, 767, A310
- 10** versions of FMS currently available from Honeywell
- 12** the flight path flown by the Boeing Seahawks 747, enabled by Honeywell's FMS
- 4** number of megabytes on the first FMS hard drive
- 2** databases that provide FMS with performance and navigation information

Honeywell aerospace.honeywell.com

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