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In-Trail Procedure Air Traffic Control Procedures Validation Simulation Study

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Acronyms

ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
AIF	Aeronautical Information
Airservices	Airservices Australia
ASAS	Airborne Separation Assistance System
ASD	Air Situation Display
ATC	air traffic control
ATG	Air Traffic Generator
ATM	Air Traffic Management
ATOL	Airspace and Traffic Operations Laboratory
ATSA	Airborne Traffic Situation Awareness
ATSP	Air Traffic Service Provider
BIGHT	Bight (ATC Group)
CASA	Civil Aviation Safety Authority
CFL	Cleared Flight Level
CPDLC	Controller Pilot Data Link Communications
DME	Distance Measuring Equipment
EUROCAE	European Organization for Civil Aviation Equipment
F	following
FIR	Flight Information Region
FL	flight level
FPL	flight plan
fpm	feet per minute
ft	feet
HF	High Frequency
HMI	human machine interface
ICAO	International Civil Aviation Organization
IFER	In Flight Emergency Response
IND	Indian (ATC sector)
INE	Indian East (ATC sector)
INS	Indian South (ATC sector)
ITP	In-Trail Procedure
kts	knots
L	leading
LaRC	Langley Research Center
LoA	Letter of Agreement
M	mean
MCH	Modified Cooper-Harper
Metrad	Meteorological Radar
NASA	National Aeronautics and Space Administration
nmi	nautical miles
NUL	Nullarbor (ATC sector)
OpSpecs	Operations Specifications
p	probability; level of (statistical) significance
PDC	Pre-Departure Clearance
PIL	Pilbara (ATC sector)
Q	Q statistic
RADAR	Radio Detection and Ranging

RAIM	Receiver Autonomous Integrity Monitoring
RFL	requested flight level
RFG	Requirements Focus Group
RIS	Radar Information Services
RTCA	formerly Radio Technical Commission for Aeronautics
SASP	Separation and Airspace Safety Panel
SD	standard deviation
SPR	Safety, Performance, and Interoperability Requirements
TAAATS	The Australian Advanced Air Traffic System
TFMS	Traffic Flow Management System
TGO	Target Generation Officer
VHF	very high frequency
WEST P	West Procedural (ATC group)

Definitions

Airservices Australia (Airservices). Airservices Australia is a government-owned corporation providing safe and environmentally sound air traffic management (ATM) and related airside services to the aviation industry. The Australian flight information region (FIR) covers 11% of the earth's surface including not only Australian airspace but also international airspace over the Pacific and Indian Oceans.

Automatic Dependent Surveillance-Broadcast (ADS-B). A system by which aircraft can constantly broadcast state, environment, and intent information. This can include: current position and altitude, category of aircraft, ground speed, flight number, whether the aircraft is turning, climbing or descending, and integrity indicators over a radio datalink.

Automatic Dependent Surveillance-Contract (ADS-C). ADS-C enables appropriately equipped aircraft to send position information messages at predetermined geographical locations, at specified time intervals or at the occurrence of specified events. ADS-C can be relayed via SATCOM data link, or VHF data link.

Controller Pilot Data Link Communication (CPDLC). A means of communications between Controller and Pilot, using text-based messages via an air traffic control (ATC) data link.

Flight Level (FL). A surface of constant atmospheric pressure, which is related to a specific pressure datum, and is separated from other such surfaces by specific pressure intervals. Each is stated in three digits that represent hundreds of feet (ft). For example, flight level 370 (FL370) represents a barometric altimeter indication of 37,000 ft.

Following Climb or Descent. A same track climb or descent performed by an aircraft when following another aircraft.

Ground Speed Differential. The difference between the In-Trail Procedure (ITP) Aircraft's ground speed and a Reference Aircraft or same-direction, potentially-blocking aircraft's ground speed.

Initial Flight Level. The flight level of the ITP Aircraft when the flight crew determines that a climb or descent is desired.

Intermediate Flight Level. Any flight level between, but not including, the Requested Flight Level and the Initial Flight Level of the ITP Aircraft.

Intervening Flight Level. Any flight level between the Requested Flight Level and the Initial Flight Level of the ITP Aircraft that has same-direction aircraft whose ADS-B report data are available to the ITP Aircraft.

In-Trail Procedure (ITP). A procedure employed by an aircraft that desires to change its flight level to a new flight level by climbing or descending in front or behind one or two same-track, potentially-blocking aircraft which are at an intervening flight level.

ITP Aircraft. An aircraft that is fully qualified (from an equipment, operator, and flight crew qualification standpoint) to conduct an ITP and whose flight crew is considering a change of flight level.

ITP Criteria. A set of conditions that must be satisfied prior to initiating or executing an ITP clearance.

ITP Distance. The distance between Reference Aircraft or potentially-blocking aircraft and the ITP Aircraft as defined by the difference in distance to a common point along each aircraft's track. For the special case of parallel tracks, an along-track distance measurement would be used to determine this value.

ITP Separation Minimum. The longitudinal separation minimum between the ITP Aircraft and Reference Aircraft. The ITP separation minimum is based on the International Civil Aviation Organization (ICAO) Distance Measuring Equipment (DME) separation method and is 10 nautical miles (nmi).

ITP Equipment. Equipment needed on the ITP Aircraft that provides ADS-B information on potentially blocking aircraft with regard to ADS-B data qualification (i.e., information sufficient to determine if ADS-B data are, or are not, qualified ADS-B data), same direction, ITP distance, ground speed differential, flight level, and aircraft identification.

ITP Speed/Distance Criteria. A specified set of maximum positive ground speed differential and minimum ITP distance values between a same-direction, potentially-blocking aircraft and the ITP Aircraft, required to be met prior to requesting or initiating an ITP with that aircraft as a Reference Aircraft.

Leading Climb or Descent. A same-track climb or descent performed by an aircraft when ahead of another aircraft.

National Aeronautics and Space Administration (NASA). An agency of the United States government whose mission is to pioneer the future in space exploration, scientific discovery and aeronautics research.

Other Aircraft. All aircraft that are not either the ITP Aircraft or Reference Aircraft.

Positive Ground Speed Differential. A ground speed differential value where the ITP Aircraft and the Reference Aircraft are closing on each other (the separation is being reduced).

Positive Mach Difference. The difference in Mach between the ITP Aircraft and the Reference Aircraft that would result in the aircraft closing on each other (the separation is being reduced).

Potentially Blocking Aircraft. Aircraft at an intervening flight level whose ADS-B report data are available to the ITP Aircraft.

Procedural Control: Term used to indicate that information derived from an Air Traffic Service (ATS) surveillance system is not required for the provision of air traffic control services.

Qualified ADS-B Data. Received ADS-B data that meet the accuracy and integrity requirements determined to be required for the ITP.

Reference Aircraft. One or two same direction, potentially blocking aircraft with qualified ADS-B data that meet the ITP speed/distance criteria and that will be identified to ATC by the ITP Aircraft as part of the ITP clearance request.

Requested Flight Level. A Flight Level above (for a climb) or below (for a descent) all intervening flight levels that is no more than 4000 feet from the initial flight level.

Same Direction. Same direction tracks and intersecting tracks or portions thereof, the angular difference of which is less than 45 degrees or more than 315 degrees.

Same Track. Same direction tracks and intersecting tracks or portions thereof, the angular difference of which is less than 45 degrees or more than 315 degrees, and whose protection areas overlap (i.e., without lateral separation).

Similar Track. Instantaneous tracks that are identical, parallel, or converge or diverge at less than 45 degrees or more than 315 degrees.

Abstract

In August 2007, Airservices Australia (Airservices) and the United States National Aeronautics and Space Administration (NASA) conducted a validation experiment of the air traffic control (ATC) procedures associated with the Automatic Dependant Surveillance-Broadcast (ADS-B) In-Trail Procedure (ITP). ITP is an Airborne Traffic Situation Awareness (ATSA) application designed for near-term use in procedural airspace in which ADS-B data are used to facilitate climb and descent maneuvers. NASA and Airservices conducted the experiment in Airservices' simulator in Melbourne, Australia. Twelve current operational air traffic controllers participated in the experiment, which identified aspects of the ITP that could be improved (mainly in the communication and controller approval process). Results showed that controllers viewed the ITP as valid and acceptable. This paper describes the experiment design and results.

Introduction

In August 2005, Airservices Australia (Airservices) and the United States National Aeronautics and Space Administration (NASA) signed a Letter of Agreement (LoA) to undertake collaborative research on Air Traffic Management (ATM) decision-support automation, communication, navigation and surveillance. One project completed under the LoA focused on validating the Automatic Dependent Surveillance-Broadcast (ADS-B) In-Trail Procedure (ITP), a new airborne procedure that leverages the benefits of ADS-B to provide a means for pilots to make more informed requests of Air Traffic Service Providers (ATSPs) and enable altitude changes that previously would not have been approvable. Intended for use in non-RADAR (radio detection and ranging) airspace that employs procedural separation, the ITP uses airborne ADS-B data, onboard tools, and a new separation standard based on these data and tools to provide ADS-B-equipped aircraft with better access to preferred flight levels in oceanic and other remote airspace.

Researchers at the Air Traffic Operations Laboratory (ATOL) at NASA Langley Research Center (LaRC) and The Advanced Australian Air Traffic System (TAAATS) Air Traffic Control (ATC) simulation facility at Airservices' Melbourne Centre conducted ground-based simulations to determine 1) whether the ITP is a viable, valid, and acceptable procedure that will not adversely impact a pilot's (ATOL experiment) or controller's (TAAATS experiment) workload, and 2) whether the ITP can be seamlessly integrated into current operations. This paper describes the TAAATS experiment design, simulation environment, and results.

The paper is organized as follows: The first section describes the new airborne procedure. The next section briefly describes the experiment hypotheses and objectives, followed by a description of the methodology and simulation facility. A description of the experiment design follows, which includes the use of modified training scenarios (to represent a realistic controller workload), scripted errors (to test controller reaction to pilot errors), and post-experiment questionnaires (to assess controller response to the ITP). The next section briefly describes the participation of 12 subject controllers in classroom training. A detailed discussion of the research results follows, including an analysis of the subject controller errors, technical issues that arose during the simulations, and controller assessments of the ITP. The paper closes with a detailed discussion of the research findings and a brief conclusion.

Background

In the current ATC system, aircraft operating in airspace without surveillance are frequently held at non-optimal flight levels due to conflicting traffic at the optimal flight level and at flight levels between the current and optimal flight level. During peak travel times, traffic produces local congestion at the most common cruising altitudes. This generally requires some aircraft to fly at altitudes other than those requested, which may be less fuel-efficient. Large, procedural separation standards used in non-surveillance airspace (such as oceanic airspace) exacerbate the problem.

To address the problem, researchers at NASA LaRC are developing a new airborne procedure that leverages ADS-B technology to help pilots improve local surveillance of ADS-B-equipped aircraft and enable pilots that would like to make flight level changes in procedural airspace to achieve them more frequently. The new procedure could also improve flight efficiency, increase safety, minimize fuel burn and other environmental impacts, and reduce operating costs.

The ITP development done by NASA LaRC was used in the RTCA/European Organization for Civil Aviation Equipment (EUROCAE) sponsored Requirements Focus Group (RFG) and the International Civil Aviation Organization (ICAO) Separation and Airspace Safety Panel (SASP). These organizations used the data for the development of standards for ITP. A complete description of the procedure can be found in the Safety, Performance, and Interoperability Requirements (SPR) document for the Airborne Traffic Situation Awareness In-Trail Procedure (ATSA-ITP) application [1].

ITP Description

The ITP enables a pilot to make use of greater situation awareness when making a request for a flight level change by using ADS-B data provided by proximate aircraft. With the ITP, leading aircraft or following aircraft classified as same-track can perform a climb or descent to a Requested Flight Level (RFL) through intervening flight levels, as shown in Fig. 1. The crew uses information derived from ADS-B equipment onboard the aircraft to determine if specific criteria for an ITP have been met with respect to one or two Reference Aircraft at intervening flight levels. The ITP speed/distance criteria are designed such that the estimated positions between the ITP Aircraft and Reference Aircraft are no closer than the ITP separation minimum until vertical separation between the ITP Aircraft and Reference Aircraft is re-established. Once these criteria have been met, the flight crew may request an ITP while identifying the Reference Aircraft in the request. ATC verifies that the ITP Aircraft and Reference Aircraft are same-track and do not exceed the maximum positive Mach differential. The positive Mach differential check accounts for potentially larger closure rates due to abnormal, adverse wind gradient conditions during climb and descent maneuvers. If the controller then determines that separation minima have been met with all other aircraft, the climb or descent request is granted. The controller does not determine or verify the separation distance between the ITP Aircraft and the Reference Aircraft.

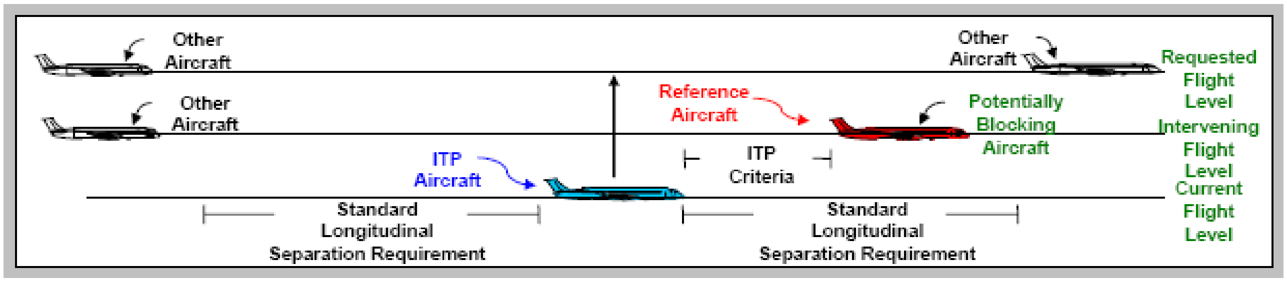

Figure 1: ITP Terminology

The ITP is an Airborne Traffic Situational Awareness application. The procedure does not change current responsibilities of pilots or controllers, although it includes new tasks for the flight crew, who must determine if the ITP criteria have been met. The flight crew continues to be responsible for the operation of the aircraft and conformance to its clearance, and the air traffic controller continues to be responsible for separation and the issuance of clearances. The ITP does not require the crew to monitor or maintain spacing between aircraft during the ITP maneuver. The safety of the aircraft using the ITP is determined by the initial conditions: ITP distance, ground speed differential, vertical speed, and the vertical distance of the flight level change. The ITP initiation criteria are designed such that the proposed 10 nautical miles (nmi) separation minimum is preserved during the ITP maneuver. After the ITP maneuver begins, the crew's compliance with the flight level change clearance assures safety.

The ITP is limited to a total flight level change of 4,000 feet (ft)[1]. Potentially blocking aircraft may fly at 1,000, 2,000, or 3,000 ft above or below the ITP Aircraft. Other aircraft flying in the same direction, or in the opposite direction of the ITP Aircraft, may occupy the remaining levels. As is achieved today, ATC provides standard separation from same-direction and reciprocal traffic, as well as from traffic crossing the ITP Aircraft's track.

Criteria for Performing ITP Maneuver

The ITP separation minimum of 10 nmi is applied between the ITP Aircraft and the Reference Aircraft during the brief portion of the flight level change where vertical separation does not exist.

The criteria for initiating and performing the ITP maneuver under normal conditions are designed such that the ITP Aircraft and Reference Aircraft may get no closer than the ITP separation minimum. The flight crew may not initiate an ITP maneuver unless the ITP distance is greater than, or equal to, the minimum ITP distance *and* the ground speed differential is less than the maximum, closing ground-speed differential. The following ITP speed/distance criteria (as measured on the ITP Aircraft between the ITP Aircraft and the Reference Aircraft) can be used to support the 10 nmi ITP separation minimum:

- Initiation ITP distance of no less than 15 nmi and a closing ground speed differential of no more than 20 knots (kts)
  or
- Initiation ITP distance of no less than 20 nmi and a closing ground speed differential of no more than 30 kts

Note that other initiation criteria or implementations that satisfy the ITP separation minimum

[1] Note that the 4,000 ft flight-level-change restriction was a feature of the ITP at the time of design and execution of the ITP ATC experiment. Subsequently (and partly as an outcome of the ATC experiment), the flight-level-change restriction was removed in favor of the actual limitation. The actual limitation is imposed on the position of the Reference Aircraft relative to the ITP Aircraft. The Reference Aircraft may not fly more than 2,000 ft above or below the ITP Aircraft.

requirement (including variable, closing ground-speed differential criteria based on ITP distance) may be developed.

An initiation ITP distance of 15 nmi or greater is allowed with a zero ground-speed differential or with ground-speed differentials that increase the distance between aircraft (i.e., negative ground-speed differentials). The 15 nmi and 20 nmi initiation-distance criteria values were selected such that when a 4,000 ft flight level change is performed at 300 feet-per-minute (fpm) with the related 20 kts or 30 kts ground-speed differential, the distance between the aircraft does not become less than the ITP separation minimum (i.e., 10 nmi).

The ITP Aircraft must qualify the ADS-B data from the Reference Aircraft, and the ITP Aircraft must maintain 1) a minimum 300 fpm rate of climb or descent, and 2) a constant cruise Mach number throughout the ITP maneuver.

The Reference Aircraft must be non-maneuvering and not expected to maneuver during the ITP. In this context, a maneuver is represented by a change in 1) speed, 2) flight level, or 3) direction. A course change to remain on the same route is not considered a maneuver if the course change is no more than 45 degrees and the aircraft remain in a same-track configuration. Similarly, with the exception of the ITP climb or descent, the ITP Aircraft must not be expected to maneuver during the ITP.

Given these conditions, a 4,000 ft flight level change (the maximum allowed under the procedure) would result in a reduction in ITP distance by 4.5 nmi (assuming a closing ground speed differential of 20 kts). Under these conditions, to assure the ITP separation minimum of 10 nmi during the flight level change, the initial ITP distance between the aircraft must be greater than 14.5 nmi. By using a 15 nmi initial distance under these conditions, the minimum ITP distance will exceed the separation of 10 nmi. At closing ground-speed differentials of more than 20 kts, but less than 30 kts, an initial ITP distance of 20 nmi is used, again ensuring the ITP separation minimum is not infringed. At closing ground-speed differentials of more than 30 kts, an ITP cannot be requested because of limits on the initiation criteria.

The flight crew may initiate the ITP from any distance at or beyond the minimum ITP distance criteria. The minimum ITP distance criteria are the same for climbs and descents and for both leading and following situations. These consistent criteria are valid because of the requirements to maintain the constant cruise Mach and a minimum 300 fpm rate-of-climb or descent during the ITP maneuver; the only variable in the ITP speed/distance criteria is the closing ground speed differential, which then determines the minimum ITP distance. Under normal conditions, when the criteria have been met, the distance between the ITP and Reference Aircraft will always be greater than the ITP separation minimum.

The flight crew may not request a climb or descent beyond the limit of the ITP flight level change. Additional flight level changes that do not involve the ITP must be requested before or after the ITP is accomplished.

The controller will not issue an ITP clearance if the Reference Aircraft is maneuvering or is expected to maneuver prior to the ITP Aircraft reaching its clearance altitude, as described earlier in this section. To ensure an acceptable closure throughout the ITP maneuver, the controller will not issue an ITP clearance if he or she determines that the closing Mach differential is greater than 0.04 Mach. The Mach differential check accounts for potentially unsafe closure rates due to adverse wind gradient conditions and verifies that the closure rate is reasonable when the ITP Aircraft and Reference Aircraft are co-altitude. The Mach number check may be achieved by: 1) assigning Mach numbers to the ITP Aircraft and Reference Aircraft (where the Mach number technique is being used); 2) requesting Mach numbers from the ITP Aircraft and Reference Aircraft; or 3) applying another methodology determined by the appropriate authority. The controller may clear the climb or descent to the Requested Flight Level or offer another flight level if separation can be achieved at that flight level.

The procedure terminates when the ITP Aircraft reports that it is established at the new flight level. If the flight crew is unable to successfully complete the ITP after initiating the climb or descent, the crew must notify ATC and request an alternative clearance. In lieu of an alternative clearance, the flight crew must follow the procedures for in-flight contingencies appropriate for the flight information region (FIR).

The controller will use appropriate separation minima and procedures to assess all other aircraft at the requested and Initial Flight Level of the ITP Aircraft as well as the intermediate flight levels.

To initiate an ITP, the flight crew must determine that the following preconditions are satisfied:

- The ITP Aircraft crew wants to change flight level based on any number of operational factors, including fuel burn, wind conditions, and weather/turbulence avoidance needs.
- The aircraft with the crew that wants permission to perform the ITP is appropriately equipped with on-board systems needed to enable the flight crew to determine the following:
  - Flight identification
  - Flight level
  - Similar track status
  - ITP distance
  - Ground-speed differential for potentially blocking aircraft with qualified ADS-B data
- The air carrier Operations Specifications (OpSpecs), operations manual, or other appropriate material as required by the regulator permits the use of the ITP.
- The flight crew of the ITP Aircraft is properly qualified for the ITP.

The ITP is comprised of four phases representing a sequence of actions and information exchange between flight crew, ATC, ground or airborne automation, and other agents. The four ITP phases are as follows:

Phase 1. **ITP Initiation:** The flight crew identifies the desire for the ITP, opportunities for its application, and the Reference Aircraft for the procedure. The flight crew also transmits the ITP request to the ground controller.

Phase 2. **ITP Instruction:** The controller issues the ITP clearance. The flight crew evaluates the clearance.

Phase 3. **ITP Execution:** The cleared ITP Aircraft performs the ITP maneuver, maintaining the required rate of climb/descent and speed. Conducting an ITP maneuver is similar operationally to standard climbing/descending maneuvers.

Phase 4. **ITP Termination:** The controller terminates the procedure after the ITP Aircraft achieves the cleared flight level or an abnormal event requires premature termination of the ITP.

Multiple, possible geometries for ITP flight level changes are shown in Fig. 2 and include the following

- Following climbs and descents
- Leading climbs and descents
- Combined leading-following climbs and descents

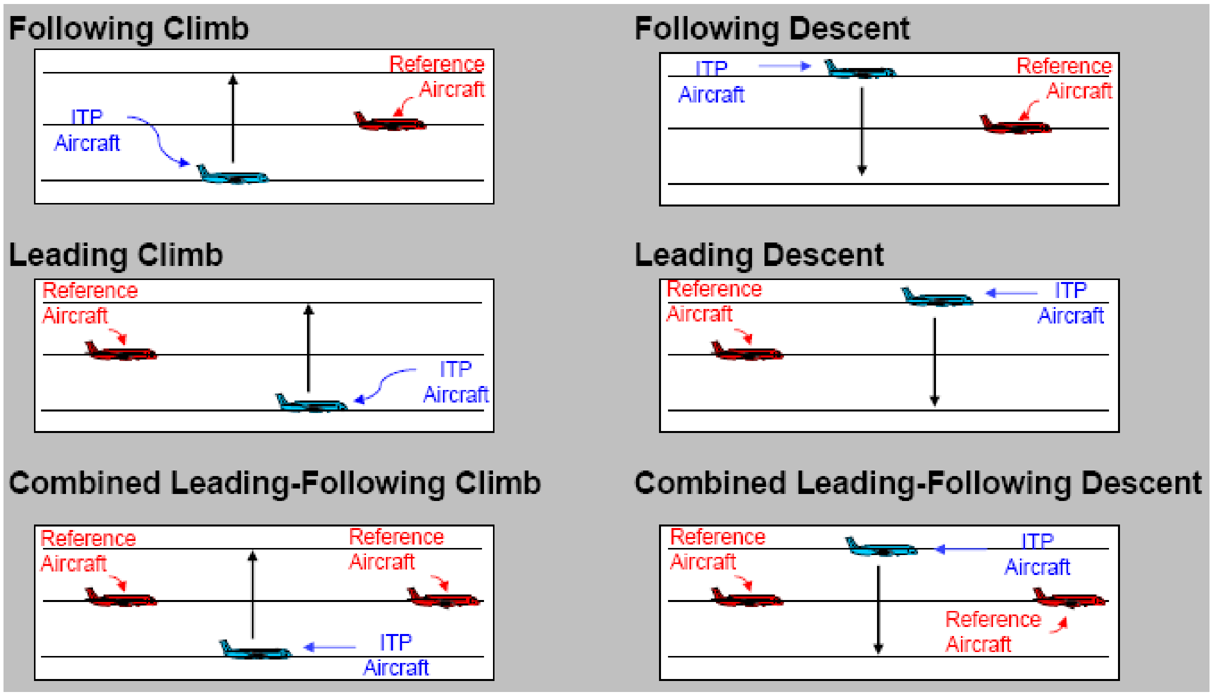

Figure 2: ITP Geometries

Phraseology for Requesting ITP Maneuver

The phraseology for requesting an ITP climb or descent differs slightly from that of a non-ITP request—i.e., the flight crew requesting an ITP climb or descent must provide additional information in a specific sequence. If ATC denies the ITP request, the same phraseology used in current procedures applies.

Syntax and Examples

The syntax for making an ITP request differs according to whether the flight crew transmits the ITP request via voice communications or Controller Pilot Data Link Communications (CPDLC). Details of each are presented below.

ITP Request and Response via Voice Communications

The syntax for making an ITP request via voice and the associated ATC responses appears below. An example follows.

Syntax

Aircraft: "(*ATC Center*), (*call sign*), request I-T-P climb/descent to (RFL) following/leading (*Reference Aircraft call sign*) (*ITP distance*) miles"

ATC: "(*Call sign*) I-T-P climb/descend to flight level (*CFL*) following/leading (*Reference Aircraft call sign*)"

Where RFL is the Requested Flight Level
CFL is the Cleared Flight Level

Example

The following is an ITP flight level change request from UAE402 with one Reference Aircraft: leading (in front of) N602AC, at an ITP Distance of 30 nmi.:

Aircraft: "Melbourne Center, Emirates 402 request I-T-P climb to flight level 390 leading N-602-AC 30 miles."

After checking that the controller ITP requirements are met, the controller may approve the requested level change using the following phraseology:

ATC: "Emirates 402, I-T-P climb to FL390 leading N-602-AC."

ITP Request and Response via CPDLC

The syntax for making an ITP request via CPDLC and the associated ATC response appears below. An example follows.

Syntax

Aircraft: "REQUEST CLIMB/DESCENT TO FLxxx
ITP F/<Reference Aircraft flight id>/nn
or
REQUEST CLIMB/DESCENT TO FLxxx
ITP L/<Reference Aircraft flight id>/nn

Where xxx is the RFL
F/ means that the aircraft is following this Reference Aircraft,
L/ means that the aircraft is leading this Reference Aircraft, and
/nn is the ITP distance for this Reference Aircraft, in nautical miles.

Example

The following is an ITP climb request with two Reference Aircraft: following (i.e., behind) UAL123, which is at an ITP distance of 65 nmi, and leading (in front of) DAL456, at an ITP distance of 30 nmi.:

Aircraft: "REQUEST CLIMB TO FL390
ITP F/UAL123/65
L/DAL456/30"

After checking that the controller ITP requirements are met, the controller may approve the requested level change using the following phraseology:

ATC: "ITP CLIMB TO FL390 F/UAL123 L/DAL456"

The controller may also deny the requested level change using the following phraseology:

ATC: "UNABLE" or "UNABLE DUE TO TRAFFIC"

ITP Experiment

Hypotheses

The ITP ATC experiment was designed to test the following hypotheses:

- The ITP is valid and usable and will not present adverse implications for a controller's workload.
- The ITP can be seamlessly incorporated into existing controller operations.

Objective

The purpose of the ITP ATC experiment was two-fold: 1) to determine if ITP is viable, valid and acceptable for the controller, and 2) whether it can be seamlessly integrated into current operations.

Methodology

The ITP ATC experiment employed a variety of techniques and activities to test the hypotheses and achieve the research objectives.

- To determine if the ITP is valid, the experiment tested 12 air traffic controllers on their ability to meet all ITP requirements while applying the ITP during simulated flights.
- To identify missing, incomplete, or extraneous procedural steps associated with the ITP, the experiment captured subject controller feedback and performance.
- The experiment evaluated whether the ITP can be accomplished over CPDLC using the current human-machine interface (HMI) and how the subject controllers managed requests over very high frequency (VHF) radio in a paperless environment. The experiment also evaluated how the ITP can be integrated with current operations with respect to current HMI techniques and operational considerations.
- To determine if the ITP is acceptable, the experiment solicited a workload rating from the subject controllers for each experimental condition tested.
- The experiment employed post-exercise questionnaires to capture subject controller feedback concerning operational concerns, ease of use, potential benefits, suggested improvements, and workload impacts.

Subject Controller Participants

Airservices' Melbourne Center line management invited 12 controllers to take part in the experiment based on group workload and availability. Each controller has a current operational rating on the ATC sectors used for the experiment. The ITP project team played no part in the selection of participants.

Each subject controller completed a brief, 13-point demographics questionnaire (reproduced for reference in Appendix A) at the beginning of the experiment. Key data captured via the questionnaire included the following:

- Subject controllers ranged in age from 23 to 54 years [Mean (M) = 38, Standard Deviation (SD) = 10].
- Four of the participants had a pilots' license and one was a Royal Australian Air Force Navigator.

- The average subject had 12 years of experience as a controller (M = 12.3, SD = 10.8, Range = 0.67 – 34) and 8 years of experience as a procedural controller (M = 8.6, SD = 7.0, Range = 0.67 - 22). At the time of the study, each controller was current on his/her experiment sector. Controller experience on his/her sector ranged from 0.5 – 20 years (M = 7.45, SD = 6.17). When asked to rate his/her level of familiarity with procedural control on a scale from 1 ("very unfamiliar") to 10 ("very familiar"), the mean response was 10 (SD = 0.85). Ten controllers rated their familiarity at 10; two controllers rated their familiarity as 8 and 12, respectively. It is unknown why one controller rated his/her familiarity with procedural control at 12 on a scale of 10.
- All participants had previous experience with using CPDLC, Automatic Dependant Surveillance-Contract (ADS-C), and ADS-B. Experience levels ranged from less than 1 year to 11 years using CPDLC and ADS-C and from a few weeks to 1 year using ADS-B.

Test Facility

Melbourne TAAATS ATC Simulator

The experiment was conducted in TAAATS ATC simulator. Located at the Melbourne ATC Center, TAAATS simulator is an operational facility in continual use for training air traffic controllers and assessing their performance. It is based on the EUROCAT-X ATM system and provides realistic operations for simulated traffic data. TAAATS also provides a training system based on an air traffic generator that uses an HMI that is identical to that used in the operational system and many (though not all) of the same functions found in the operational system.

The facility closely mirrors the actual performance of Airservices' automation system, although certain aspects limited its use in the ITP simulation exercise, including: 1) reliance on pseudo-pilots and controllers to play the role of pilots and other controllers during simulations, and 2) the inability to realistically simulate High Frequency (HF) voice communication. It was not operationally possible or financially reasonable to modify the simulator to provide this functionality during the ITP simulations.

The system design philosophy is based on a practical analysis of typical ATC environments and incorporates a variety of features to make it easier for controllers to interact with and control the air traffic environment. TAAATS gathers, collates, processes, and displays data from radar, ADS-C, ADS-B, Aeronautical Information (AIF), Receiver Autonomous Integrity Monitoring (RAIM) predictions and flight plans in a form that enables controllers and other personnel to perform their operational duties in radar and non-radar environments. Additional functions include Pre-Departure Clearance (PDC) management and sequencing of arrival traffic through the Tactical Flow Management System (TFMS). TAAATS can also record data for historical purposes, play back recordings as needed, and extract operational data for analysis. TAAATS provides a paperless (stripless) operating environment within the Australian Airservices ATC centers at Melbourne and Brisbane. The HMI is adapted to Airservices' requirements and is shown in Fig. 3.

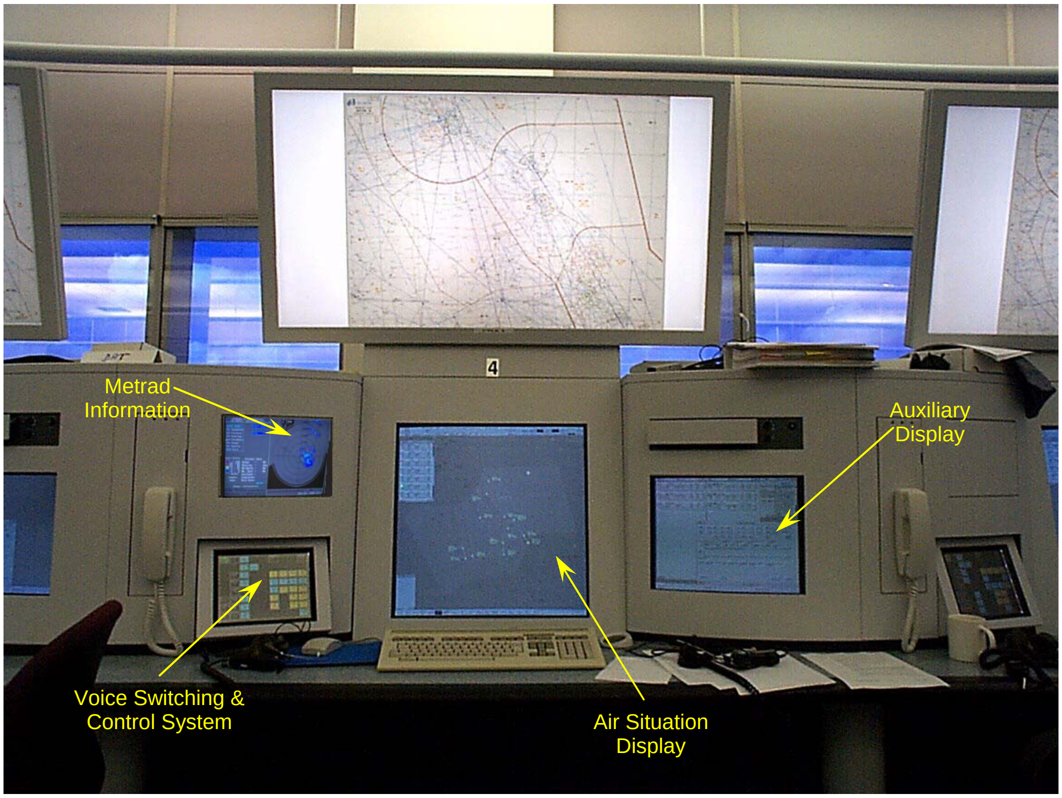

Figure 3: TAAATS Controller Workstation

During the experiment, the same console was used for all ATC roles (radar, non-radar, planner, and executive). A plan view of traffic was presented to controllers on the Air Situation Display (ASD). The Auxiliary Display can be used for a number of functions, including viewing and modifying flight plans and providing a detailed view of a section of jurisdiction airspace. Radar, ADS-C, ADS-B, and flight plan (computed) tracks were displayed to the controller using different symbology. Examples of the symbols used to represent each type of flight data are shown in Fig. 4–Fig. 7.

Figure 4: TAAATS Radar Symbol

Figure 6: TAAATS ADS-C Symbol

Figure 5: TAAATS ADS-B Symbol

Figure 7: TAAATS Flight Plan Symbol

Target Generation Officers

Target Generation Officers (TGOs) functioned as pseudo-pilots and air traffic controllers in the simulation environment. TGOs followed scripts created offline for use in the simulation experiment. TGO scripts used for the experiment are reproduced for reference in Appendix B. All aircraft in the exercises operated according to performance specifications that closely resembled actual operations. The simulator was operated in conjunction with an Air Traffic Generator (ATG) that provided simulated data to other functions in the training system, including:

- Simulated radar data (including multi-radar tracking)
- Flight plan data
- ADS-B data
- ADS-C data
- CPDLC data
- Simulation of aircraft characteristics and operating profiles
- AIF data
- Recording and playback functions
- Timing and control functions

TGOs and subject controllers also received classroom training to ensure familiarity with the ITP and facilitate a more realistic experience for the experiment. For details, see “Classroom Training and Post-Training Questionnaire,” later in this paper.

Experiment Groups

The subject controllers in the experiment were drawn from two procedural airspace groups: the West Procedural Airspace group (WEST P) and the Bight Procedural Airspace group (BIGHT). Each group is described in the following sections.

WEST P Airspace Experiment Group

The bulk of WEST P airspace is procedural airspace over the Indian Ocean. WEST P airspace has a daily traffic flow of approximately 480 aircraft, with hourly rates varying from two to 132 aircraft[2]. WEST P airspace sectors include Indian (IND), Indian East (INE), Indian South (INS), and Pilbara (PIL), as shown in Fig 8. The WEST P Airspace group provides the following services:

- Radar control services
- Radar Information Services (RIS)
- Weather surveillance and advice service
- Navigational assistance
- In-Flight Emergency Response (IFER)
- Traffic information service
- Hazard alerting service
- Directed traffic service

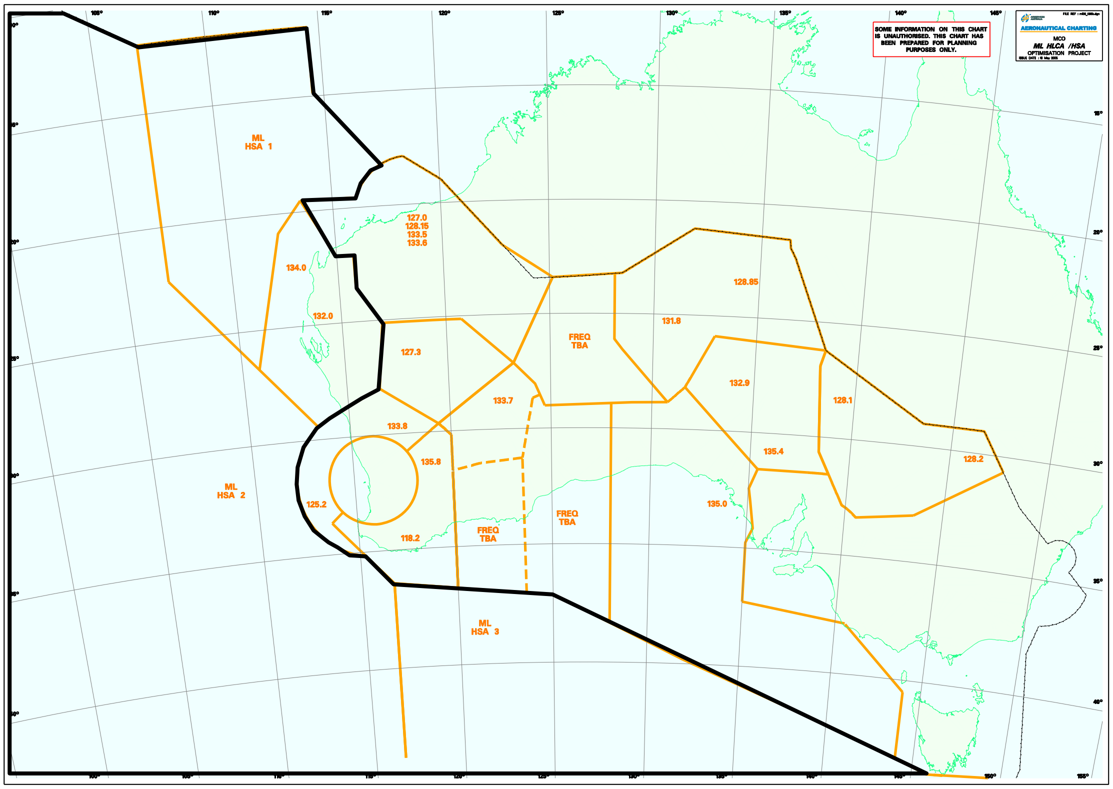

Figure 8: WEST P Airspace

BIGHT Airspace Experiment Group

The BIGHT airspace group provides the same services within its defined airspace as the WEST P airspace group provides in the WEST P airspace. BIGHT airspace is largely procedural airspace over continental Western Australia. Surveillance in the form of ADS-B is slowly being introduced to this

[2] Based on Airservices Australia data from August 2004.

airspace, although the majority of aircraft will not be ADS-B-equipped for some time. BIGHT has a daily traffic flow of approximately 510 aircraft, with hourly rates varying from 61 to 137 aircraft[3]. The experiment used the Nullarbor (NUL) sector of BIGHT airspace, as shown in Fig. 9.

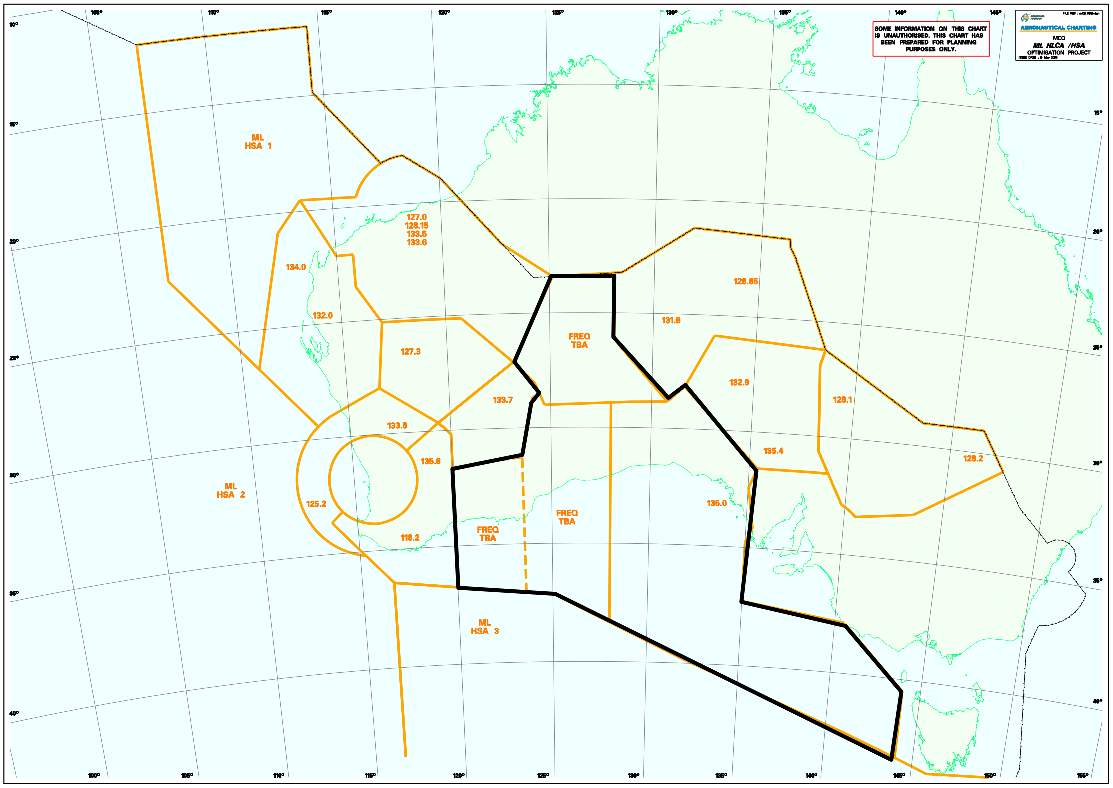

Figure 9: BIGHT Airspace

Experiment Design

Subject Distribution

Ten controllers were from the WEST P airspace group and two controllers were from the BIGHT airspace group. Four WEST P controllers participated in a morning session. Both of the BIGHT group controllers and six WEST P controllers participated in an afternoon session.

Each controller completed three 50-minute simulator exercises on the sector for which he or she was current. Each exercise was developed around the following parameters:

- Eight ITP requests
- Type of communication used for the ITP request
- Controller ability to grant the ITP request
- Level of difficulty

Two independent variables in the experiment design were the type of communications used

3 Based on Airservices Australia data from August 2004.

(either voice communications or CPDLC) and the ability of the controller to grant an ITP clearance. Where possible—depending on the communications coverage of the sector—an equal number of requests were transmitted via CPDLC and VHF voice. Each exercise was designed with four ITP requests that would be approved under nominal conditions and four that would be rejected unless further action was taken that would enable the controller to approve the request. An event described as “approvable” was an ITP request considered by the experiment design team to meet all the criteria required for the controller to clear the level change.

The level of difficulty was influenced by additional variables, including the number of Reference Aircraft involved in the maneuver/request, the geometry of the ITP (whether the ITP Aircraft was leading, following, or between Reference Aircraft), and the controller’s total workload. The nominal combination of experiment conditions are shown below in Table 1 and Table 2.

Table 1: Experiment Conditions part 1

Exercise #	1131/1136		1132/1137		1133/1138	
Event #	**Approvable**	**COMM**	**Approvable**	**COMM**	**Approvable**	**COMM**
1	Yes	CPDLC	No	CPDLC	No	VHF
2	No	CPDLC	Yes	VHF	Yes	CPDLC
3	Yes	CPDLC	No	VHF	No	CPDLC
4	No	VHF	Yes	CPDLC	Yes	CPDLC
5	Yes	CPDLC	No	VHF	No	CPDLC
6	Yes	VHF	No	CPDLC	Yes	VHF
7	No	CPDLC	Yes	VHF	No	VHF
8	No	CPDLC	Yes	CPDLC	No	CPDLC

Table 2: Experiment Conditions part 2

Exercise #	1301/1334		1302/1335		1303/1336	
Event #	**Approvable**	**COMM**	**Approvable**	**COMM**	**Approvable**	**COMM**
1	Yes	VHF	Yes	CPDLC	Yes	VHF
2	Yes	CPDLC	No	CPDLC	No	VHF
3	No	VHF	Yes	VHF	Yes	CPDLC
4	Yes	CPDLC	No	VHF	Yes	CPDLC
5	N/Y	VHF	Yes	VHF	No	CPDLC
6	No	CPDLC	Yes	VHF	No	VHF
7	Yes	CPDLC	No	CPDLC	Yes	VHF
8	Yes	VHF	Yes	CPDLC	No	CPDLC

Scenario Design and Development

The design and development of the controller ITP experiment differed from that of the pilot ITP experiment (which involved a human-in-the-loop simulation) [2] in that it was not feasible to evaluate controller performance using a single example of an ITP request. The reason is that a controller must manage multiple conflict situations and monitor 20 or more aircraft at any given time. To ensure a realistic evaluation of the workload implications of the ITP, the simulation exercises presented the subject controllers with multiple aircraft and a traffic complexity representative of the typical work environment.

Each experiment exercise was based on an actual Airservices training exercise. Aircraft groupings suitable for appropriate ITP situations and communication methods were then selected. On occasion, an aircraft was relocated or added to the exercise to enable the desired ITP geometry.

Following the creation of each exercise, a duplicate was created with new aircraft call signs. The process reduced the opportunity for subjects to discuss exercises or for two subjects to perform the same exercise at the same time. The exercise numbers in Table 1 and Table 2 above indicate the original exercise number and the duplicate exercise number created for the experiment (e.g., Exercise # 1131/1136). The exercise numbers derive from the numbering scheme used for Airservices' training exercises. Initial scenario conditions and experiment-related requests remained the same throughout the experiment. However, the subject controllers had a range of capabilities, experience, and backgrounds and employed a variety of separation standards and techniques. Thus, two controllers may have managed identical traffic scenarios quite differently. Therefore, the traffic setup that resulted as a subject controller approved or denied requests and managed traffic in a particular scenario could change in ways that were quite different from the traffic that would result from different decisions made by other subject controllers. Therefore, it was not possible to expose all of the subject controllers to the same traffic scenarios throughout each experiment condition.

Scripted Errors

Many pilot errors occurred during a similar experiment in September 2006 that tested the pilot procedures at NASA LaRC [2]. Part of the current experiment involved testing controller reaction and response to these errors when receiving ITP requests and communications. Accordingly, the TGO scripts included the following errors:

- Incorrect ITP distances (e.g., less than 15 nmi)
- Typographical errors in Reference Aircraft call signs (e.g., SIA224 versus SIA442)
- Typographical errors in the location of a Reference Aircraft (e.g., L/ for leading versus F/ for following)
- Invalid altitude requested in ITP (i.e., greater than 4,000 ft limit or when ITP was not required)

Departure from TGO Scripts

During the course of the experiment, several ITP requests departed from the TGO script. In most cases, this did not cause a problem since the errors were similar to the scripted errors. Another change from the scripted exercise involved the occasional departure from the scripted communication link. In some instances, a planned VHF voice request was made over CPDLC instead. In other instances, a request was not made due to TGO workload. All of the departures from the original scripted requests were taken into account during the data analysis.

Subject Participation

Each of 12 subject controllers viewed three exercises for a particular sector: 36 exercises across all subjects. The goal was for each subject to see the original exercise or a duplicate. Eight of 12 subjects completed one of three duplicate pairs for their sector. The remaining four subjects completed two exercises and repeated one duplicate exercise, which occurred because of a mistake in the sequence of loading the exercise in the simulator.

Subjective Assessments

Post-exercise and post-experiment questionnaires captured controller feedback concerning their experience using the ITP. Each subject completed a questionnaire following each exercise (reproduced for reference in Appendix C) and completed another questionnaire following completion of the experiment (reproduced for reference in Appendix D). The questionnaires were designed to capture the controller's impressions and reaction to using the ITP. Questions covered application of the ITP, communication mode, perceived benefits, workload associated with the ITP, HMI/system considerations, and other issues.

In addition to questionnaires to capture feedback on using the ITP, a workload assessment was obtained via a Modified Cooper-Harper (MCH) rating scale [4] (reproduced for reference in Appendix E). The assessment asked each subject to answer up to three yes-or-no questions pertaining to operator decision-making while moving through a flowchart and corresponding rating scale, as shown in Fig. 10. A rating of 1 indicated a difficulty level of "VERY EASY" and a demand level that "Operator mental effort is minimal and desired performance is easily attainable." The worst rating was 10, which indicated a difficulty level of "IMPOSSIBLE" and an operator demand level that the "Instructed task cannot be accomplished reliably." Subject workload ratings of 3 or lower were desirable. Higher ratings may have indicated the need to redesign the tested operation.

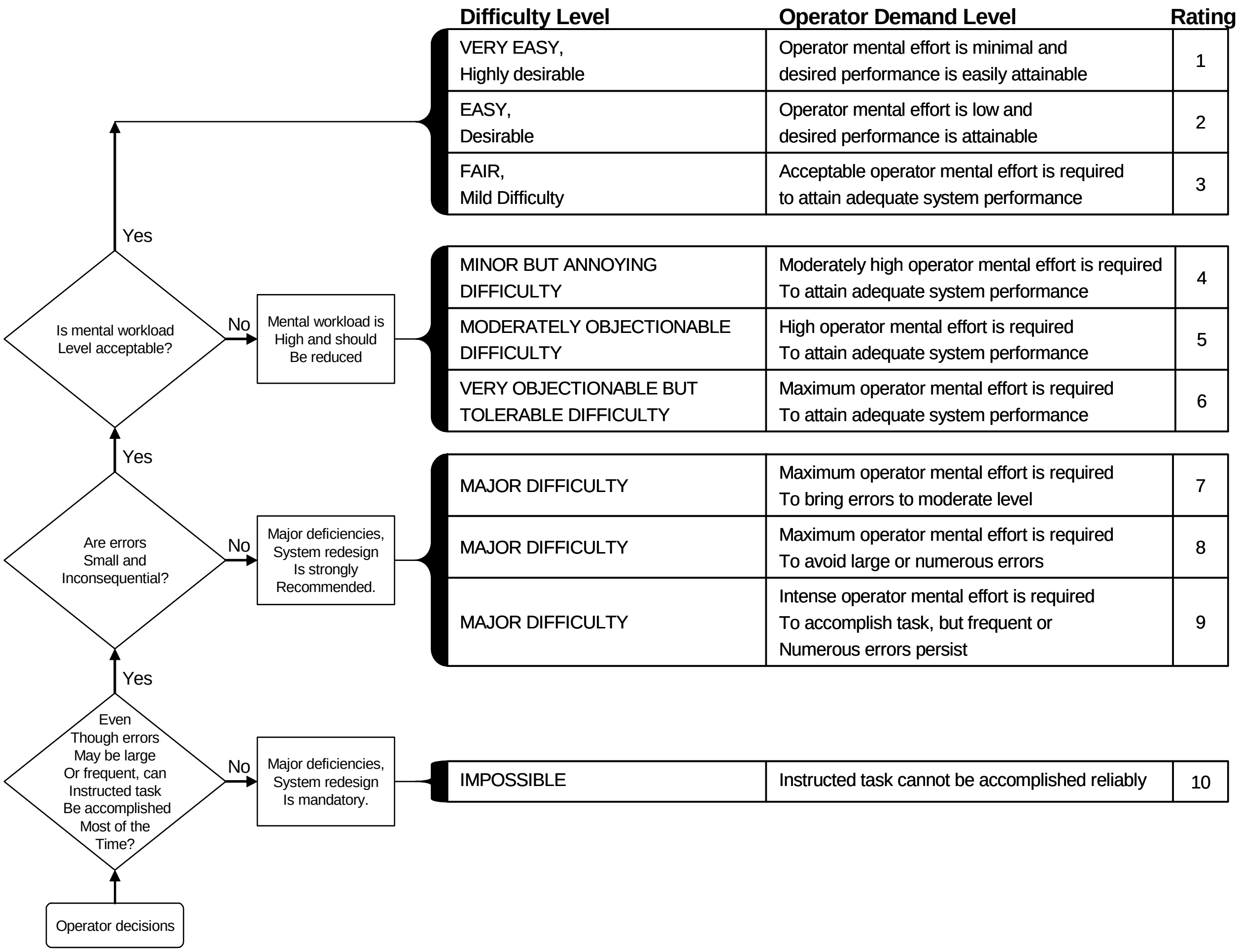

Figure 10: Modified Cooper-Harper (MCH) Rating Scale

Experiment Schedule

Twelve air traffic controllers participated in the experiment over 6 days (2 controllers per day). Experiment sessions commenced either at 0700 hours for morning sessions or at 1130 hours for afternoon sessions. Subjects received food and refreshments and breaks between exercises. Each experiment day lasted approximately seven hours and followed the schedule shown in Table 3. Subjects participated in either a morning or an afternoon schedule as shown in the section on Subject Distribution.

Table 3: Experiment Schedule

Session	Duration (In Minutes)	Documentation
Pre-experiment	30	Demographic information
Training 1	90	ITP introduction ITP application training ITP training scenarios
Training 2	15	MCH scale Post-scenario questionnaire Post-training questionnaire
ITP simulator exercise 1	50	MCH scale Post-scenario questionnaire
ITP simulator exercise 2	50	MCH scale Post-scenario questionnaire
ITP simulator exercise 3	50	MCH scale Post-scenario questionnaire
Group debrief	75	Post-experiment questionnaire Post-experiment scenarios/discussion Group debrief/feedback

Background Reading, Classroom Training, and Post-Training Questionnaire

The subject controllers received background reading material 2–7 days prior to the experiment day. The material is reproduced for reference in Appendix F. The experiment assumed that the controllers had not read the pre-briefing material prior to receiving the experiment training from the ITP experiment team.

On the day of the experiment, subject controllers participated in classroom training prior to commencing the simulator sessions. Training covered the experiment background, ITP development, ITP application, and example scenarios (reproduced for reference in Appendix G). The goal of the training was to bring all subject controllers to the same level of ITP knowledge and understanding prior to evaluating their performance in using the new procedure.

The subjects were apprised of differences between the ITP simulations and a typical traffic environment. Subjects also saw and responded to ITP requests using CPDLC. Following completion of the training, participants completed a brief post-training questionnaire (reproduced for reference in Appendix H) to assess training efficacy and ensure that the controllers understood the basics of the ITP—particularly the ITP criteria. Additional training was conducted as needed prior to commencing the first simulator exercise.

Recording Observations, Errors, and Actions

During each exercise, an observer familiar with the ITP and the simulator exercise recorded details of the subject controller's errors, actions, and other information for use in testing the experiment hypotheses. "Observer Data Collection Sheets" for Exercise 1131 is reproduced for reference in Appendix I. All "Observer Data Collection Sheets" are similar.

During the course of the experiment, each controller completed three exercises. Each exercise lasted approximately 50 minutes and included up to 8 ITP opportunities. Errors and actions were classified in three categories:

Category 1. Safety-critical errors and actions, including those that could lead to a breakdown in separation

Category 2. Procedural errors and actions, such as failure to conduct a Mach check

Category 3. Technical errors and actions, such as typographical errors in CPDLC messages

Results

Data were analyzed using Cochran's Q and McNemar tests for nonparametric, within-subject tests appropriate for analyzing related samples of nominal data. [5],[6] Paired sample t-tests were used to determine whether there was a significant difference between the average values of the same measurement made under two different conditions. [7] The statistical analyses of the data were performed individually on the data for each airspace group that participated in the experiment and for the aggregate of all subjects. A 5% significance-level for the statistical analyses of all data collected in the experiment was set a priori. The subject numbers used to track the data in this paper were assigned only as a means to organize the data in the paper and have no relevance to the execution of the experiment.

Controller Errors/Actions

Controllers made 65 errors and unexpected actions: 14 procedural, 51 technical, and 0 safety-critical. The distribution of errors and actions by controller subject (Subject #) is shown in Table 4.

Table 4: Distribution of Error by Type and Subject

Subject #	Safety Critical	Procedural	Technical
1	0	2	4
2	0	1	5
3	0	0	5
4	0	0	3
5	0	1	7
6	0	0	2
7	0	0	3
8	0	1	3
9	0	1	1
10	0	2	2
11	0	2	12
12	0	4	4
Total	**0**	**14**	**51**

When analyzing the total of all errors and unexpected actions for the experiment the following statistical tests were performed. Cochran's Q Test (Q) was administered to determine if a significant difference exists among error/actions in each classification. The test revealed a significant difference between at least two classifications: (Q [2] = 59.220; probability (p) <0 .001). A McNemar Test was administered to determine between which error/action classifications the statistical difference exists. The test revealed significantly fewer safety-critical error/actions (zero) than procedural (p <0 .001) or technical (p <0 .001). A McNemar test also showed that significantly fewer procedural error/actions occurred than technical ($p < 0.001$). These results are in line with the desired distribution of the error/action type by severity of the outcome of the error/action.

When conducting the same analysis tests on the WEST P data the Cochran's Q Test showed a statistical difference ($Q[2] = 42.667$ $(p) < 0.001$). A McNemar Test performed on the West P data showed that significantly more procedural ($p=0.008$) and technical ($p<0.001$) errors occurred than safety critical and more procedural than technical errors ($p<0.001$). The BIGHT group data showed similar statistical results as the WEST P group, except that there was no statistical difference found between the number of procedural and technical errors ($p=0.064$).

Safety-critical Errors/Actions

Subject controllers made zero safety-critical errors/actions.

Procedural Errors/Actions

Subject controllers made 14 procedural errors/actions in two categories:

- *Failure to perform a speed check.* Subject controllers failed 13 times to perform any kind of speed check between the ITP and Reference Aircraft. While the procedure specifically called for a check of Mach differential between the requesting aircraft and other aircraft included in the ITP request, controllers were permitted to employ other methods to assess the possibility that aircraft may be closing on each other. In cases where controllers failed to conduct a Mach differential check—but used ground-speed information or an aircraft-type comparison (e.g., assuming that a B737 following a B747-400 would not be closing on the B747-400)—the occurrence was classified as a technical error rather than a procedural error.
- *Misidentification of a Reference Aircraft.* This error occurred one time. The subject controller identified as a Reference Aircraft an aircraft that was not part of the ITP request. The result of such an error was dependent on the circumstances. If the reference aircraft in the clearance did not meet the criteria, the pilot rejected the ITP clearance. On the other hand, if the reference aircraft in the clearance met the criteria, the error had no impact.

Technical Errors/Actions

Subject controllers made 51 technical errors/actions in nine categories, as shown in Table 5.

Table 5: Distribution of Technical Errors/Actions

Error/Action Category #	Description of Error/Action	# of Instances of Error/Action
1	Failure to perform a Mach differential check	18
2	Level change clearance beyond ITP limits	14
3	Syntax errors	3
4	Missing information in clearance	4
5	Maneuvering Reference Aircraft	3
6	Invalid Reference Aircraft	4
7	ITP geometry confusion	1
8	Reference aircraft call sign confusion	3
9	Non-existent Reference Aircraft	1
Total		**51**

In 18 instances, controllers issued an ITP clearance without performing a Mach differential check (Technical Error/Action Category 1). Errors/Actions in this category differed from Procedural Errors/Actions (discussed previously) because the subject controller used an alternative means to ensure that aircraft were not closing. In 17 instances, the controller undertook an aircraft type-comparison instead of the Mach check. In the remaining instance, the subject controller only performed a groundspeed comparison using Flight Plan (FPL) tracks. In five instances, the controller performed a type-comparison that also included a ground speed check.

In 14 instances, controllers approved an ITP to a flight level outside the ITP criteria (Technical Error/Action Category 2). In six instances, the controllers indicated that they used the ITP standard for part of the issued clearance and that they applied another standard during the remainder of the clearance; the other standard was specific to each exercise situation and controller. In one instance, the controller approved a 1,000 ft ITP request. This controller was aware of the error but issued an ITP clearance anyway.

In three instances, controllers made syntax errors and typographical mistakes (Technical Error/Action Category 3). In one instance, the controller typed the ITP keyword at the end of the clearance instead of at the beginning. In another instance, the controller failed to insert a forward slash (/) after the location of the Reference Aircraft (typing "L" instead of "L/"). The final instance occurred when the controller typed "IPT" instead of "ITP."

In four instances, the controller failed to provide essential information in the ITP clearance by omitting either the keyword "ITP" or the Reference Aircraft call sign (Technical Error/Action Category 4).

In three instances, the controller issued an ITP clearance while a Reference Aircraft was maneuvering (Category 5). An evaluation of each error/action determined that at no time did a breakdown of separation occur.

In four instances, four controllers—each on one occasion—issued an ITP clearance with an invalid Reference Aircraft (Technical Error/Action Category 6). In three of these instances, the controllers identified as a Reference Aircraft an aircraft that was not located at an intermediate flight level (i.e., the Reference Aircraft included in the clearance was located above the requested flight level in the case of a climb request). In the remaining instance, the controller issued a clearance with a Reference Aircraft that was located outside the Mach-closure criteria. The controller issued an ITP clearance even though another separation standard was available between the two aircraft.

In one instance, the controller failed to confirm the aircraft position (leading versus following), between the ITP request and the ITP clearance (Technical Error/Action Category 7).

In three instances, split between two controllers, the controllers failed to confirm a Reference Aircraft call sign when there was a difference between the request and the clearance (Technical Error/Action Category 8).

In one instance, the controller made a typographical error when typing the Reference Aircraft's call sign, which resulted in a reference to a Reference Aircraft that did not exist.

Subjects Who Completed Both Original and Duplicate Simulator Exercise Pairs

Four of the 12 subject controllers completed both the original and duplicate simulator exercises for one exercise pair, as shown in Table 6. The number of errors that occurred in the original simulator exercises differed from the number of errors that occurred in the duplicates. Three of the four controllers improved overall performance after completing the second exercise in the pair. Two of the three controllers committed the same error in both the original and the duplicate exercise. While the improvement in performance could be attributed to the similarity in the exercises, normal variability in performance was a more likely cause. This was supported by the fact that all four subjects committed at least one error during the third exercise and that the overall trend in errors committed by the four subjects was similar to that of other subject controllers.

All subjects completed the duplicate simulator exercise immediately before or after the original. For example if the duplicate exercise was experienced first, then the original exercise was number two, or if the original was number two then the duplicate was number three. Subjects 4 and 5 completed the original exercise first. Subject 6 completed the duplicate exercise first. Subject 3 completed the original exercise second and the duplicate exercise third.

Table 6: Duplicate Exercise Pairs

Subject #	Completed Original and Duplicate (1st/2nd) Simulator Exercises	Errors on Original Simulator Exercise	Errors on Duplicate Simulator Exercise
3	1133/1138	3	1
4	1132/1137	0	1
5	1132/1137	4	2
6	1136/1131	0	1

Distribution of Errors

The experiment team examined the procedural errors/actions and technical errors/actions according to the order in which the controllers completed the exercises. The distribution of errors is shown in Table 7.

The goal of the training was to bring all of the subject controllers to the same level of knowledge and understanding of the ITP prior to the experiment exercises. Only three of the 12 subject controllers (Subject # 5, 9, and 12) demonstrated a general improvement in their performance as they proceeded through the experiment. Cochran's Q Test on the aggregated data revealed no statistically significant difference between the number of errors that occurred in the first, second, or third exercise (Q [2] = 0.050; p = 0.975). The WEST P and BIGHT data also showed no statistical difference from the Cochran's Q test with values of Q[2] = 1.448 p=0.485 (WEST P) and Q[2] = 5.636 p=0.060 (BIGHT).

Table 7: Distribution of Errors by Exercise Sequence

Subject #	First	Second	Third
1	3	1	2
2	1	1	4
3	1	3	1
4	0	1	2
5	4	2	2
6	1	0	1
7	0	3	0
8	0	2	2
9	2	0	0
10	0	0	4
11	5	7	2
12	5	2	1
Total	**22**	**22**	**21**

ITP requests were designed in two broad categories of difficulty: simple and hard. Simple requests were straightforward and tested more common situations. Hard requests tested situations that will not occur on a regular basis during normal operations. The number of simple requests greatly outnumbered the number of hard requests, as shown in Table 8. Examples are described below.

Simple ITP Requests

- No errors are present in the ITP request. The controller may approve the request without additional action.
- No errors are present in the ITP request, but the request does not meet the Mach-check criteria. The controller may not approve the request.

Hard ITP Requests

- The ITP request is valid, but crossing traffic at the destination altitude must be deconflicted prior to approval of the request.
- The ITP request is valid but requires ATC to coordinate with the next sector prior to approval.

Table 8: Distribution of Requests by Request Difficulty

Subject #	Simple	Hard
BIGHT	19	5
WEST P	21	3
3	**19**	**5**
4	**23**	**1**
5	**22**	**2**
6	**20**	**4**
Total	**248**	**40**

There was a difference in the difficulty distribution between the WEST P and the BIGHT group exercises. This difference was primarily due to sector and traffic configurations, which did not allow for identical distribution of request classifications between the two groups. Table 8 shows Subjects 3 through 6 (who completed duplicate exercises) in addition to the BIGHT and WEST P groups because they received a different combination of requests.

Table 9 shows the distribution of errors that controllers made relative to the degree of difficulty of the request. Far more errors occurred during simple requests than during hard requests; however this was similar to the distribution of requests made to the controllers. A paired t-test of the ratios of errors to requests showed that there were statistically more errors committed during the simple category of requests than in the hard category of requests ($p = 0.038$). This statistical difference did not exist when only looking at the WEST P ($p=0.133$) or BIGHT ($p=0.212$) data.

Table 9: Distribution of Errors by Request Difficulty

Subject #	Simple Request	Hard Request
1	6	0
2	4	2
3	3	2
4	3	0
5	8	0
6	2	0
7	3	0
8	4	0
9	2	0
10	4	0
11	12	2
12	8	0
Total	**59**	**6**

A significant variable of interest in the experiment was the difference in the ability of the subject controllers to handle ITP requests via CPDLC relative to VHF voice. (This was of interest because there currently are no requirements placed on the communication method to be used for an ITP request.) A comparison of the errors by subject controllers based on communication method is shown below in Table 10. The nominal distribution was as follows:

- 15 requests via CPDLC for the WEST P controllers
- 12 requests via CPDLC for the BIGHT controllers
- 9 requests via VHF for the WEST P controllers
- 12 requests via VHF voice for the BIGHT controllers

Table 10: Distribution of Errors by Communication Method

Subject #	CPDLC	VHF
1	5	1
2	3	3
3	1	4
4	2	1
5	3	5
6	2	0
7	0	3
8	3	1
9	2	0
10	2	2
11	9	5
12	3	5
Total	**35**	**30**

A Paired t-test showed no significant difference between the total number of errors committed using CPDLC versus VHF voice (p = 0.633), this was also true when the WEST P (p=0.449) and BIGHT (0.705) data were analyzed separately. However, individual controllers seemed to perform better using one method over the other.

The final comparison considered whether the request could be approved by the controller, as received, without further action. The nominal distribution of request outcome was as follows:

- 12 approvable for the WEST P controllers
- 15 approvable for the BIGHT controllers
- 12 WEST P requests and 9 BIGHT requests required additional action or consideration by the controller prior to approval.

Table 11 shows the breakdown of errors by subject controller and planned outcome. A paired t-test indicated no statistical difference in the number of errors committed during one planned outcome versus the other (p =0 .564). However, when testing the airspace groups separately they both showed that there was a significant difference in the number of errors committed by controllers between the Approvable and Not Approvable conditions. The difference for the WEST P airspace was (p=0.040) and for the BIGHT group it was (p=0.045).

Table 11: Distribution of Errors by Planned Outcome

Subject #	Approvable	Not Approvable
1	1	5
2	1	5
3	1	4
4	2	1
5	2	6
6	1	1
7	2	1
8	1	3
9	1	1
10	1	3

Subject #	Approvable	Not Approvable
11	10	4
12	6	2
Total	**29**	**36**

Subjective Assessment: Post-Exercise Questionnaire

After each exercise, the subject controllers responded to post-exercise questionnaires (reproduced for reference in Appendix C). In summary, 100% of the subject controllers said that the ITP would be operationally acceptable. While some expressed concerns over specific aspects of the procedure (e.g., the accuracy of the ITP request made by the pilot, confusion about the terms "leading" and "following," the use of pre-formatted CPDLC messages, individual HMI interaction, and call sign confusion), the subjects indicated that the ITP would "provide a valuable tool for controller[s] and a way of helping aircraft get their desired level" (subject 10).

ITP Application

The data captured in the post-exercise questionnaire supported the recorded observations that all 12 subject controllers were able to correctly identify ITP requests when they were received. See "Recording Observations and Subject Controller Errors/Actions." In 32 of 36 exercises, the controllers easily applied the ITP standard. In the remaining four exercises, the controllers reported that they could not easily apply the ITP standard. The controllers attributed the difficulty in applying the ITP standard to the following:

- Lack of familiarity with the ITP standard
- The speed, phraseology, and text requirements of an ITP request
- Cumbersome CPDLC interactions
- Simulation problems

ITP Requirements Checklist

A desired outcome of the experiment was to determine if controllers would remember all ITP requirements. This was measured through observation of controller performance and in a post-experiment questionnaire (reproduced for reference in Appendix D) that asked, "Do you think an ITP checklist is required?" (i.e., necessary).

The experiment presented 285 ITP requests (12 subjects × 3 exercises × 8 ITP requests – 3 missed requests). Of these, controllers missed one or more requirements 24 times, or approximately 8.4% of the time. Missed requirements included the following:

- Mach differential check
- Maximum flight level constraint
- Inclusion of a non-referenced aircraft in an ITP clearance
- Reference aircraft cannot be maneuvering

When asked, "Do you think an ITP checklist is required?" (i.e., necessary), 58.3% of the controllers replied "Yes." Of these, 57.1% said that a checklist would be necessary only during initial implementation or training.

One-third of the controllers said a checklist is not necessary, and 8.3% said that the need for a checklist would depend on the approval granted by the Civil Aviation Safety Authority (CASA) (i.e., there may be aircraft in a particular volume of airspace that are equipped with ADS-B but do not have operational approval for the ITP; a checklist of approved aircraft may be useful to assist the controller in determining the validity of a request).

ITP Communications

91.7% of the 12 subject controllers indicated in their responses on the questionnaire that ITP communications were easy to understand and use with CPDLC. However, seven controllers added that improvements to the CPDLC interface and HMI would help reduce workload and minimize possibilities for confusion. Suggested improvements included: pre-formatted CPDLC messages to reduce the amount of free text used, on-screen procedures for the ITP (i.e., label data fields), and highlighting the requesting ITP Aircraft.

When asked, "Could the ITP standard be successfully applied using VHF voice communications?" and "Was the ITP communication easy to understand and use with VHF?" 100% of respondents said "Yes." Controllers also provided the following feedback concerning ITP communications over VHF:

- Defined standards for note-taking would improve ease-of-use for ITP voice communications due to the volume of information and the speed in which it is transmitted and received.
- Workload using voice communications is less than workload using CPDLC. Pre-formatted messages in place of free text would reduce CPDLC workload.
- Resolving confusion in ITP requests is faster and easier with VHF voice. In some cases, controllers used VHF voice to resolve issues that originated from a CPDLC ITP request.
- Voice requests can provide better situation awareness than a CPDLC request.
- In general, phraseology was logical and straightforward. For some controllers, ITP communications over HF voice could pose problems.

One-third of the subjects expressed concern over the meaning of the terms "leading" and "following" and their potential for confusion across both CPDLC and VHF voice communications.

ITP Workload Assessment

After completing each scenario, the subject controllers were asked to rate workload using a Modified Cooper Harper Scale, which is reproduced for reference in Appendix E.

For unknown reasons, two controllers failed to provide the data. Across the remaining 10 controllers, the average workload rating was 3.3, with a standard deviation of 1.8. While a rating of 3 was acceptable for the Modified Cooper Harper rating scale, a mean workload rating that was slightly above 3 was attributed to simulation problems that occurred on some exercises, which resulted in workload ratings that were higher than the norm.

When asked to compare the workload for an ITP request with that of a standard flight level change, 41.7% (5 out of 12) of the subject controllers said that they were comparable. Another 41.7% (5 out of 12) said that the ITP would increase workload because of the Mach check requirement as currently implemented. The remaining 16.7% (2 out of 12) said ITP would simply increase workload.

ITP Safety Implications

Ten of the 12 controllers responded that they thought the ITP was as safe as current day procedures. One controller stated it was safer than current day procedures and one controller abstained from comment, explaining that it would depend on the validity of the on-board information available to pilots.

Suggested Improvements

When asked, "Would you recommend changes to the ITP to assist you with application of this standard?" 11 controllers responded with recommendations, and one declined to comment. Among the recommendations, four major themes emerged.

- Mach check requirement
- Preformatted CPDLC messages
- Terminology confusion
- Flight level limitations

Refine Mach Check Requirement

The first recommendation by the subject controllers addressed the Mach check requirement. Comments dealt with two issues.

The first issue addressed the need for the Requesting Aircraft to include its Mach number in any ITP request. This suggestion was made by seven of 11 controllers. It should be noted that in the sectors used for this experiment, aircraft were not assigned a Mach number. For ITP applications in environments where all or most aircraft have an assigned Mach number, controllers would not need to request this information.

The second issue addressed the application of the Mach check. Three controllers suggested the need for greater flexibility in the application of this requirement—e.g., based on controller knowledge of aircraft types. The topic was discussed at length during the group debrief (which is summarized later in the paper).

Implement Pre-formatted CPDLC Messages

Five subjects expressed the need for pre-formatted CPDLC messages and the difficulty of using free text messages for the application of the ITP standard. Some of the difficulties identified with the use of CPDLC include:

- The ease of missing the L/ or F/ in the messages describing the Reference Aircraft location
- Confusion associated with exactly what was meant by L/ or F/ in terms of the ITP and Reference Aircraft
- The fact that the handling of free text in TAAATS means that as soon as the controller acknowledges a free text ITP request, it will be removed from their active message list.

Improvements suggested by the controllers include:

- The use of the entire word for the Reference Aircraft location ("leading" or "following")
- Standard phraseology for use with Reference Aircraft clarifications
- Standardized on screen procedures

Address Terminology Confusion

Four controllers commented on the use of the terminology "leading" and "following." They found these terms to be a potential source of confusion since they are currently defined from the pilot's perspective. Subjects noted that the L/ or F/ symbology used in the ITP requests is similar to the way in which pilots may refer to locations using Left (L) or Right (R).

Change Flight Level Limitations

Two subjects addressed the limitation of a 4,000 ft maximum flight-level change on the ITP.

They recommended use of a 3,000 ft restriction on the relative vertical position of a Reference Aircraft at initiation instead of the 4,000 ft limitation on the ITP Aircraft's change in flight level.

Supplemental Data Collection: Group Debrief

Following all of the ITP simulations, the subject controllers and group training specialists (who had assisted in the validation of the simulator exercises) were invited to participate in a group debrief session. The discussion covered the following:

- Communication issues (voice communications versus CPDLC; difficulties and confusion; phraseology; and need for preformatted messages)
- HMI discrepancies and discrepancies between the ITP request and the ATC surveillance picture
- Level of effort and workload
- Mach checks

The agenda used to guide the discussion is reproduced for reference in Appendix J. Key points made during the discussion include the following:

- The ITP was regarded as little different from a Distance Measuring Equipment (DME) go-through maneuver or use of ADS-C information for separation.
- In general, the ITP represents a shift of workload rather than an increase in workload.
- While the pilot re-check requirement represents a fundamental change in the application of a separation standard, it may serve to overcome some of the limitations associated with the provision of standards using HF communications.
- Use of VHF communications and possible confusion associated with use of a third-party call sign was not seen as a particular problem, as pilots today respond to incorrect call signs (particularly call signs similar to their own) and/or fail to respond to their call sign. Several participants considered that training and experience would likely overcome such confusion.
- There was some concern with the way the ITP requirements were written and taught for the simulation activities (with initiation criteria, rather than a minimum separation distance). Subject controllers were not actually aware of the standard they were protecting.
- It was noted that with a potential breakdown of separation, the first thing a controller does today is pass traffic. With the ITP, the traffic has technically already been passed once the procedure is cleared.
- New procedures are being added to make use of new technology instead of being integrated with, or replacing, older standards. One example cited was that there already is a distance standard with no more than 0.06 Mach closing at same level.

Group Discussion

The primary objectives of the ITP ATC experiment were to evaluate whether the ITP is a valid procedure from the perspective of an air traffic controller and to determine whether ITP would be an acceptable tool. Overall, the subject controllers experienced little difficulty in applying the ITP standard. In fact, they took no actions that resulted in a loss of separation. When the controllers made an error, it was usually minor and would, at most, require an extra communication to rectify.

Key issues identified during the course of the experiment included the requirement for, and application of, the Mach differential check; the 4,000 ft limitation on an ITP flight level change; and communication issues.

ITP Mach Check

The current ITP safety analysis is based on a closing Mach differential of no more than Mach 0.04. The Mach differential check is included in the ITP to account for the potential for adverse wind gradients or other factors that could result in an unsafe closure rate during the ITP maneuver. For the purposes of the experiment, controllers were required to check it, but they were not given detailed guidance about how to determine the Mach differential between the ITP and Reference Aircraft.

Thirty-one of the errors that were observed related to the requirement to perform a Mach differential check. Not all subject controllers performed the check as specified in the ITP; in 17 instances controllers used their experience to instead perform an aircraft type comparison between the ITP aircraft and the reference aircraft. Multiple subjects unexpectedly performed this action and five times combined it with a comparison of the last reported ground speeds of the aircraft. This approach reduces the workload required in an airspace environment that does not use assigned Mach numbers; however, it does not achieve the original purpose of the Mach differential check.

During the group debrief several controllers suggested that since there are existing separation standards that are based on a Mach differential of Mach 0.06, it might benefit controllers if the ITP were consistent with current practice (i.e., requiring a Mach differential of Mach 0.06 rather than Mach 0.04). The safety analysis team considered this proposed change following the experiment and determined that it would have no significant reduction on the safety of the ITP. Consequently, the team proposed a change to the ITP criteria that will align them with current standards.

To simplify the Mach check and reduce the workload associated with the requirement, a few controllers suggested that the communications requirements associated with the ITP could be modified to require the ITP Aircraft to include their own Mach number in the ITP request. However, this would only improve the procedure in an airspace environment that does not regularly assign Mach numbers to aircraft at FIR entry or clearance.

Note: Changes to the implementation could introduce differences into the airborne procedures based on the FIR in which an ITP is being conducted, which may limit the usefulness of the procedure.

ITP Level Change Limitation

The ITP, as implemented for this ATC experiment, specified level change restrictions of 2,000–4,000 ft. During the experiment, controllers were exposed to ITP requests with level changes less than 2,000 ft and greater than 4,000 ft. In the case of a 1,000 ft ITP request, one controller commented that it was easier to approve the ITP and apply a different standard for separation at the requested altitude than to issue a different clearance, even though the ITP was not valid for a 1,000 ft level change. The training specified that approval of a non-ITP request was a valid response to an ITP level change request. Controller impressions that this could cause confusion for the pilot was not observed in the companion study of the pilot procedures.[2] Requests that included a level change greater than 4,000 ft were usually granted, despite the 4,000 ft limitation as a key part of the training. When issuing an ITP clearance of more than 4,000 ft, four controllers commented that another means of separation would exist between the ITP Aircraft and Reference Aircraft as the ITP Aircraft climbed or descended more than 4,000 ft from its initial flight level; the controller was, therefore, able to issue a single clearance using the ITP.

This approach to using the ITP standard was consistent with a proposed revision to the ITP, which resulted from this experiment—i.e., to remove the 4,000 ft limitation on an ITP and replace it with the limitation that a Reference Aircraft must be flying no more than 2,000 ft from the initial flight level of the ITP Aircraft. This would allow additional flight levels in an ITP request after the actual ITP portion of the maneuver is complete.

If more than 2,000 ft exists between the ITP Aircraft and a desired Reference Aircraft, a non-ITP level change maneuver would be required prior to issuing an ITP request.

ITP Communication and Phraseology

To determine whether the ITP can work with existing communication formats and procedures, the experiment tested the subject controllers' ability to handle ITP requests using both VHF voice communications and CPDLC. No issues emerged that would prevent the implementation of the ITP using either communication format.

Several subjects suggested strategies for using both CPDLC and VHF communication that would improve performance and reduce workload. For details, see "Suggested Improvements." Most controllers agreed that standardized message formats would improve performance. This issue was known going into the experiment; however, the simulator required use of free-text CPDLC messages instead of completely pre-formatted messages. The time required to implement an ITP-specific message set exclusively for the experiment (at this time no ITP implementation is scheduled) did not outweigh the additional effort for the subjects to use free-text for the ITP messages.

Of greater significance in the discussion of standard message formats and phraseology was the use of the phrases "leading" and "following" to describe the ITP Aircraft's relative position to the Reference Aircraft. As currently defined in the ITP, the terms represent the perspective of the pilot and are potentially confusing to a controller. The subject controllers suggested revising the terms to more closely reflect the controller's perspective.

Limitations of the Airservices simulator facility precluded the simulation of HF communication links. Concerns have been raised in a number of forums about the use of HF for the ITP. Further research is needed before any statements can be made about the use of HF communication for the ITP.

Conclusion

In summary, results from the ITP ATC experiment demonstrated that the ITP is both valid and acceptable from the air traffic controller perspective and would be useful in today's ATC environment. Participants in the study identified key changes to simplify the procedure. The experiment team conveyed them to the RTCA/EUROCAE RFG and the ICAO SASP, who are working to develop standards and requirements for the ITP. Approval of the ITP standards by the ICAO SASP was received in November 2009.

References

[1] Safety, Performance and Interoperability Requirements Document for the In-Trail Procedure in Oceanic Airspace (ATSA-ITP) Application, RTCA DO-312, June 19, 2008.

[2] Murdoch et al, Enhanced Oceanic Operations Human-In-The-Loop In-Trail Procedure Validation Simulation Study, NASA/TP-20080215313, June 2008

[3] Chartrand et al, Operational Improvements from Using the In-Trail Procedure in the North Atlantic Organized Track System, NASA/Draft TM, 2009

[4] Wierwille, W. W.; and Casali, J. G.: A Valid Rating Scale for Global Mental Workload Measurement. Proceedings of the Human Factors Society 27th Annual Meeting, 1983, pp. 129-133.

[5] SPSS Inc.: SPSS® for Windows™: SPSS Base 12.0 User's Guide, Release 12.0. SPSS Inc. (Chicago, IL), 2003.

[6] Winer, B. J.; Brown, D. R.; and Michels, K. M.: Statistical Principles in Experimental Design. Third ed., McGraw-Hill, Inc., 1991.

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Appendix A - Demographic Information Questionnaire

DEMOGRAPHIC INFORMATION QUESTIONNAIRE

AIRSERVICES AUSTRALIA

Personal Information

1. What is your current age? ____________

2. How much time did you spend reviewing the material for this experiment? [**0 mins** is a valid option] ______

3. Are you a pilot?

   Yes No

   If Yes, what type of flying experience do you have?

General Experience

4. Provide your best estimate for each of the following:

   - Total Time as Controller: _______________
   - Time as Procedural Controller: _______________
   - Time on Experiment Sector: _______________

Current Position

5. What is your current position? ______________

6. On a scale of 1 to 10, rate your level of familiarity with procedural control.

   A rating of **1** corresponds to **"very unfamiliar."**
   A rating of **10** corresponds with **"very familiar."**

   Level of familiarity with procedural control: _____

7. What groups have you worked in?

8. Under what circumstances would you expect to be more or less likely to deny approval for a flight level change? Consider the time of year, time of day, direction of flight, particular tracks, and/or particular flight levels.

9. Use a scale of 1 to 10 to indicate how important it is to approve a level change request

   A rating of **1** corresponds to **“very unimportant.”**
   A rating of **10** corresponds with **“very important.”**

   Importance of obtaining approving flight level change requests: _____

   What is this rating based on?

10. Do you have experience with data link communications?

    Yes No If Yes, how many years of experience do you have? _________

11. Do you have experience with ADS-C (i.e. data link position reporting)?

    Yes No If Yes, how many years of experience do you have? _________

12. Do you have experience with ADS-B?

    Yes No If Yes, how many years of experience do you have? _________

13. When unable to approve a flight level request, do you typically offer an alternative?

    Yes No

Appendix B - TGO Scripts

WEST P: Exercise 1136

```
--SCRIPT-EXERCISE 1136--MODIFIED 15/06/07 ITP TRAIL --1EC/1R/2P
--------------------------------------------------------------------------------
--PIL/IND/INS STAND ALONE SECTOR
--EXERCISE NUMBER:EXE1136
--START TIME:0000
--FREEZE TIME:0002
--SECTOR GROUP:WEST NON RADAR
--TITLE:IND/INS/INE/PIL
--DATASET: A SHIFT
--VSCS DATASET:
--
--OPSUP:
--AUTO HANDOFF " OFF"  FOR IND,INS,PIL,INE,
--
--TURN OFF STCA,DAIW,MSAW,RAM,CLAM ALARMS: "ROW"
--
--DAIW: RR131A-RR131G "ON"  FROM   0002 TO 0200
--RMAP: R153,R166AB PEARES "ON"  [0002-0200]
--NOTE: PEARES= R155,R156,R160AB,R161AB,
--
-- SIM CONSOLE SET_UP
--ROW: VSCS:
--  TOGGLE "FPASD"
--
--  ACCEPT CWO PRL=CFL PETO MEK 0050
--  ACCEPT FNY PRL=CFL PETO AGREK 0024
--
--TOGGLE "FPASD"
--
--PIL/IND/INS VSCS:
-- TOGGLE "FPASD"
--
-- ACCEPT ALL A/C IN IND,INE,INS,PIL AND PETO TO NEXT POINT
-- TOGGLE "FPASD"
--
--PILOT DELEGATION:
--          1Controller, 1ROW & 2PILOTS


--SCRIPT FOR PILOT 1 - EXERCISE 1136
----------------------------------------------------------
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY.
--
```

--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--...EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
--
0000 | 1 | NOTE | SECTOR:IND/PIL/INS VSCS: A_WES PA
0000 | 1 | NOTE | CPDLC A/C:SIA219
0005 | 1 |TROJ202|CALL APPROACHUNG F180 FOR CLR
0005 | 1 |ASY176 |CPDLC:"ITP F320 F/ASY174 31"
0013 | 1 |MAS123 |CPDLC:"ITP F380 F/SIA225 45"
0018 | 1 |QFA42 |REQ ITP DESC F310 LEADING SIA219 89nmi
0022 | 1 |SIA232 |CPDLC:"ITP F310 L/QFA72 30"
0022 | 1 |GIA727 |REQ ITP CLI F330 FLWG QFA600 16nmi
0022 | 1 |ASY174 |CPDLC:"ITP F370 F/ASY176 32"
--
--
--YARG=ARGYLE--YBRY=BARIMUNYA--YANG=WEST ANGELAS--YBGO=BALGO HILL
--

--
--SCRIPT FOR PILOT 2 - EXERCISE 1136

--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY.
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--...EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
--
0000 | 2 | NOTE |SECTOR:IND/PIL/INS VSCS: A_WES PB
0000 | 2 | NOTE |CPDLC A/C:SIA225
0005 | 2 | *KLG |VIA AGREK FNY,NUL HAVE THE COORD
0009 | 2 |QFA290 |CPDLC:"ITP F390 F/QFA434 40 L/BAW42 81"
0017 | 2 | *KNG |DEP RBA65 & ANZ26
0027 | 2 | *MAG |VIA MEK CWO
0032 | 2 |QFA434 |CPDLC:"ITP F410 L/BAW42 127"
0035 | 2 | *KNG |DEP ZLT
0040 | 2 |ASY174 |CPDLC:"ITP F370 F/ASY176 32"
0049 | 2 | *MAG |VIA ISNIB RBA65
0050 | 2 | *WIIR |ESTIMATE RCH8F7Y POSOD 0130 FL350
0056 | 2 | COCOS |POSN ASY174 GUDUG 0057 FL... EST UBNIS 0140
--
--YBGO=BALGO HILL--YANG=WEST ANGELAS--YARG=ARGYLE--YBRY=BARIMUNYA
--

--

--ROW SCRIPT EXERCISE 1136
--
-- 0003   *NWN | TXY OYD PD-NWN
-- 0003   OYD "R230" IN LABEL DATA
--
-- 0009   OYD PETO NWN .... HAND-OFF
--
-- 0025   NIF PETO ROOBY 0059
--
-- 0030   *NWN | TXY NJA NWN-PH
-- 0030   NJA "R260" IN LABEL DATA
--
-- 0030   *NWN | TXY NJJ KA-PH
-- 0030   NJJ "R260" IN LABEL DATA
--
-- 0036   NJJ PETO ROSEY 0100 HAND-OFF
--
-- 0036   NJA PETO MEK .... HAND-OFF
--
-- 0037   *NWN | TXY FNJ KA-PH
-- 0037   FNJ "R340" IN LABEL DATA
--
-- 0040   RBA65 PETO ISNIB ....
--
-- 0043   FNJ PETO ROSEY 0105 HAND-OFF
--
-- 0043   TLZ "R270" IN LABEL DATA
-- 0043   *YAL | TXY TLZ MEK-WWI
--
-- 0047   *NWN | TXY FNR PD-PH
-- 0047   FNR "R340" IN LABEL DATA
--
-- 0049   TLZ PETO ALFIE .... HAND-OFF
--
-- 0054   FNR PETO PBO .... HAND-OFF
--
-- 0115   *NWN | TXY NJT YANG-PH
-- 0115   NJT "R300" IN LABEL DATA
--
-- 0120   *NWN | TXY IYP YNWN-BGO
-- 0120   IYP "R210" IN LABEL DATA
--
-- 0122   NJT PETO NICKO 0159 H.O
--
-- 0125   QFA1083 "R380" IN LABEL DATA
-- 0125   *NWN | TXY QFA1083 YPKA-PH
--
-- 0126   IYP PETO TEF 0208 H.O
--
-- 0132   QFA1083 "40R" IN LABEL DATA
--

-- 0132 *NWN | QFA1083 DIVERTING 40ROT DUE WX

WEST P: Exercise 1137

-- SCRIPT-EXERCISE 1137--AMENDED 31/7/07 ITP TRAIL--1EC/1R/2P
--
--EXERCISE NUMBER:EXE1137
--START TIME:0000
--FREEZE TIME:0003
--SECTOR GROUP:WEST GROUP
--TITLE:IND/PIL/INS [STAND ALONE]
--DATASET: A SHIFT
--VSCS DATASET:
--
--OPSUP:
--Sector:EC POSITION: IND/PIL/INS
-- ROW: MAG,YAL, KLG,MZI,NWN,KNG,LCI,PHR,PHF,PHN,PHS,JAR,NUL,
--AUTO HANDOFF " OFF" FOR IND,INS,PIL
--
--TURN OFF STCA,DAIW,MSAW,RAM,CLAM ALARMS for "ROW"
--
--DAIW: RR131A-RR131G "ON" FROM 0002 TO 0200
--RMAP: R153,R166AB PEARES "ON" [0002-0200]
--NOTE: PEARES= R155,R156,R160AB,R161AB
--
-- SIM CONSOLE SET_UP
-- ROW: VSCS: A_WESROW
-- TOGGLE "FPASD"
-- Accept: FNB
-- Accept: NXD,GREEN CFL=PRL PETO MEK 0033
-- ASY900 LABEL DATA "R390"
-- IN OYD LABEL DATA "R230" CFL=180,PETO BORAH 0026
-- IN NXC LABEL DATA "R320" CFL=180
-- Accept:NXA GREEN CFL=PRL, PETO MEK0028
-- TOGGLE "FPASD"
--
-- IND/PIL VSCS:A_WES
-- TOGGLE "FPASD"
-- Accept:SIA224 PETO NONOG 0030 GREEN CFL
-- Accept:SIA481, GREEN CFL, PRL=CFL PETO SAKEG 0057
-- QFA42 WHITE CFL PETO FECTI 0020 PRL=CFL DO NOT ACCEPT
-- Accept:SIA478,WHITE CFL,PETO POSOD 0007,
-- Accept:GIA727,GREEN PRL=CFL,PETO AKBAT 0006,
-- Accept: SIA231 PETO PD 0030 FECTI 0012 HD IN LABEL
-- TOGGLE "FPASD"
--PART 2;
--PILOT POSITION SETUP: ONLY SEND CPDLC MESSAGES[Do Not Climb acft]
--SEND CPDLC MESSAGES FOR THE FOLLOWINF ACFT TO ESTABLISH CONNNECTION:
-- SIA481 SIA478 SIA231 SIA224 SAA286 SIA400 UAE424 AUZ7873

-- GIA727 QFA42 ANZ26
--Go Back to Controller Posn
--left click BROWN & RED HIGHLIGHTED Call signs in CPDLC Messages WINDOW.
--
--PILOT DELEGATION: 1Controller, 1ROW & 2PILOT

--
--SCRIPT PILOT 1 - EXERCISE 1137
-- --NOTES:
-- Initial Calls Scripts, Pilots make I/C at PIL Sector Boundary
--BA46 DO NOT REPORT POSITION at MOG/OXBLU
--Inform ROW of the following details:
-- . When DTI aircraft on descend passes FL180
-- . Re-routing ROW aircraft
-- . Change of aircraft Planned Level during the ATC coordinations
--IND OCEAN FLTS.
-- . I/C & Posn Rep for Flights over IND ocean is relayed via AFTN ARP
-- . Refer to INFO below Pilot2 Scripts if IND req for posn report thr COCOS
-- . COCOS uses voice coord to pass Posn Rep when LVL change is expected
--CPDLC & ADS Acft from another FDRG will send Posn Reports at boundary only
--CPDLC Acft no ADS send Posn Reports using CPDLC at all mandatory reporting points.
--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH
-- A POSN REP IN PROCEDURAL...EG: 'QFA5, ITP REQUEST'...WAIT FOR
-- CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
0000 | 1 | NOTE | Sector:IND/PIL/INS VSCS:A_WES_PA
0002 | 1 |ADS/AGCW| SIA224 SIA231,SIA481 SIA478 UAE421
0010 | 1 |QFA42 |REQ ITP CLI F380 F/SIA231 70nmi,L/ANZ26 39nmi
0015 | 1 |GIA727 | REQ F320
0030 | 1 |AUZ7873 |REQ ITP CLI F330 LEADING GIA727 13nmi
0050 | 1 | QFA42 | REQ F370
--
--NOTE:
--SAA286 KALBI 0110 F380 KABTA 0147
--
--YBWX=BARROW ISLAND YBRY=BARIMUNYA YSHG=SHAY GAP

--SCRIPT PILOT 2 - EXERCISE 1137
-- --NOTES:
-- Initial Calls Scripts, Pilots make I/C at PIL Sector Boundary
--BA46 DO NOT REPORT POSITION at MOG/OXBLU
--Inform ROW of the following details:

--   . When DTI aircraft on descend passes FL180
--   . Re-routing ROW aircraft
--   . Change of aircraft Planned Level during the ATC coordinations
--IND OCEAN FLTS.
--   . I/C & Posn Rep for Flights over IND ocean is relayed via AFTN ARP
--   . Refer to INFO below Pilot2 Scripts if IND req for posn report thr COCOS
--   . COCOS uses voice coord to pass Posn Rep when LVL change is expected
--CPDLC & ADS Acft from another FDRG will send Posn Reports at boundary only
--CPDLC Acft no ADS send Posn Reports using CPDLC at all mandatory reporting points.
--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH
-- A POSN REP IN PROCEDURAL...EG: 'QFA5, ITP REQUEST'...WAIT FOR
-- CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
0000 | 2 | NOTE |Sector:IND/PIL/INS VSCS: A_WES_PB
0001 | 2 |ADS/AGCW|SIA224,SIA231,SIA481 SIA478 UAE421
0008 | 2 | SIA478 |CPDLC:"POSN POSOD 0008 F350 PIBED 0036"
0009 | 2 |SIA478 |CPDLC:"ITP F310 F/SIA481 50"
0016 | 2 |QFA77 |1)REQ ITP CLI F370 FLWG SIA442 43nmi..
0016 | 2 |QFA77 |2)..WHEN QUERIED - APOLOGIES SIA224!!
0024 | 2 |UAE424 |CPDLC:"ITP F340 F/UAE421 39"
0025 | 2 |*MAURACC|TXY RCH52P6 FJDG-WSSS REQ CLR,VIA GUDUG F370
0026 | 2 | ANZ26 |I/C FECTI 0026 F... PD 0045
0032 | 2 |*MAURACC|DEP RCH52P6 @30 CLI FL... EST GUDUG 0055
0035 | 2 |SAA286 |CPDLC:"ITP F300 L/SIA400 10"
0036 | 2 |SIA478 |ADS NO POSN REPORTS REQD
0040 | 2 | ANZ26 |"REQ ITP CLI F390 FLWG QFA42 44nmi
0045 | 2 |SIA481 |CPDLC:"ITP F310 L/SIA478 52"
0105 | 2 | *MAG | VIA ISNIB QFA75
--YBWX=BARROW ISLAND
--YBRY=BARIMUNYA
--YSHG=SHAY GAP
--ARP MESSAGES
-- 0007 | 2 | INFO | SIA478 POSOD 07 F350 PIBED 0036
-- 0032 | 2 | INFO | SIA478 PIBED 36 F350 SAKEG 0120
-- 0032 | 2 | INFO | SIA481 SAKEG 57 F370 PIBED 0141
-- 0032 | 2 | INFO | SIA478 SAKEG 20 F350 PEDPI 0243
-- 0035 | 2 | INFO | UAE421 BIGAK 0034 F320 UXORA 0111
-- 0054 | 2 | INFO | RCH52P6 GUDUG 0053 F... IDEVI 0156
-- 0112 | 2 | INFO | UAE421 UXORA 0111 F320 IKASA 0206
-- 0113 | 2 | INFO | SAA286 KALBI 0111 F320 KABTA 0145
-- 0157 | 2 | INFO | RCH52P6 IDEVI 0156 F... PIBED ....

--ROW SCRIPT EXERCISE 1137

```
--
--
--ROW POSN:
--vscs:A_WESROW
--
--0001  PUT IN LABEL DATA FOR NXH " R340 "
--
--0002  PUT IN LABEL DATA FOR NXC " R320 "
--
--0005  PETO NXC NIPEM @0034HAND OFF
--
--0006  PETO NXH YMEK @0035 Hand-off to PIL
--
--0006  PETO ASY900 VEPUD @0031 Hand-off to PIL
--
--0007  PUT IN LABEL DATA FOR QFA1083 " R360 "
--0007 *NWN   | TXY QFA1083 KA-PH
--
--0009 *YAL   | TXY LKF GEL-KA
--0009  PUT IN LABEL DATA R270
--
--0012  PUT IN LABEL DATA FOR ZLE "R380"
--0012 *NWN   | TXY ZLE TEF-PH
--
--0024  OYD GLOBAL OPS "T/NXA"
--
--0014  PETO QFA1083 ROSEY @0033 Hand-off
--
--0015  ASK PILOT 1 FOR FNB MEK EST THEN PETO MEK @.....
--0016  PETO LKF LATAP @0053 HAND OFF
--
--0018  PETO ZLE SAVRY @0050 Hand-off to PIL
--
--0030  PETO NXE MEK @0052
--
--0033  PETO NJT NOPED @0101
--
--0034  NXA GLOBAL OPS "T/OYD"
--
--0038  PETO QFA1084 KAGUX @0104
--
--0041  PETO NJR KAGUX ....
--
--0045  PUT IN LABEL DATA FOR YAD "R300"
--0045 *NWN   | TXY YAD BRY-PH
--

--0051  PETO YAD NICKO @... Hand-off to PIL
--
--0055  PUT IN LABEL DATA FOR NXB "R360"
--0055 *NWN   | TXY NXB NWN-PH
--
--0101  PETO NXB MEK @... Hand-off to PIL
--
--0104  PETO QFA75 ISNIB @0125
--
--0106  PETO NXI NIPEM @0130
--
--0111  PUT IN LABEL DATA FOR OYD " R230 "
--0113*NWN   | TXY OYD, NWN-SHG (SHAY GAP)
--
--0119  PETO OYD YSHG @0200
--0120  PUT IN LABEL DATA FOR FNY " R350 "
--0120*NWN   | TXY FNY, KA-PH
--
--0126  PETO FNY ROSEY @....
--
--0135  PETO NJN KAGUX @0200
```

WEST P: Exercise 1138

-- SCRIPT-EXERCISE 1137--AMENDED 31/7/07 ITP TRAIL--1EC/1R/2P
--
--EXERCISE NUMBER:EXE1137
--START TIME:0000
--FREEZE TIME:0003
--SECTOR GROUP:WEST GROUP
--TITLE:IND/PIL/INS [STAND ALONE]
--DATASET: A SHIFT
--VSCS DATASET:
--
--OPSUP:
--Sector:EC POSITION: IND/PIL/INS
-- ROW: MAG,YAL, KLG,MZI,NWN,KNG,LCI,PHR,PHF,PHN,PHS,JAR,NUL,
--AUTO HANDOFF " OFF" FOR IND,INS,PIL
--
--TURN OFF STCA,DAIW,MSAW,RAM,CLAM ALARMS for "ROW"
--
--DAIW: RR131A-RR131G "ON" FROM 0002 TO 0200
--RMAP: R153,R166AB PEARES "ON" [0002-0200]
--NOTE: PEARES= R155,R156,R160AB,R161AB
--
-- SIM CONSOLE SET_UP
-- ROW: VSCS: A_WESROW
-- TOGGLE "FPASD"
-- Accept: FNB
-- Accept: NXD,GREEN CFL=PRL PETO MEK 0033
-- ASY900 LABEL DATA "R390"
-- IN OYD LABEL DATA "R230" CFL=180,PETO BORAH 0026
-- IN NXC LABEL DATA "R320" CFL=180
-- Accept:NXA GREEN CFL=PRL, PETO MEK0028
-- TOGGLE "FPASD"
--
-- IND/PIL VSCS:A_WES
-- TOGGLE "FPASD"
-- Accept:SIA224 PETO NONOG 0030 GREEN CFL
-- Accept:SIA481, GREEN CFL, PRL=CFL PETO SAKEG 0057
-- QFA42 WHITE CFL PETO FECTI 0020 PRL=CFL DO NOT ACCEPT
-- Accept:SIA478,WHITE CFL,PETO POSOD 0007,
-- Accept:GIA727,GREEN PRL=CFL,PETO AKBAT 0006,
-- Accept: SIA231 PETO PD 0030 FECTI 0012 HD IN LABEL
-- TOGGLE "FPASD"
--PART 2;
--PILOT POSITION SETUP: ONLY SEND CPDLC MESSAGES[Do Not Climb acft]

--SEND CPDLC MESSAGES FOR THE FOLLOWINF ACFT TO ESTABLISH CONNNECTION:
-- SIA481 SIA478 SIA231 SIA224 SAA286 SIA400 UAE424 AUZ7873
-- GIA727 QFA42 ANZ26
--Go Back to Controller Posn
--left click BROWN & RED HIGHLIGHTED Call signs in CPDLC Messages WINDOW.
--
--PILOT DELEGATION: 1Controller, 1ROW & 2PILOT

--
--SCRIPT PILOT 1 - EXERCISE 1137
-- --NOTES:
-- Initial Calls Scripts, Pilots make I/C at PIL Sector Boundary
--BA46 DO NOT REPORT POSITION at MOG/OXBLU
--Inform ROW of the following details:
-- . When DTI aircraft on descend passes FL180
-- . Re-routing ROW aircraft
-- . Change of aircraft Planned Level during the ATC coordinations
--IND OCEAN FLTS.
-- . I/C & Posn Rep for Flights over IND ocean is relayed via AFTN ARP
-- . Refer to INFO below Pilot2 Scripts if IND req for posn report thr COCOS
-- . COCOS uses voice coord to pass Posn Rep when LVL change is expected
--CPDLC & ADS Acft from another FDRG will send Posn Reports at boundary only
--CPDLC Acft no ADS send Posn Reports using CPDLC at all mandatory reporting points.
--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH
-- A POSN REP IN PROCEDURAL...EG: 'QFA5, ITP REQUEST'...WAIT FOR
-- CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
0000 | 1 | NOTE | Sector:IND/PIL/INS VSCS:A_WES_PA
0002 | 1 |ADS/AGCW| SIA224 SIA231,SIA481 SIA478 UAE421
0010 | 1 |QFA42 |REQ ITP CLI F380 F/SIA231 70nmi,L/ANZ26 39nmi
0015 | 1 |GIA727 | REQ F320
0030 | 1 |AUZ7873 |REQ ITP CLI F330 LEADING GIA727 13nmi
0050 | 1 | QFA42 | REQ F370
--
--NOTE:
--SAA286 KALBI 0110 F380 KABTA 0147
--
--YBWX=BARROW ISLAND YBRY=BARIMUNYA YSHG=SHAY GAP

--SCRIPT PILOT 2 - EXERCISE 1137
-- --NOTES:
-- Initial Calls Scripts, Pilots make I/C at PIL Sector Boundary

--BA46 DO NOT REPORT POSITION at MOG/OXBLU
--Inform ROW of the following details:
-- . When DTI aircraft on descend passes FL180
-- . Re-routing ROW aircraft
-- . Change of aircraft Planned Level during the ATC coordinations
--IND OCEAN FLTS.
-- . I/C & Posn Rep for Flights over IND ocean is relayed via AFTN ARP
-- . Refer to INFO below Pilot2 Scripts if IND req for posn report thr COCOS
-- . COCOS uses voice coord to pass Posn Rep when LVL change is expected
--CPDLC & ADS Acft from another FDRG will send Posn Reports at boundary only
--CPDLC Acft no ADS send Posn Reports using CPDLC at all mandatory reporting points.
--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH
-- A POSN REP IN PROCEDURAL...EG: 'QFA5, ITP REQUEST'...WAIT FOR
-- CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
0000 | 2 | NOTE |Sector:IND/PIL/INS VSCS: A_WES_PB
0001 | 2 |ADS/AGCW|SIA224,SIA231,SIA481 SIA478 UAE421
0008 | 2 | SIA478 |CPDLC:"POSN POSOD 0008 F350 PIBED 0036"
0009 | 2 |SIA478 |CPDLC:"ITP F310 F/SIA481 50"
0016 | 2 |QFA77 |1)REQ ITP CLI F370 FLWG SIA442 43nmi..
0016 | 2 |QFA77 |2)..WHEN QUERIED - APOLOGIES SIA224!!
0024 | 2 |UAE424 |CPDLC:"ITP F340 F/UAE421 39"
0025 | 2 |*MAURACC|TXY RCH52P6 FJDG-WSSS REQ CLR,VIA GUDUG F370
0026 | 2 | ANZ26 |I/C FECTI 0026 F... PD 0045
0032 | 2 |*MAURACC|DEP RCH52P6 @30 CLI FL... EST GUDUG 0055
0035 | 2 |SAA286 |CPDLC:"ITP F300 L/SIA400 10"
0036 | 2 |SIA478 |ADS NO POSN REPORTS REQD
0040 | 2 | ANZ26 |"REQ ITP CLI F390 FLWG QFA42 44nmi
0045 | 2 |SIA481 |CPDLC:"ITP F310 L/SIA478 52"
0105 | 2 | *MAG | VIA ISNIB QFA75
--YBWX=BARROW ISLAND
--YBRY=BARIMUNYA
--YSHG=SHAY GAP
--ARP MESSAGES
-- 0007 | 2 | INFO | SIA478 POSOD 07 F350 PIBED 0036
-- 0032 | 2 | INFO | SIA478 PIBED 36 F350 SAKEG 0120
-- 0032 | 2 | INFO | SIA481 SAKEG 57 F370 PIBED 0141
-- 0032 | 2 | INFO | SIA478 SAKEG 20 F350 PEDPI 0243
-- 0035 | 2 | INFO | UAE421 BIGAK 0034 F320 UXORA 0111
-- 0054 | 2 | INFO | RCH52P6 GUDUG 0053 F... IDEVI 0156
-- 0112 | 2 | INFO | UAE421 UXORA 0111 F320 IKASA 0206
-- 0113 | 2 | INFO | SAA286 KALBI 0111 F320 KABTA 0145
-- 0157 | 2 | INFO | RCH52P6 IDEVI 0156 F... PIBED ....

--ROW SCRIPT EXERCISE 1137
--
--
--ROW POSN:
--vscs:A_WESROW
--
--0001 PUT IN LABEL DATA FOR NXH " R340 "
--
--0002 PUT IN LABEL DATA FOR NXC " R320 "
--
--0005 PETO NXC NIPEM @0034HAND OFF
--
--0006 PETO NXH YMEK @0035 Hand-off to PIL
--
--0006 PETO ASY900 VEPUD @0031 Hand-off to PIL
--
--0007 PUT IN LABEL DATA FOR QFA1083 " R360 "
--0007 *NWN | TXY QFA1083 KA-PH
--
--0009 *YAL | TXY LKF GEL-KA
--0009 PUT IN LABEL DATA R270
--
--0012 PUT IN LABEL DATA FOR ZLE "R380"
--0012 *NWN | TXY ZLE TEF-PH
--
--0024 OYD GLOBAL OPS "T/NXA"
--
--0014 PETO QFA1083 ROSEY @0033 Hand-off
--
--0015 ASK PILOT 1 FOR FNB MEK EST THEN PETO MEK @.....
--0016 PETO LKF LATAP @0053 HAND OFF
--
--0018 PETO ZLE SAVRY @0050 Hand-off to PIL
--
--0030 PETO NXE MEK @0052
--
--0033 PETO NJT NOPED @0101
--
--0034 NXA GLOBAL OPS "T/OYD"
--
--0038 PETO QFA1084 KAGUX @0104
--
--0041 PETO NJR KAGUX ....
--
--0045 PUT IN LABEL DATA FOR YAD "R300"

--0051 PETO YAD NICKO @... Hand-off to PIL
--
--0055 PUT IN LABEL DATA FOR NXB "R360"
--0055 *NWN | TXY NXB NWN-PH
--
--0101 PETO NXB MEK @... Hand-off to PIL
--
--0104 PETO QFA75 ISNIB @0125
--
--0106 PETO NXI NIPEM @0130
--
--0111 PUT IN LABEL DATA FOR OYD " R230 "
--0113*NWN | TXY OYD, NWN-SHG (SHAY GAP)
--
--0119 PETO OYD YSHG @0200
--0120 PUT IN LABEL DATA FOR FNY " R350 "
--0120*NWN | TXY FNY, KA-PH
--
--0126 PETO FNY ROSEY @....
--
--0135 PETO NJN KAGUX @0200

--0045 *NWN | TXY YAD BRY-PH

BIGHT: Exercise 1301

--EXE 1301 LAST MODIFIED 16/07/07CK

--EXERCISE NUMBER:BIT1301 ITP TRAIL
--START TIME:0000
--FREEZE TIME:0004
--SECTOR GROUP:BIGHT GROUP
--TITLE:NUL FLEX
--DATASET: A SHIFT
--VSCS DATASET: [VSCS: A_BIT]
--
--OPSUP:
--
--SECT: NUL
--AUTO H/O : ALL ON
--FPCF OFF
--
--SET UP:
--NUL:
--TOGGLE FPASD
--
--ACCEPT PRL=GREEN CFL: BAW15, QFA6, SIA221, SIA227, MAS149, BAW17, MAS139,
--THA980, QFA10, UAE406
--ACCEPT UAE412 PRL=GREEN CFL PETO CAG 0017
--
--WHITE CFL A/C OUTSIDE NUL SECTOR
--
--
--ROW:
--ACCEPT QFA648 PRL=GREEN CFL PETO RERON 0037
--ACCEPT SIA285
--
--
--PILOT POSITION SETUP: SEND CPDLC MESSAGES TO ESTABLISH LINK
--THA980, QFA10, SIA221, QFA6, QFA648, SIA285, SIA227, MAS149, MAS139
--BAW15, UAE406, QFA652,UAE412
--
--

--ROW SCRIPT EXE 1301

--AUTO HAND-OFF "ON"
--PETO AS PER ROW SCRIPT BELOW

--If Reporting Position at Boundary pilot make Initial Calls as per script.
--If no Reporting Position at Boundary;ROW to advise pilot to make I/C when Label
--has been accepted.
--
--0020 VOZ436 PETO CAG 0100
--0020 QFA581 CPDLC REPORT SPEED
--0020 VOZ967 PETO HITCH 0106
--
--0030 VOZ645 PETO HITCH 0109
--0030 QFA7778 PETO CAG 0111
--0030 QFA720 PETO HITCH 0116
--
--0035   JTE22 PETO CANDY 0106
--
--0059   VOZ298 PETO RERON 0146
--
--0103   MAS139 PETO VISAS 0150 28S126E 0232
--
--
--BIT1301 -NUL PILOT 1

-- TIME | PILOT | IDENT |TEXT

-- POSN REPORTS : IMPORTANT INFO
-- REPORTS ARE SCRIPTED FOR THOSE POSNS THAT ARE NOT MACHINE GENERATED
-- YOU WILL BE USING **BOTH**
-- IF WE MISSED ANY THAT YOU FIND YOU NEED SCRIPTED...
-- NOTE EM DOWN & WE'LL FIX IT!
--
0000 | 1 | NOTE | VSCS:A_BIT SECT: NUL
0000 | 1 |NEW NOTE|NO POSN REP REQ.FOR MTP ABTOD LONLY CANDY
--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--ADS/CPDLC ACFT
--SIA285,SIA221,SIA218,SIA227,QFA518,QFA10,QFA6,QFA648,QFA2,QFA518
--UAE406,UAE412,UAE430
--CPDLC ONLY MAS149 , THA980
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--...EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340, F/L ACFT'
--IF BELOW F250 ON CLIMB SAY M0.71
--
0008 | 1 | QFA648 |I/C EST RERON 0037
0010 | 1 | THA980 |REQ ITP CLI F360 FLWG QFA10 16nmi

0015 | 1 | SIA221 |CPDLC:"ITP F310 F/QFA6 55 L/SIA285 48"
0021 | 1 | QFA648 |REQ ITP DESC F380 FLWG QFA652 43nmi
0026 | 1 | MAS149 |1.CPDLC:"ITP F380 L/SIA227 49 F/BAW17 92"
0026 | 1 | MAS149 |2.IF ASKED TO CFM F BAW17 RESEND MSG WITH L
0031 | 1 | QFA648 |REQ ITP DESC F350 FLWG QFA652 47nmi
0037 | 1 | MAS139 |1.CPDLC:"ITP F390 L/BAW17 17, F/MAS149 82"
0037 | 1 | MAS139 |2.IF ASKED TO CFM LEADING MAS149, DO SO
0041 | 1 | UAE412 |CPDLC:"ITP F380 F/UAE406 19"
0059 | 1 | VOZ436 |CAG 0059 F390 EST IVPEM 0114
0100 | 1 | VOZ967 |I/C POSN SEVSI 59 F390 FRT 0125
0117 | 1 | MAS149 |POSN 28S126E 0116 FL... ABTOD 0215
--
--IF NEEDED SIA285 BIDAP 13 ISMOR 0104
--
--
--BIT1301 -NUL PILOT 2

-- TIME | PILOT | IDENT |TEXT

-- POSN REPORTS : IMPORTANT INFO
-- REPORTS ARE SCRIPTED FOR THOSE POSNS THAT ARE NOT MACHINE GENERATED
-- YOU WILL BE USING **BOTH**
-- IF WE MISSED ANY THAT YOU FIND YOU NEED SCRIPTED...
-- NOTE EM DOWN & WE'LL FIX IT!
--
0000 | 2 | NOTE | VSCS:A_BIT SECT: NUL
0000 | 2 |NEW NOTE|NO POSN REP REQ.FOR MTP ABTOD LONLY CANDY
--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--ADS/CPDLC ACFT
--SIA285,SIA221,SIA218,SIA227,QFA518,QFA10,QFA6,QFA648,QFA2,QFA518
--UAE406,UAE412,UAE430
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--...EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340, F/L ACFT'
--IF BELOW F250 ON CLIMB SAY M0.71
--
0006 | 2 | BAW17 |I/C F...
0010 | 2 | *KNGA |VIA DOTOP VOZ436 & QFA518
0015 | 2 | *KNGA |VIA DOTOP QFA7778 & VIA HALIT,VOZ967 & VOZ645
0027 | 2 | *KNGA |VIA HALIT QFA720
0031 | 2 | QFA518 |I/C (ADS)
0040 | 2 | VOZ645 |I/C EST HITCH 09
0044 | 2 | *TBD |VIA CANDY JTE22

0045 | 2 | QFA720 |I/C EST HITCH 15
0046 | 2 | QFA518 |1..REQ ITP CLI F410 LEADING QFA7778 65nmi
0046 | 2 | QFA518 |2..FLWG VOZ436 39nmi
0058 | 2 | *KNGA |VIA RERON VOZ298
0104 | 2 | VOZ645 |I/C POSN SEVSI 0104 F360 FRT 0130,REQ F370
0105 | 2 | JTE22 |I/C POSN CANDY 05 F300 CLAMY 0127

BIGHT: Exercise 1302

--BIT1302 LAST MODIFIED 31/07/07 CK

--EXERCISE NUMBER:BIT1302   ITP TRIAL
--START TIME:0000
--FREEZE TIME:0004
--SECTOR GROUP:BIGHT GROUP
--TITLE:NUL ADSB STAGE 2 TRAINING
--DATASET:
--VSCS DATASET:A_BIT/A_BIT_PA/A_BIT_PB
--
--OPSUP:
-- AUTO HANDOFFS ALL ON
-- FPCF OFF
-- SECT: NUL
--
--CONSOLE SETUP:
--Maps: ELW_NUL, ROUTES_W,REPORT_W,COAST_NUL,ALL_SECTOR
-- MODE 'LOW' TO 'NORMAL'
-- TOGGLE FPASD
--EC: NUL
--ACCEPT QFA6 PRL=CFL PETO CAG 0026
--ACCEPT VOZ107 PRL=CFL PETO LESON 0019
--ACCEPT QFA598 PRL=CFL PETO CAG 0038
--ACCEPT QFA587 PRL=CFL PETO FAGIN 0032
--ACCEPT UAE405 PRL=CFL PETO BEZZA....
--ACCEPT QFA577 PRL=CFL PETO FAGIN 0032
--ACCEPT VOZ355 PRL=CFL PETO FAGIN 0040

--ACCEPT ALL A/C IN NUL SECTOR PRL=GREEN CFL
--
--WHITE CFL: SIA233, UAE404,QFA574, SIA227 QFA577,QFA324, QFA498
--ROW:
--ACCEPT: QFA642 PRL=GREEN CFL PETO CAG 0032
--ACCEPT: VOZ107 PRL=GREEN CFL PETO LESON 0023

--TOGGLE FPASD
--PILOT POSN SETUP:
--SIA227 SEND CPDLC F350
--UAE404 SEND CPDLC F350
--QFA577 SEND CPDLC F360

--UAE405 SEND CPDLC F350
--QFA587 SEND CPDLC F340
--UAE407 SEND CPDLC F360
--SIA225 SEND CPDLC F370
--QFA574 SEND CPDLC F340
--QFA598 SEND CPDLC F350
--QFA647 SEND CPDLC F350
--SIA233 SEND CPDLC F340

--
--NUL BIT1302 PILOT 1 ITP TRIAL

-- TIME | PILOT | IDENT |TEXT

--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--...EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
--
0000 | 1 | NOTE |VSCS:A_BITPA   SECTOR: NUL
0000 | 1 | NOTE |NO POSN REP REQ.FOR FLTS USING AFTN ARP MSG BELOW
0000 | 1 | ADSCPDL |SIA227 UAE404 UAE405 QFA598 UAE407 QFA647
0000 | 1 |NEW NOTE |NO POSN REP REQ.FOR MTP ABTOD LONLY CANDY
0006 | 1 | UAE407 |CPDLC:"ITP F380 F/SIA225 38"
0012 | 1 | QFA574 |I/C
0019 | 1 | VOZ355 |I/C
0021 | 1 | SIA227 |I/C
0026 | 1 | QFA324 |I/C
0026 | 1 | QFA647 |REQ ITP CLIMB F380 LEADING VOZ107 62nmi
0042 | 1 | QFA574 |CPDLC:"ITP F380 F/QFA598 45 L/QFA324 123"
0048 | 1 | QFA574 |POSN CAG 47 F... IVPEM 04
0055 | 1 | FND |LEFT F230
0101 | 1 | QFA498 |I/C
0126 | 1 | NJJ |POSN WENER 26 F250 EST AGTIK 0212
0130 | 1 | NJJ |REQ BLOCK LEVELS F230-F270
--
--

-- NUL BIT1302 PILOT 2 ITP TRIAL

-- TIME | PILOT | IDENT |TEXT

--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.

--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--...EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
0000 | 2 | NOTE |VSCS:A_BITPB[COLD LINE] SECTOR: NUL
0000 | 2 | NOTE |NO POSN REP REQ.FOR FLTS USING AFTN ARP MSG BELOW
0000 | 2 | ADSCPDL |SIA227 UAE404 UAE405 QFA598
0000 | 2 | CPDLC |QFA577 QFA587
0000 | 2 | NEW NOTE |NO POSN REP REQ.FOR MTP ABTOD LONLY CANDY
0011 | 2 | QFA598 |CPDLC:"ITP F330 L/QFA574 48 F/QFA642 97"
0015 | 2 | QFA577 |I/C
0015 | 2 | UAE404 |I/C
0016 | 2 | UAE404 |REQ ITP CLI F380 LEADING SIA227 69nmi
0017 | 2 | QFA642 |REQ FL350
0020 | 2 | QFA577 |1..REQ ITP DESC F320 FLWG QFA587 13nmi LEADING
0020 | 2 | QFA577 |2..VOZ355 48nmi
0031 | 2 | UAE405 |REQ ITP CLI F360 LEADING SIA233 27nmi
0031 | 2 | UAE405 |IF CLIMB APVD DO NOT REP MNTG NEW LEVEL.
0037 | 2 | SIA233 |CPDLC:"ITP F300 F/UAE405 28"
0039 | 2 | KNGA |VIA TAMOD VOZ292
0108 | 2 | ASP |VIA WENER,NJJ
0108 | 2 | UAE405 |I/C
0109 | 2 | VOZ292 |I/C
0116 | 2 | KLG |VIA AGTIK, NJL
0138 | 2 | TBD |VIA LONLY, VOZ107
--
-- YMRA = MARALINGA FRT=FOREST ABA = ALBANY
--

BIGHT: Exercise 1303

--BIT1303 BIGHT LAST MODIFIED 31/07/07   sde data

--EXERCISE NUMBER:EXE1303 ITP TRAIL
--START TIME:0000
--FREEZE TIME:0005
--SECTOR GROUP:BIGHT
--TITLE:NUL
--DATASET: A SHIFT
--VSCS DATASET:
--
--OPSUP:
--Sectors:EC: NUL
--   ROW:KLG,MZI,JAR,WRA,OPL,ASP,ASC,AUG,SPN,TBD,MLE,CAN,BKE,BOG:
--AUTO HANDOFFS ALL ON
--ALARMS "OFF" for ROW: STCA,DAIW,MSAW,RAM,CLAM,SAR
--FPCP OFF
--
--NUL SETUP:
--MAPS: ROUTE_W, REPORT_W, ELW_NUL, ALL_SECTORS
--STAL017:Accept, PRL=GREEN CFL; PETO NSM 0041
--QFA593: Accept, PRL=GREEN CFL; PETO FILET 0018
--VOZ297: Accept, PRL=GREEN CFL; PETO CRICK 0032
--QFA775: Accept, PRL=GREEN CFL; PETO COBEL 0014 'HF' IN LABEL DATA
--QFA499: Accept, PRL=GREEN CFL; PETO TAPAX 0035 'HF' IN LABEL DATA
--BLDK14: Accept, PRL=GREEN CFL; PETO FILET 0031
--BAW21: Accept, PRL=GREEN CFL; PETO NONAX 0007
--QFA570: Accept, WHITE CFL; PETO CAG 0042
--UAE404: DON'T Accept, WHITE CFL; PETO WENER 0041
--WHITE CFL: ASY303, VOZ108, XMG, QFA566 ; DON'T Accept,
--
--ROW SETUP:
--QFA566: Accept, PRL=GREEN CFL; PETO SEVSI 0023
--VOZ108: Accept, PRL=GREEN CFL; PETO CAG 0057
--XMG: Accept, PRL=GREEN CFL; PETO BEZZA 0050
--ASY303: Accept, PRL=GREEN CFL; PETO AGTIK 0019
--RCH5E1: Accept, PRL=GREEN CFL; PETO AGTIK 0019
--ENVY601: Accept, PRL=GREEN CFL; PETO SEVSI 0018
--
--CLICK " FPASD"
--
--Pilot Screen set up:
--   QFA566 Send CPDLC Message"LEVEL ..."
--
--PILOT DELEGATION:
--   1 Controller,1 ROW, 2PILOTS
--
----NUL EX1303 PILOT 1

-- TIME | PILOT | IDENT |TEXT

--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--..EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.
--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
0000 | 1 | NOTE |Sector: NUL   VSCS:A_BITPA
0000 | 1 | NOTE |PH-SY VIA CAG - NO SYSTEM RPTS GENERATED (BEWARE)
0000 | 1 | ADSCPDL |QFA566 UAE404
0004 | 1 | QFA593 |REQ CLI F340 (THEN REP MNTNG IF CLRD)
0005 | 1 |NEW NOTE |NO POSN REP REQ.FOR MTP ABTOD LONLY CANDY
0006 | 1 | UAE404 |REQ ITP CLI F400 LEADING BAW21 46nmi
0007 | 1 | BAW21 |I/C POSN NONAX 07 F390 EST WENER @46
0011 | 1 | QFA593 |REQ ITP CLI F360 LEADING BLDK14 85nmi
0016 | 1 | UAE404 |I/C ...(ADS)
0019 | 1 | VOZ108 |I/C EST CAG 0045
0020 | 1 | QFA499 |CPDLC:"ITP F380 L/JST343 19"
0020 | 1 | SSO |QFA499 DO NOT REP MNTNG IF CLRD
0024 | 1 | QFA566 |I/C MAINT...(ADS)
0029 | 1 | VOZ297 |CPDLC:"REQ CLI F340"
0032 | 1 | JST343 |CPDLC:"ITP F390 F/QFA499 17"
0035 | 1 | QFA499 |POSN TAPAX 35 F... TAMOD 0125
0037 | 1 | VOZ294 |REQ ITP CLI F370 F/QFA570 12nmi L/VOZ108 22nmi
0041 | 1 | VOZ108 |REQ ITP DESC F340 FLWG QFA570 29nmi
0045 | 1 | RCH5E1 |CPDLC:"ITP F310 F/ASY303 16"
0055 | 1 | VOZ297 |REQ 20nmi R.O.T TO AVOID WX
0057 | 1 | VOZ108 |POSN CAG 57 F... IVPEM 0114
0106 | 1 | UAE404 |I/C REQ FL SAME AS QFA566
0109 | 1 | VOZ294 |I/C EST RERON 0147 REQ F350 DUE MOD TURB
--
--OKV= OAK VALLEY   YRAW= RAWLINNA   KBY= STREAKY BAY   WUD= WUDINNA
--PAG=PORT AUGUSTA   NSM=NORSEMAN

-- NUL EX1303 PILOT 2
-- TIME | PILOT | IDENT |TEXT

--
--NOTE: ALL A/C TO REP MAINTAINING CHANGED LEVEL UNLESS SCRIPTED NOT TO.
--NOTE: SOME ITP REQUESTS HAVE BEEN PUT IN WRONGLY, DELIBERATELY
--
--SPECIAL NOTE....WHEN GIVING A VOICE REQUEST FOR ITP, DO AS YOU WOULD WITH A POSN REP IN PROCEDURAL
--...EG: 'QFA5, ITP REQUEST'...WAIT FOR CONTROLLER REPLY-'QFA5 GO AHEAD'...THEN GIVE THE REQUEST.

--ALSO, WHEN CLR'D TO AN ITP REQUESTED LEVEL, REPLY THUS- EG: 'QFA5, ITP FL340'
--
0000 | 2 | NOTE |Sector: NUL VSCS:A_BITPB[cold line]
0000 | 2 | NOTE |PH-SY VIA CAG - NO SYSTEM RPTS GENERATED (BEWARE)
0000 | 2 | NOTE |ASY303 -NO SYSTEM GENERATED RPT FOR FRT
0005 | 2 |NEW NOTE |NO POSN REP REQ.FOR MTP,ABTOD,LONLY,CANDY
0006 | 2 | QFA570 |I/C EST CAG 0047
0015 | 2 |STAL017 |REQ CLI F210
0026 | 2 |ASY303 |CPDLC:"ITP F310 L/RCH5E1 17"
0040 | 2 |STAL017 |POSN NSM @40 F... EST DOTOP @10
0048 | 2 |QFA570 |POSN CAG@48 F... EST IVPEM @06
0051 | 2 |ASY303 |POSN FRT@51 F... EST ISLAV @23
0105 | 2 | *AUG |VIA MTP EVY601
--
--OKV= OAK VALLEY YRAW= RAWLINNA KBY= STREAKY BAY WUD= WUDINNA
--PAG=PORT AUGUSTA NSM=NORSEMAN
--
--NUL EXE1303 ROW SCRIPT
--AUTO HAND-OFF "ON"
--PETO AS PER ROW SCRIPT BELOW
--If Reporting Position at Boundary pilot make Initial Calls as per script.
--If no Reporting Position at Boundary;ROW to advise pilot to make I/C when Label
--has been accepted.
--
--0044-- ZLT PETO ESP 0114 PUT NRD IN LABEL DATA
--0049-- VOZ294 PETO RERON 0146
--

--PILOT NOTES IF NEEDED
--
--1.Pilot are to makes I/C on reaching the NUL boundary with full PositioN Reports.
--- However acft entering the NUL airspace via.........
--- DOTOP,HALIT, BIDDY,& TAMOD will give FL & est for next Reporting Point.
----eg: Full Position reports;----"Melbourne Centre TJF position"
----Wait for "Go Ahead", then----"TJF position...FL...,est....@....."
--2.Position report for TUNGO, TAGOD, TEKUP, TAPAX(eastbound)
----SUBUM, VIBUX, RIDLE, CLAMY(HF when advised) are done through COCOS AFTN ARP
----However, TAPAX Poition [westbound] is to be given on VHF.
--3.Pilots are to refer to Overhead map for open/close Triangles.
----Closed triangles are mandatory Reporting Points
--Open Triangles are only required for acft to report if ground speed is less than 300kts.
--The common open triangles in NUL/WRA airspace are :
--FRILL,DUNDA,HECTO,STILE,MUKIN,RAKET,MOLGA, LANOP, BLARY,
ARENI,OOD,ISMOR,CARTS,CDU,ESP,
--4.Pilot are to report maintaining and leaving levels.
--5.Expect frequent requests for dist.to run to next point and Mach No.
----Using the INFO command will give a more accurate distance.
--6.Expect frequent requests for Ground speed:
----Quickest Technique is to run BRL from acft to 60min
--7.Co-ordinations with ML TAAATS units consists of 'HEAD-UP'are scripted
----'via NONAX QFA81" These are preferably 25min from the boundary.

--8.DTI ACFT: TAXY/DEP/CNL SAR Calls are scripted.

Appendix C - Post Exercise Questionnaire

<u>POST EXERCISE QUESTIONNAIRE</u>

Please consider the exercise that you just completed and respond to the questionnaire items that follow.

1. Could you easily identify ITP requests?

   _____ Yes

   _____ No

2. Was the ITP standard easily applied (please provide details)?

   _____ Yes

   _____ No

3. Could the ITP standard be successfully applied using VHF voice communications?

   _____ Yes

   _____ No

   Please explain further:

4. Did any abnormal conditions occur at any stage?

   _____ Yes (If Yes, please explain how the situation was resolved)

_____ No

How easy would it be for you to resolve the situation?

Very Easy	Easy	Somewhat Easy	Undecided	Somewhat Difficult	Difficult	Very Difficult

Please explain your answer:

5. Was there superfluous information provided or additional information required to support your application of the ITP standard (please explain)?

6. Would you recommend changes to the ITP to assist you with application of this standard?

   ______ Yes (If Yes, please describe your recommended changes unless you have already done so in another post-scenario questionnaire)

   ______ No

   Please explain:

Appendix D - Post Experiment Questionnaire

AIRSERVICES AUSTRALIA

Post Experiment Questionnaire

1. What was your impression of the simulations:

2. Did you receive adequate training with respect to applying the ITP?

   ______ Yes

   ______ No

   Please explain and provide any suggested improvements for the training protocol:

3. Do you have any suggested improvements for other aspects of the experiment:

4. Please describe any operational concerns that you have with the ITP:

5. Do you think this procedure is operationally acceptable?

   _____ Yes

   _____ No

   Please explain:

6. Please describe how the workload required for standard flight level changes compares with the workload required for ITP flight level changes:

7. Please comment on the possible benefits that the ITP may have for a) air traffic controllers, b) pilots, and c) an airline:

   a) Benefits that the ITP may have for air traffic controllers include:

   b) Benefits that the ITP may have for pilots include:

   c) Benefits that the ITP may have for an airline include:

8. Compared with current day procedures, the ITP is (circle the applicable answer):

    Less safe than current day procedures

    Equally as safe as current day procedures

    Safer than current day procedures

    Please explain:

9. Are there any problems or suggested improvements for the HMI in the application of ITP?

10. Did you experience any issues with pilot-supplied information conflicting with the HMI presentation?

11. Do you think an ITP checklist is required?

_____ Yes

_____ No

Please explain:

12. Was the ITP communication easy to understand and use with CPDLC?

_____ Yes

_____ No

Please explain:

13. Was the ITP communication easy to understand and use with VHF?

    ______ Yes

    ______ No

    Please explain:

14. Would resolving an abnormal condition during the application of an ITP be any more or less difficult than resolving abnormal conditions during the application of any other level change procedures?

Much Easier	Easier	Somewhat Easier	Undecided	Somewhat More Difficult	More Difficult	Much More Difficult

    Please explain your answer:

Appendix E–Modified Cooper-Harper Subjective Workload Rating Scale

MODIFIED COOPER-HARPER
SUBJECTIVE WORKLOAD RATING SCALE

Overview

After completing each scenario, you will be asked to give a rating on a Modified Cooper-Harper Scale for workload. This rating scale and important definitions are described below.

Important Definitions

To understand and use the Modified Cooper-Harper Scale properly, it is important that you understand the terms used on the scale and how they apply in the context of this experiment.

First, the "instructed task" is the simulator exercise you have been assigned to perform in this experiment. It includes controlling the traffic within specified levels of accuracy and performing all duties that are requested of you during the exercise.

Second, the "operator" in this situation is you. Since the scale can be used in different situations, the person performing the ratings is called an operator. You will be operating the system and then using the rating scale to quantify your experience.

Third, the "system" is the complete group of equipment you will be using in performing the instructed task. Together you and the system make up the "operator/system."

Fourth, "errors" include any of the following: mistakes, incorrect or incomplete actions or responses, and blunders. In other words, errors are any appreciable deviation from desired "operator/system" performance.

Finally, "mental workload" is the integrated mental effort required to perform the instructed task. It includes such factors as level of attention, depth of thinking, and level of concentration required by the instructed task.

Rating Scale Steps

On the Modified Cooper-Harper Scale, you will notice that there is a series of decisions that follow a predetermined logical sequence. This logic sequence is designed to help you make more consistent and accurate ratings. Thus, you should follow the logic sequence on the scale for each of your ratings in the experiment.

The steps that you will follow in using the rating scale logic are as follows:

1. First, you will decide if the instructed task can be accomplished most of the time; if not, then your rating is a 10, and you should circle 10 on the rating scale.

2. Second, you will decide if adequate performance is attainable. Adequate performance means that the errors are small and inconsequential in performing the instructed task. If errors are not small and inconsequential, then there are major deficiencies in the system, and you should proceed to the right. By reading the descriptions associated with the numbers 7, 8, and 9, you should be able to select the one that best describes the situation you have experienced. You would then circle the most appropriate number.

3. If adequate performance is attainable, your next decision is whether or not your mental workload for the instructed task is acceptable. If it is not acceptable, you should select a rating of 4, 5, or 6. One of these three ratings should describe the situation you have experienced, and you would circle the most appropriate number.

4. If mental workload is acceptable, you should move to one of the top three descriptions on the scale. You would read and carefully select the rating 1, 2, or 3 based on the corresponding description that best describes the situation you have experienced. You would circle the most appropriate number.

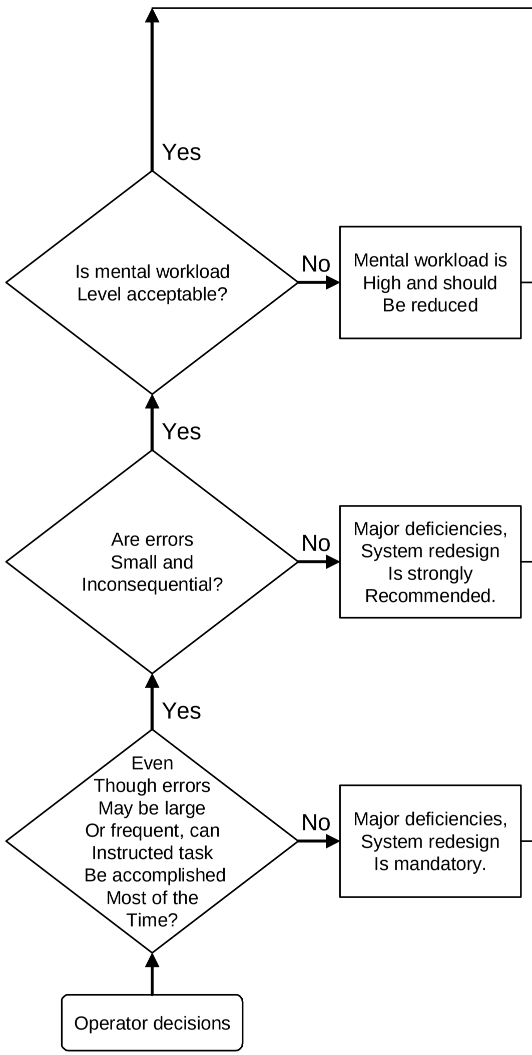
Remember that you are to circle only one number, and the number should be arrived at by following the logic of the scale. **You should always begin at the lower left and follow the logic path until you have decided on a rating.** In particular, do not skip any steps in the logic. Otherwise, your rating may not be valid and reliable.

How You Should Think of the Rating

Before you begin making ratings, there are several points that need to be emphasised. First, be sure to try to perform the instructed task as instructed and make all of your evaluations within the context of the instructed task. Try to maintain adequate performance as specified for your task.

Second, the rating scale is not a test of your personal skill. On all of your ratings, you will be evaluating the system for a general user population, not yourself. You may assume that you are an experienced member of that population. You should make the assumption that problems you encounter are not problems you created. They are problems created by the system and the instructed task. In other words, don’t blame yourself if the system is deficient; blame the system.

Third, try to avoid the problem of nit picking an especially good system, and of saying that a system that is difficult to use is not difficult to use at all. These problems can result in similar ratings for systems with quite different characteristics. Also, try not to overreact to small changes in the system. This can result in ratings that are extremely different when the systems themselves are quite similar. Thus, to avoid any problems, just always try to “tell it like it is” when making your ratings.



Difficulty Level	Operator Demand Level	Rating
VERY EASY, Highly desirable	Operator mental effort is minimal and desired performance is easily attainable	1
EASY, Desirable	Operator mental effort is low and desired performance is attainable	2
FAIR, Mild Difficulty	Acceptable operator mental effort is required to attain adequate system performance	3
MINOR BUT ANNOYING DIFFICULTY	Moderately high operator mental effort is required To attain adequate system performance	4
MODERATELY OBJECTIONABLE DIFFICULTY	High operator mental effort is required To attain adequate system performance	5
VERY OBJECTIONABLE BUT TOLERABLE DIFFICULTY	Maximum operator mental effort is required To attain adequate system performance	6
MAJOR DIFFICULTY	Maximum operator mental effort is required To bring errors to moderate level	7
MAJOR DIFFICULTY	Maximum operator mental effort is required To avoid large or numerous errors	8
MAJOR DIFFICULTY	Intense operator mental effort is required To accomplish task, but frequent or Numerous errors persist	9
IMPOSSIBLE	Instructed task cannot be accomplished reliably	10

Appendix F–Pre-Experiment Briefing

The following pre-briefing material was emailed to all participants between one and seven days before their simulation session.

AIRSERVICES AUSTRALIA

Pre-Experiment Briefing

Purpose

The purpose of Airservices Australia's In-Trail Procedure (ITP) Validation Simulation is to validate the ATC procedures associated with normal execution of ITP and to assess controller acceptability in conjunction with NASA. This research complements NASA's simulations of ITP from a pilot perspective.

You have been selected to participate in this research because you are a controller with the appropriate knowledge and skills required for this activity. The simulation is intended to test the procedures and standards that have been developed for ITP; assessment of individual controller performance is not a part of the research. All data gathered during the course of the research will be de-identified.

Twelve participants from three different groups are expected to take part. Your participation in this research endeavour will assist with the design and development of future separation standards.

Schedule

Participation in the ITP Validation Simulation will require one full day consisting of 3½ hours of training and discussion, plus three 50 minute simulator exercises. Lunch will be provided and a detailed schedule is included in this package.

There will be a follow-up debriefing and hazard identification session of approximately three hours after all participants have taken part.

Background

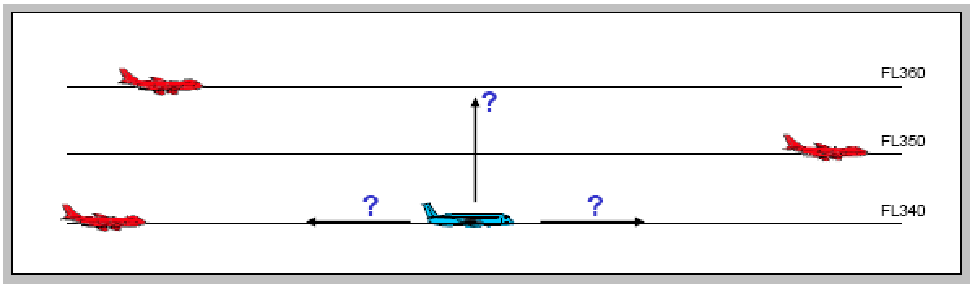
Airservices is collaborating with NASA on research in areas of ATM decision support automation, communication, navigation, and surveillance. We are exploring potential for a globally accepted, near-term application of an Airborne Separation Assistance System (ASAS) based on ADS-B.

NASA's current focus is on addressing separation standards in procedural airspace, with applications that are compatible existing ATM systems, and provide tangible benefits to operations. NASA has a four-phase program that looks towards very long term applications for procedural airspace. Airservices is participating in development of tools and procedures for the first two phases.

Enhanced Operations

- Phase 1 – Situation Awareness Tool
- Phase 2 –ADS-B In-Trail Procedures
- Phase 3 – Enhanced ADS-B In-Trail Procedures (In-Trail Following)
- Phase 4 – Airborne self-separation corridor

Phase 1 (Situation Awareness Tool)



In today's system pilots could often improve their operation with more information in the cockpit. A cockpit display of traffic, like that shown below, allows the pilot to make improved strategic decisions and more informed requests to the controller.

- Airborne ADS-B is a technology that can provide flight crews with this valuable information
- No change is required to current day pilot / controller roles and responsibilities
- Advisory system only

Phase 2 (ITP)

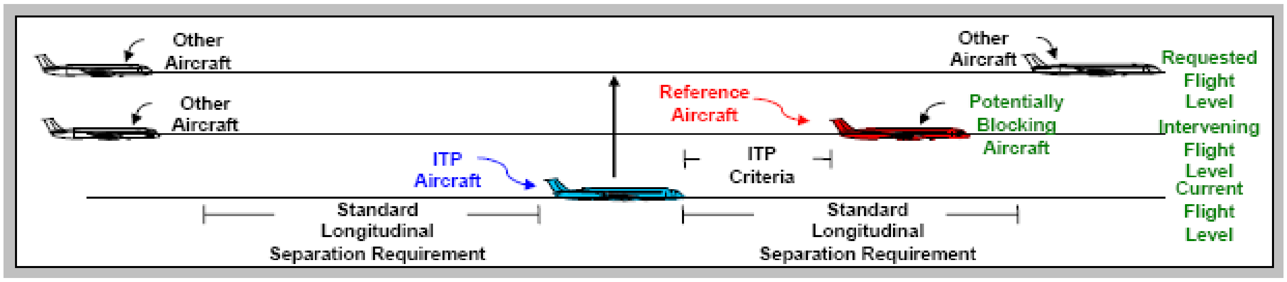
ITP is a climb or descent separation standard for procedural airspace, based on airborne speed and distance measurements between aircraft using ADS-B. Using the situational awareness tool described above, the pilot has a new means to provide separation distance information to the controller.

Phase 2 is the current focus of the collaborative work between NASA and Airservices.

Airservices ITP Trials

Together, Airservices and NASA are planning ITP Trials conducted in four stages:
1. Simulations to evaluate controller procedures (this is what we are doing now).
2. Flight trials in airspace where ATC surveillance exists to validate equipment and procedures, and to assist in obtaining regulatory approval (possibly Canty airspace).
3. Operational ITP flight evaluations in selected non-surveillance Australian Flight Information Region (FIR) airspace (i.e. oceanic airspace).
4. Operational ITP flight evaluations in selected international non-surveillance airspace.

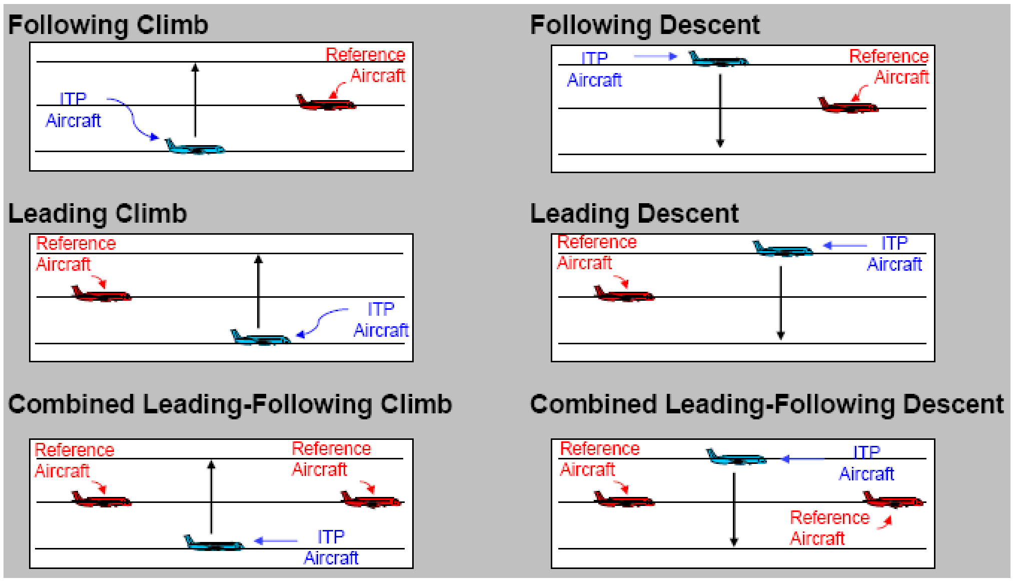
Definitions



- **Intervening Flight Level.** Any Flight Level between the Requested Flight Level and the Initial Flight Level of the ITP Aircraft that has same direction aircraft whose ADS-B report data are available to the ITP Aircraft.
- **Requested Flight Level.** A flight level above (for a climb) or below (for a descent) all Intervening Flight Levels that is no more than 4000 feet from the Initial Flight Level.
- **ITP Aircraft.** An aircraft that is fully qualified (from an equipment, operator, and flight crew qualification standpoint) to conduct an ITP and whose flight crew is considering a change of flight level.
- **Potentially Blocking Aircraft.** Aircraft at an Intervening Flight Level whose ADS-B report data are available to the ITP Aircraft.
- **Reference Aircraft.** One or two Same Direction, Potentially Blocking Aircraft with Qualified ADS-B Data that meet the ITP Speed/Distance Criteria and that will be identified to ATC by the ITP Aircraft as part of the ITP clearance request.
- **Other Aircraft.** All Aircraft that are not either the ITP Aircraft or Reference Aircraft.

Flight Level Change Possibilities

There are several possible ITP geometries including:



ITP Criteria

- ITP distance/speed criteria
  - Distance between aircraft is greater than 15 nm and ground speed differential is less than 20 knots; or
  - Distance between aircraft is greater than 20 nm and ground speed differential is less than 30 knots
- Maximum Flight Level (FL) change of 4000 feet
- ITP Aircraft is capable of climb/descent at a minimum of 300ft/min and constant Mach number
- Mach differential (between the two aircraft) is equal to or less than 0.04 Mach
- Reference aircraft is not manoeuvring and not expected to manoeuvre during the ITP
- ITP Aircraft is on the same track as the Reference Aircraft
- ITP and Reference Aircraft are travelling in same direction
- ITP Aircraft has qualified surveillance performance (accuracy and integrity)
- Potentially blocking aircraft has qualified ADS-B (accuracy and integrity)
- No more than two Reference Aircraft
- On receipt of an ITP clearance from ATC, flight crew have to reassess the criteria before they can accept it and commence the manoeuvre.

Phraseology (voice)

Aircraft: **"Melbourne Centre, (call sign), request I-T-P climb/descent to (RFL) following/leading (Reference Aircraft call sign) (ITP Distance) miles"**

ATC: **"(Call sign) I-T-P climb/descend to flight level (CFL) following/leading (Reference Aircraft call sign)"**

EXAMPLE: “Melbourne Centre, Emirates 402 request I-T-P climb to flight level 390 leading N-602-AC 30 miles.”

Is an ITP flight level change request from UAE402 with one Reference Aircraft: leading (in front of) N602AC, at an ITP Distance of 30 nm.

After checking all requirements are met, the controller may approve the requested level change using the following phraseology:

“Emirates 402, I-T-P climb to FL390 leading N-602-AC.”

Phraseology (CPDLC)

Aircraft: **REQUEST CLIMB/DESCENT TO FLxxx**
ITP F/<Reference Aircraft flight id>/nn
or
REQUEST CLIMB/DESCENT TO FLxxx
ITP L/<Reference Aircraft flight id>/nn

where xxx is the RFL
F/ means that the aircraft is following this Reference Aircraft,
L/ means that the aircraft is leading this Reference Aircraft, and
/nn is the ITP distance for this Reference Aircraft, in nautical miles

EXAMPLE: REQUEST CLIMB TO FL380
ITP F/UAL123/65
L/DAL456/30

Is an ITP climb request with two Reference Aircraft: following (i.e., behind) UAL123, which is at an ITP Distance of 65 nm, and leading (in front of) DAL456, at an ITP Distance of 30 nm.

After checking all requirements are met, the controller may approve the requested level change using the following phraseology:

ITP CLIMB TO FL390 F/UAL123 L/DAL456

Appendix G –Training Material

Participants in the simulation sessions were presented with three presentations:

- Introduction and overview of simulation sessions
- Introduction to ITP
- ITP scenario training and refresher.

The slides from each of these presentations are shown in the following sections.

Introduction & Overview

~ Introductions ~

airspace | airside | AIRSERVICES AUSTRALIA

ADS-B In Trail Procedures Project Objective and Rationale

- **Airservices is collaborating with NASA on research in areas of ATM decision support automation, communication, navigation, and surveillance:**
  - Under a Letter of Agreement which was signed in mid-2005
  - We are exploring potential for a globally accepted, near-term application of an Airborne Separation Assistance System (ASAS)
  - We are looking at applications of ADS-B and other technology available today (such as EFBs)
- **Near term applications provide:**
  - Extension of Airservices ADS-B work
  - Incentives for operators to voluntarily equip with transformational technologies
  - Operational ATC experience with ASAS

airspace | airside | AIRSERVICES AUSTRALIA

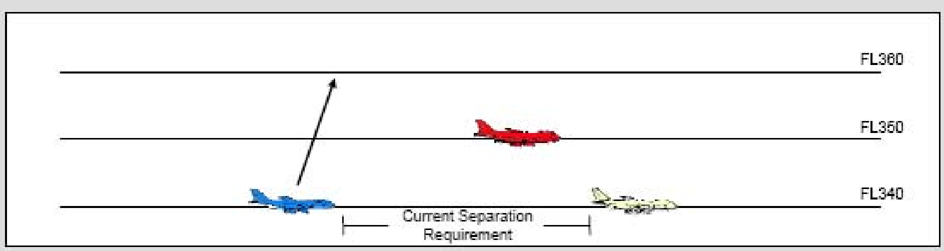
ADS-B In Trail Procedures Project Objective and Rationale

- **Research Objective**
  - Develop globally accepted, early applications of airborne ADS-B that result in user benefits while providing opportunities for further research of Airborne Separation Assistance Systems (ASAS)
- **Why airborne ADS-B?**
  - Airborne ADS-B technology and ASAS are key components of both NextGen and SESAR concepts of operation for future air transportation systems
    - ADS-B enabled self-separation is accepted as part of the future
    - People are unsure how to get there
  - Early applications will provide:
    - Operational experience with airborne ADS-B
    - Incentive for operators to voluntarily equip with transformational technologies
- **Why Oceanic?**
  - ASAS applications are be compatible with existing oceanic operations
  - Potential to provide tangible benefits for operators who participate in early applications of ASAS
  - Unique domain for conducting and obtaining valuable research data

In-Trail Procedures (ITP)

In-Trail Procedures (ITP):

- Leverage the capabilities of Automatic Dependant Surveillance-Broadcast (ADS-B) and onboard automation
- Enable the use of alternative distance-based separation minima during a procedural climb or descent
- Allow an aircraft to climb or descend through the intervening FL of a "blocking" aircraft



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ITP Simulation Study Objectives

- **Assess the Validity of the ITP**
  - Are any missing, incomplete, or extraneous procedural steps associated with the ITP?
- **Assess Acceptability of the ITP**
  - Is the level of workload associated with performing the ITP acceptable?
  - Does the ITP provide a perceived benefit?

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Schedule

- **7:00 to 7:30AM – Pre-Experiment Session**
  - Demographic Information Questionnaire
- **7:30 to 9:00AM – Training Session**
  - In-Trail Procedure (ITP) Introduction
  - ITP Application Training
  - ITP Training Scenarios
  - Post-Training Questionnaire
- **9:00AM to 9:15AM – Break**
- **9:15 to 9:30AM – Training Session**
  - Modified Cooper-Harper (MCH) Workload Rating Scale and Post-Scenario Questionnaire

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Schedule

- **9:45 to 10:35AM – ITP Simulator Exercise 1**
  - MCH Rating Scale and Post-Exercise Questionnaire completed after each exercise

- **10:50 to 11:40AM – ITP Simulator Exercise 2**
  - Complete MCH Rating Scales and Post-Exercise Questionnaires

- **11:55 to 12:45PM – ITP Simulator Exercise 3**
  - Complete MCH Rating Scales and Post-Exercise Questionnaires

Schedule

- **12:45 to 2:00PM – Group Debrief Session**
  - Working Lunch
  - Post-Experiment Questionnaire
  - Post-Experiment Scenarios
  - Group Debrief / feedback

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Pre-Experiment Session

- **Coffee / Drink Orders**
- **Demographic Information Questionnaire**
- **A Few Reminders:**
  - Please refrain from talking about the experiment among yourselves while you're here.
  - Please refrain from talking about the experiment with other controllers after you leave, until the month of October.
  - No mobile phones, please.

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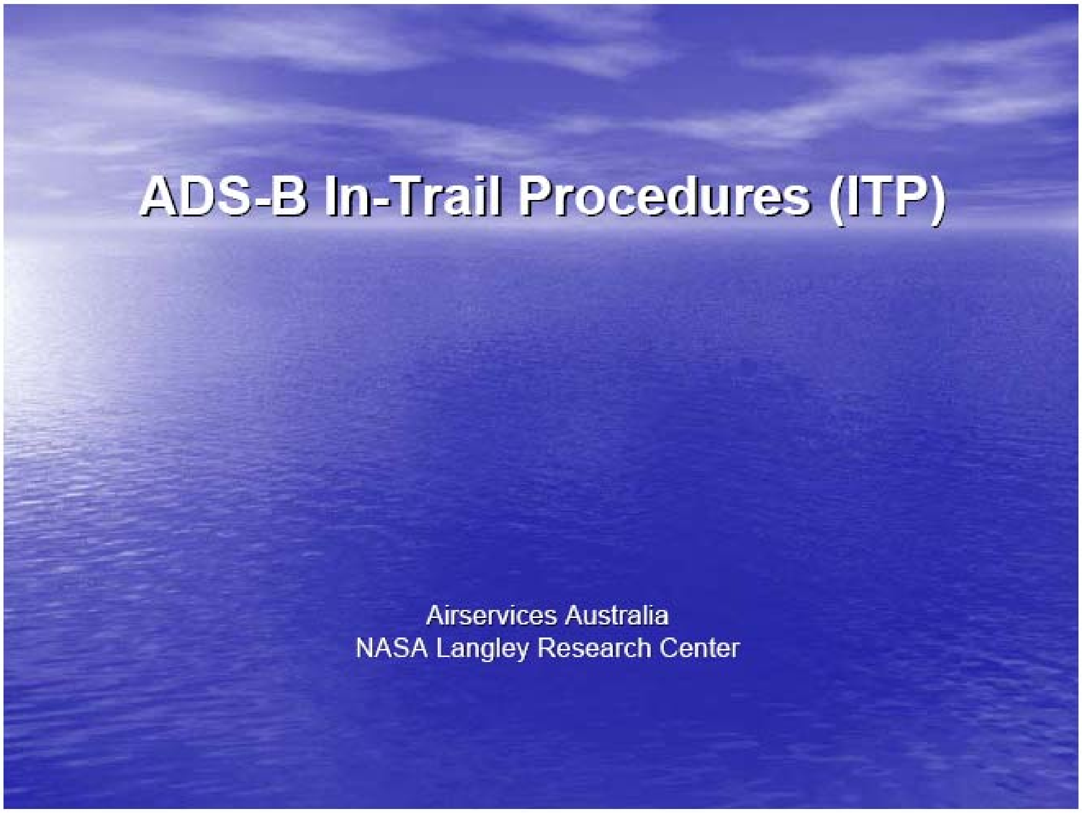
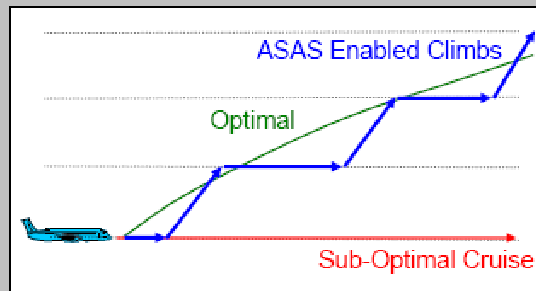
Introduction to ITP



Challenges and Incentives

- **Pilots often desire altitude changes**
  - Altitude changes for favorable winds or to avoid turbulence
  - Desire climbs as they burn fuel for optimal performance



- **Current operations sometimes limit opportunities for climb**
  - Many pilots want to fly along the same trajectories at the same time
  - Reduced surveillance performance (compared with radar) results in large separation minima for safe procedural separation
  - Large separation minima often restrict aircraft from making desirable altitude changes
- **Use of ASAS applications (including airborne surveillance and onboard automation) facilitate altitude changes which save fuel and/or increase payload capacity**

3

Enhanced Operations

Phased Approach

- **Phase 1 – Situation Awareness Tool**
  - Tool that advises pilot of available altitudes for altitude changes
  - Advisory information only (low certification requirements)
- **Phase 2 –ADS-B In-Trail Procedures**
  - Altitude changes allowed based on cockpit derived data
  - No delegation of separation authority
- **Phase 3 – Enhanced ADS-B In-Trail Procedures**
  - Active monitoring of other traffic during altitude change
  - Limited delegation of separation authority to cockpit
  - Reduced separation criteria
- **Phase 4 – Airborne self-separation corridor**
  - Aircraft allowed to maneuver on specially approved tracks
  - Closer to optimal fuel burn profile

Increased Delegation of Separation Authority

4

ITP Display Options

- **ASAS applications require hardware, software and an appropriate crew interface**
- **Options for crew interface include primary field of view (e.g. PFD), forward field of view (e.g. EICAS or TCAS) or other secondary fields of view (e.g. EFB mounted on the side)**
- **NASA Research: Display Development**
  – Initial display designs conceptualized
  – Survey questionnaires distributed to 1500 oceanic line pilots
  – Design revised based on the 250 survey responses received

5

ADS-B In-Trail Procedures (ITP)
Support Activities

- **RTCA/EUROCAE Requirements Focus Group (RFG) ADS-B ITP application description**
  – Establish a single, *globally accepted,* concept of operations (domain independent)
  – Concept of operations development for normal and non-normal operations
- **Preliminary Safety Analyses**
  – RFG ADS-B ITP safety assessment studies (including Operational Hazard Analysis)
  – Safety and collision risk analysis using probabilistic methods and simulations for the ITP procedure
- **Evaluation of ITP and cockpit decision support tools in NASA Langley's Air Traffic Operations Lab (ATOL)**
- **Benefits Analyses**
  – Use of batch studies to evaluate ITP climb opportunities and fuel efficiency gains
  – Evaluation of economic impact of ITP in various oceanic domains

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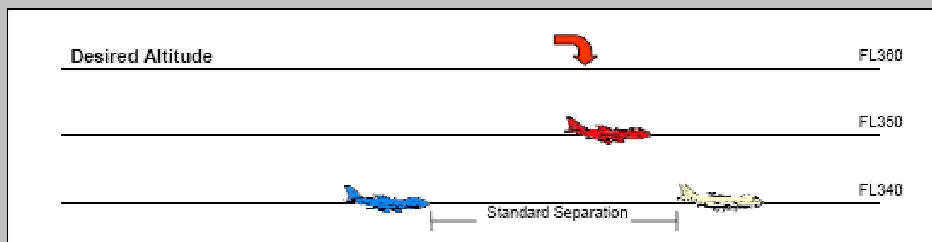
In Trail Procedure (ITP)
Current Separation



blue = ADS-B transceiver and onboard decision support system (ITP aircraft)
red = ADS-B out minimum required (Reference aircraft)
white = no ADS-B requirements

Sequence of Events

Realise that a climb is desired	
Standard climb?	Unable
ITP following climb?	Valid
Request ITP following climb	Approved

ITP criteria

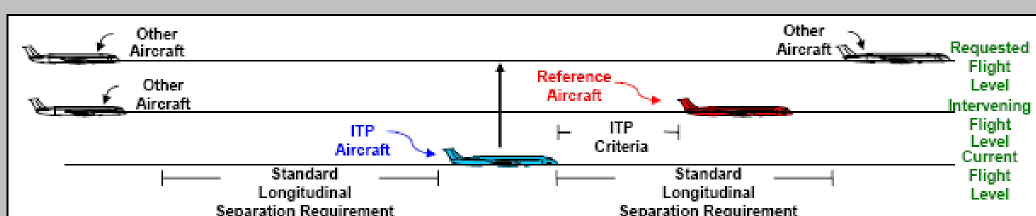
Groundspeed difference < 20 kt and difference in range > 15 nm

or

Groundspeed difference < 30 kt and difference in range > 20 nm

7

In-Trail Procedures (ITP)



- **Intervening Flight Level.** Any Flight Level between the Requested Flight Level and the Initial Flight Level of the ITP Aircraft that has Same Direction aircraft whose ADS-B report data are available to the ITP Aircraft.
- **Requested Flight Level.** A flight level above (for a climb) or below (for a descent) all Intervening Flight Levels that is no more than 4000 feet from the Initial Flight Level.
- **ITP Aircraft.** An aircraft that is fully qualified (from an equipment, operator, and flight crew qualification standpoint) to conduct an ITP and whose flight crew is considering a change of flight level.
- **Reference Aircraft.** One or two Same Direction, Potentially Blocking Aircraft with Qualified ADS-B Data that meet the ITP Speed/Distance Criteria and that will be identified to ATC by the ITP Aircraft as part of the ITP clearance request.
- **Other Aircraft.** All Aircraft that are not either the ITP Aircraft or Reference Aircraft.

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ADS-B In-Trail Procedures

ITP Criteria

- **ITP distance/speed criteria**
  - Distance between aircraft is greater than **15 nm** and ground speed differential is less than 20 knots; or
  - Distance between aircraft is greater than 20 nm and ground speed differential is less than 30 knots
- **Maximum Flight Level (FL) change of 4000 feet**
- **ITP aircraft is capable of climb/descent at a minimum of 300ft/min at cruise Mach number**
- **Closing Mach differential (between the two aircraft) is no more than 0.04 M**
- **Reference aircraft is not manoeuvring and not expected to manoeuvre during the ITP**
- **ITP aircraft is on the same track as the reference aircraft**
- **ITP and reference aircraft are travelling in same direction**
- **ITP aircraft has qualified surveillance performance (accuracy and integrity)**
- **Reference aircraft has qualified ADS-B (accuracy and integrity)**
- **ITP aircraft is not a Reference aircraft for another ITP**
- **No more than two Reference aircraft**

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ADS-B In-Trail Procedures

ITP Criteria – Controller Requirements

- **Reported ITP distance between aircraft is at least 15 nm**
- **Maximum Flight Level (FL) change is 4000 feet**
- **Closing Mach differential (between the two aircraft) is no more than 0.04 M**
- **Reference aircraft is not manoeuvring and not expected to manoeuvre during the ITP**
- **ITP aircraft is on the same track as the reference aircraft**
- **ITP aircraft is not a Reference aircraft for another ITP**
- **No more than two Reference aircraft**

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Mach Difference Check

- Under no wind conditions (or homogeneous conditions at different FL), a ground speed restriction will be sufficient to prevent the ITP aircraft from excessively reducing the distance to the Reference aircraft.
- A ground speed and Mach difference restriction will prevent the ITP aircraft from excessively reducing the distance to the Reference aircraft under any wind condition including severe wind conditions.

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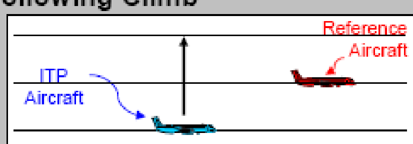
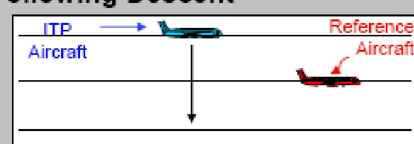
ADS-B In-Trail Procedures

Sample ITP Fight Level Changes

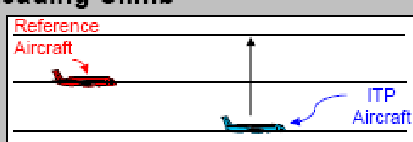
Following Climb



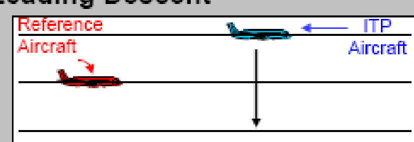
Following Descent



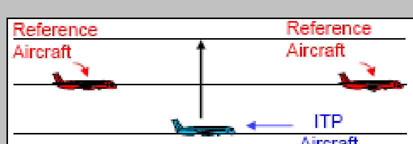
Leading Climb



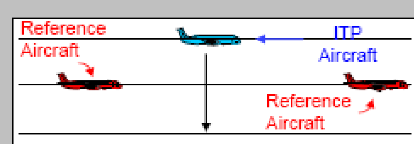
Leading Descent



Combined Leading-Following Climb



Combined Leading-Following Descent



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In-Trail Procedure (ITP)
Details of Procedure

An ITP has three parts:

1. **The crew's request:** Crew decides whether and how to make a flight level change, and if so sends the request
2. **ATC's reply:** Controller evaluates the request & sends a response
3. **The crew's response:** Crew reassesses situation, responds, and makes the flight level change as appropriate

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In-Trail Procedure (ITP)
Crew Request

- **The ITP request**
  - For voice comms, crew will initiate the request with "ITP request"
  - Just like a standard flight level change, but with additions
- **For a data link request, the free text fields will include:**
  - The keyword **ITP** followed by reference aircraft info
  - For each reference aircraft:
    - **F/** or **L/** (depending on whether the ITP aircraft is **F**ollowing or **L**eading this reference aircraft), then the
    - Reference aircraft flight id, then
    - ***/xx*** (replace ***xx*** with the ITP distance in nautical miles)

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In-Trail Procedure (ITP)
Crew Request, continued

- **ITP request free text field examples**
  - ITP F/UAL123/65
  - "ITP flight level change Following UAL123, 65 nm" (ahead of us)
  - ITP L/DAL456/23
  - "ITP flight level change Leading DAL456, 23 nm" (behind us)
  - ITP F/UAL123/65 L/DAL456/23 ***-or-*** ITP L/DAL456/23 F/UAL123/65

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In-Trail Procedure (ITP)
ATC Considerations

- **First check conditions for a standard (non-ITP) flight level change**
  - Reply with a standard FL change if possible
- **Then check for conflicts other than the reference aircraft**
  - If other conflicts exist, controller will deny request, unless another form of separation can be achieved

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In-Trail Procedure (ITP)

- **Some possible conflicts other than reference aircraft:**
  - Crossing or opposite direction traffic
  - Other traffic not ADS-B equipped
  - The aircraft making the ITP request is already a reference aircraft

- **If no conflicts other than reference aircraft:**
  - For each reference aircraft, controller checks:
    - Not manoeuvring or expected to manoeuvre
    - Closing Mach number difference no greater than 0.04

- **ITP aircraft is not a reference aircraft**

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In-Trail Procedure (ITP)

ATC

- **If reference aircraft checks are OK, then controller approves ITP flight level change**

- **Flight level change clearance includes:**
  - The keyword ITP
  - Relevant reference aircraft flight IDs

- **Sample ITP clearance (CPDLC):**

ELMT1:	**CLIMB/DESCEND TO nnn**	*PREDEFINED*
ELMT2:	**ITP F/L C/S (X2)**	*FREE TEXT*

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In-Trail Procedure (ITP)
Crew Response

- **If ATC approves a standard flight level change, or denies the request:**
  - Crew will respond per standard operating procedures
- **If ATC replies with an ITP flight level change clearance:**
  - Crew will recheck that the reference aircraft **in the clearance** still meet ITP conditions

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In-Trail Procedure (ITP)
Crew Response, continued

- **If reference aircraft in the clearance no longer meet ITP conditions:**
  - The ITP clearance will be rejected by the flight crew
- **If reference aircraft in the clearance still meet ITP conditions:**
  - The crew will accept the clearance and start the flight level change as per normal operations

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In-Trail Procedure (ITP)

Crew Responsibility

- **Once the flight level change is in progress:**
  - Crew will monitor aircraft performance
  - At least **300 feet per minute** at **cruise (constant) Mach**
- **If minimum performance cannot be maintained:**
  - **The crew will advise you and normal contingency procedures will apply**
- **On completion of ITP, crew will report established at new flight level as per normal operations**

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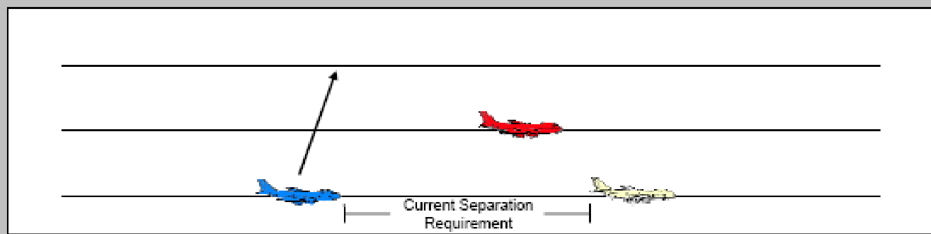
Questions?

22

ITP Scenario Training

In-Trail Procedure

Overview



ITP aircraft, with ADS-B In transceiver and onboard processing equipment
"Reference aircraft," with ADS-B Out equipment

On-board system provides traffic information

- ADS-B In and on-board processing equipment display traffic information to the flight crew
- Flight crew evaluates traffic information on display, decides if ITP is desired
- Flight crew includes "reference aircraft" information in ITP flight level change request

In the absence of other traffic conflicts or restrictions, controllers can approve flight level change based on ITP information derived in the cockpit

- No delegation of separation responsibility
- Controller approves flight level change based on knowledge of all aircraft (including non-equipped aircraft)

2

ADS-B In-Trail Procedures

ITP Criteria – Controller Requirements

- Reported ITP distance between aircraft is at least 15 nm
- Maximum Flight Level (FL) change is 4000 feet
- Mach differential (between the two aircraft) is equal to or less than 0.04 Mach
- Reference aircraft is not manoeuvring and not expected to manoeuvre during the ITP
- ITP aircraft is on the same track as the reference aircraft
- ITP aircraft is not a Reference aircraft for another ITP
- No more than two Reference aircraft

3

ITP Flight Level Change Geometries

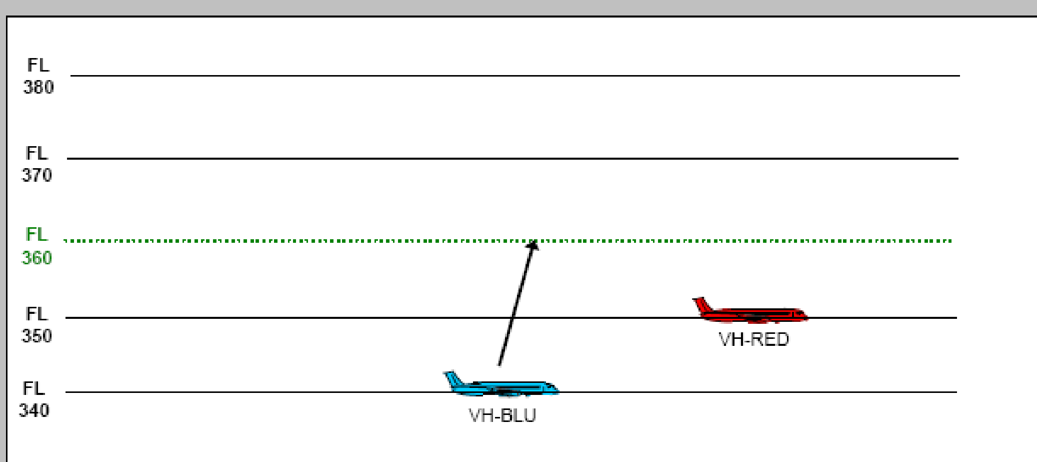
Several ITP geometries are possible:

- **Following climb** (ITP aircraft *following*, i.e. behind, the reference aircraft)
- **Following descent**
- **Leading climb** (ITP aircraft *leading*, i.e. ahead of, the reference aircraft)
- **Leading descent**
- **Combinations** (with 2 reference aircraft)

4

ITP Flight Level Change Geometries

Example: Following climb



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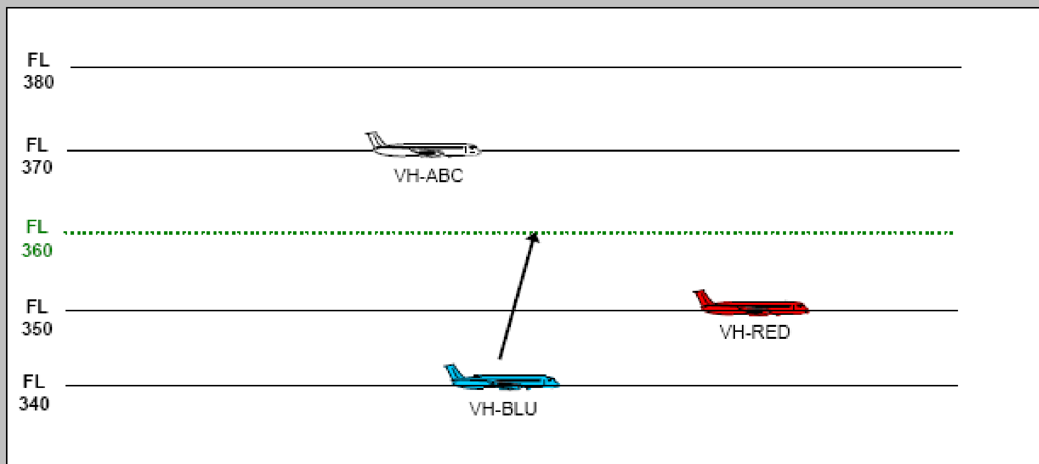
ITP Flight Level Change Geometries

Example: Following climb



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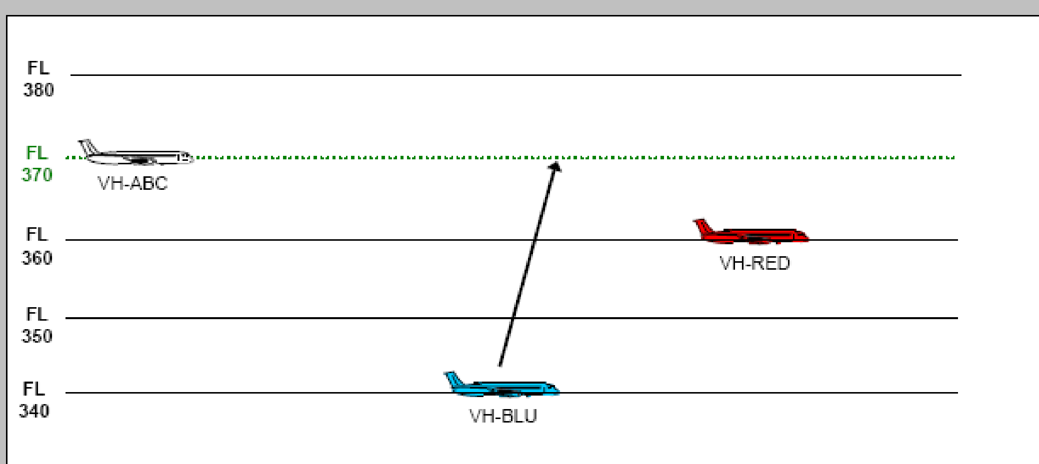
ITP Flight Level Change Geometries

Example: Following climb



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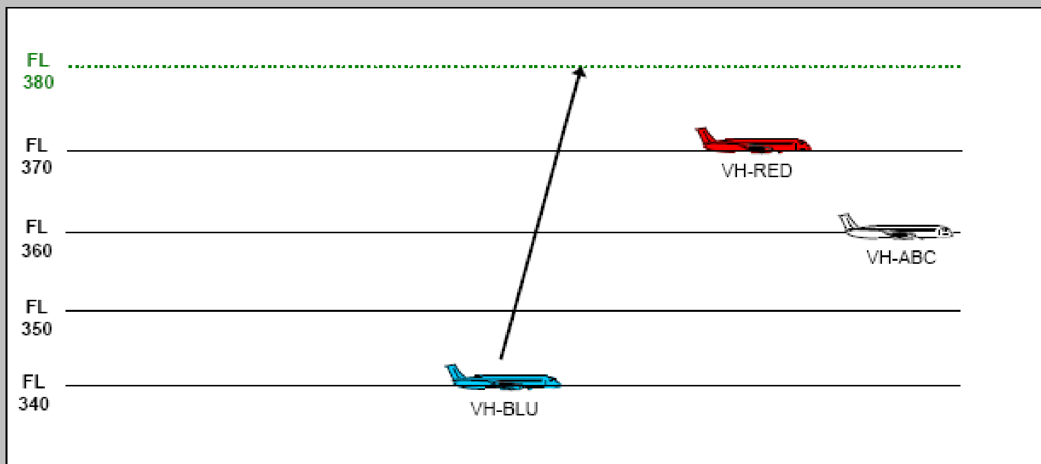
ITP Flight Level Change Geometries

Example: Following climb



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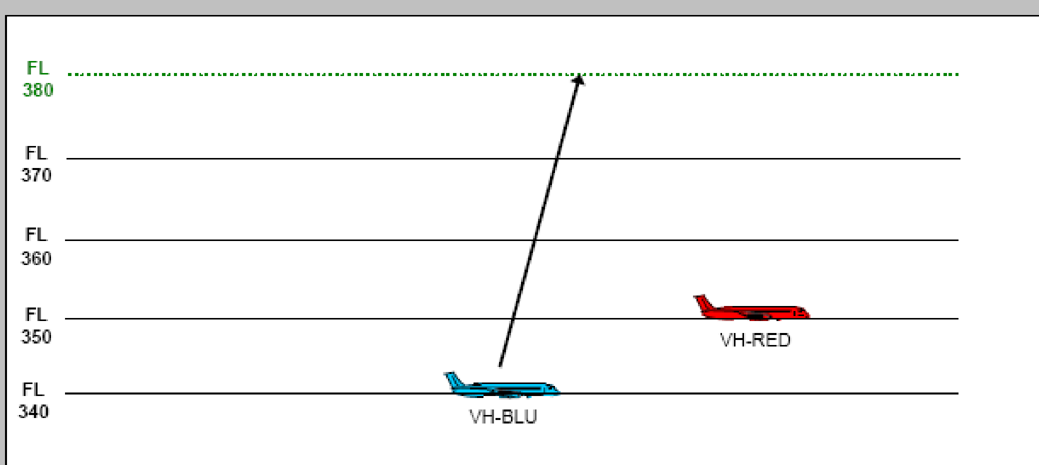
ITP Flight Level Change Geometries

Example: Following climb



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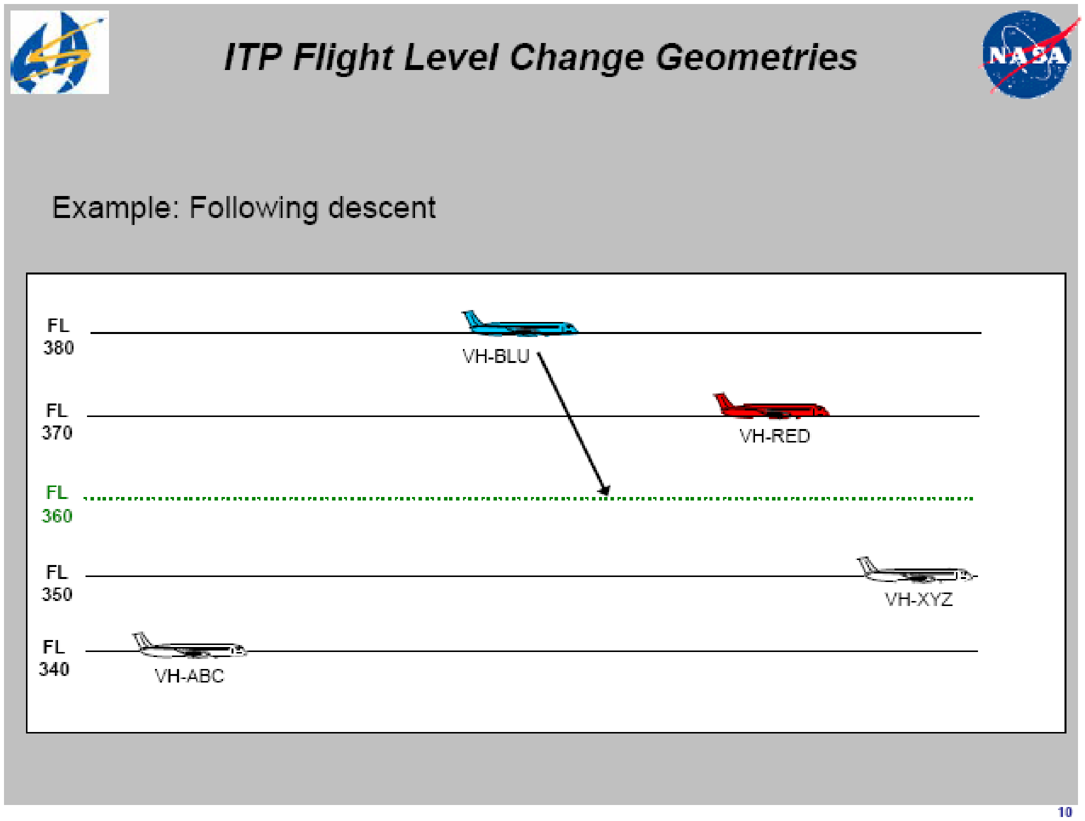
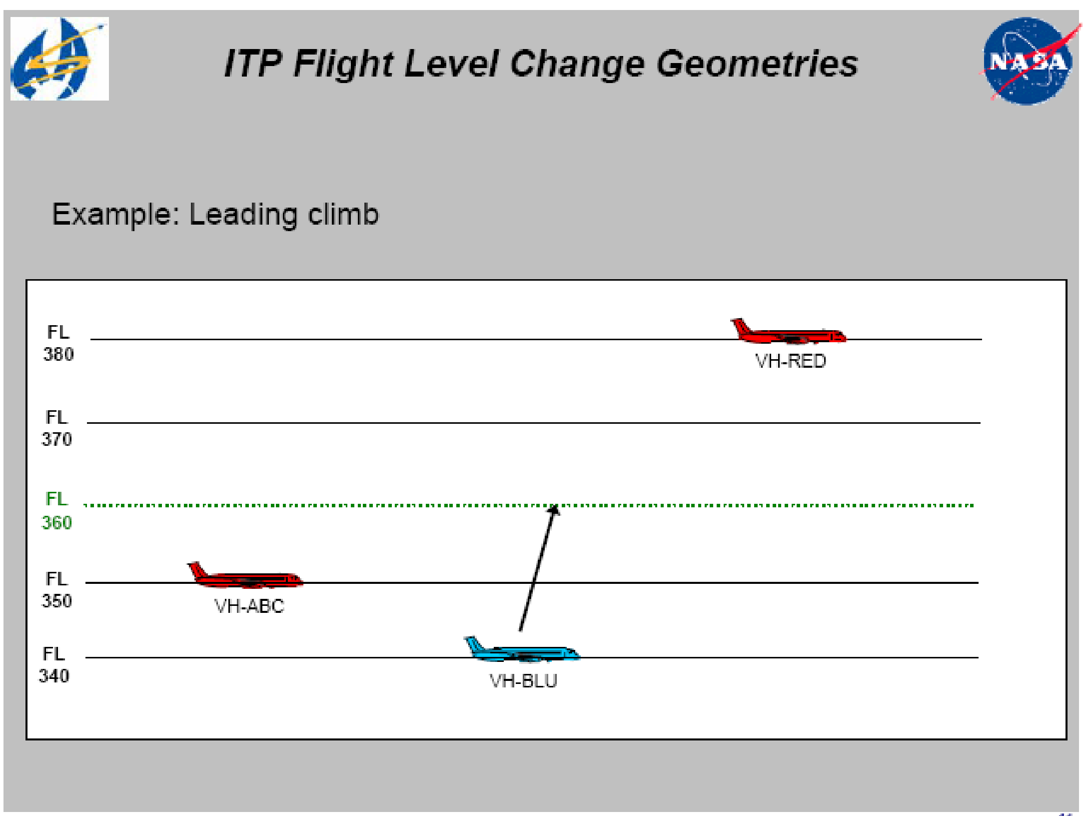
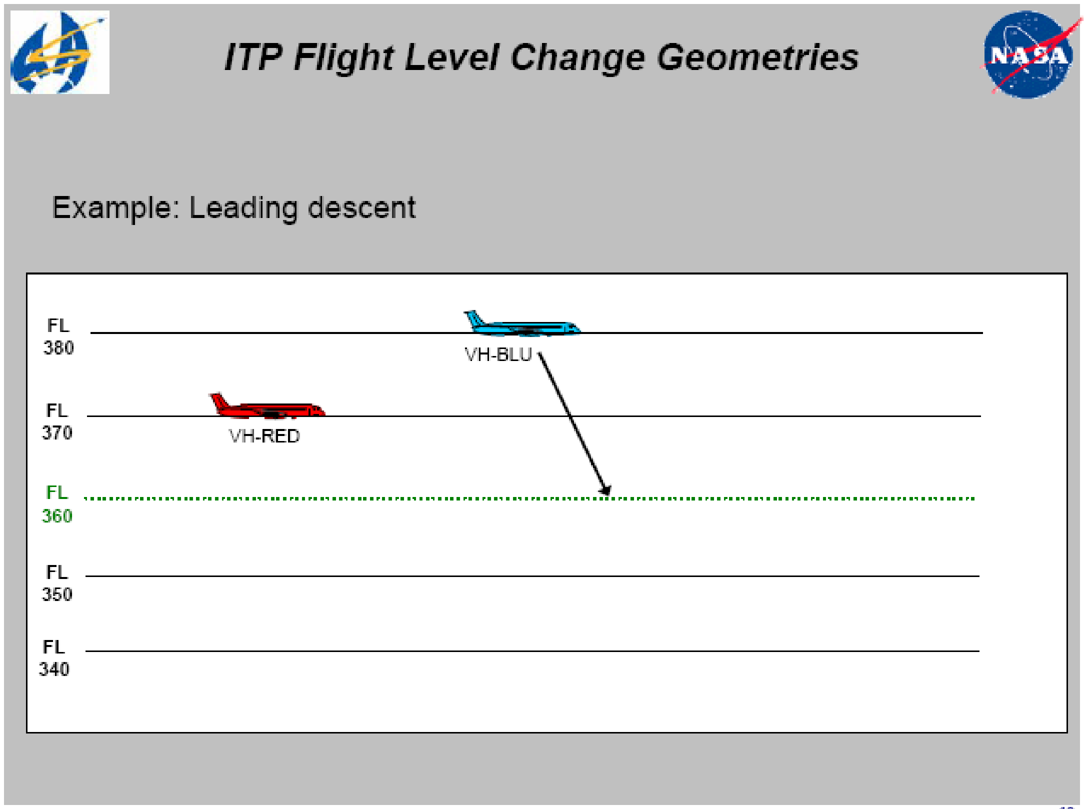
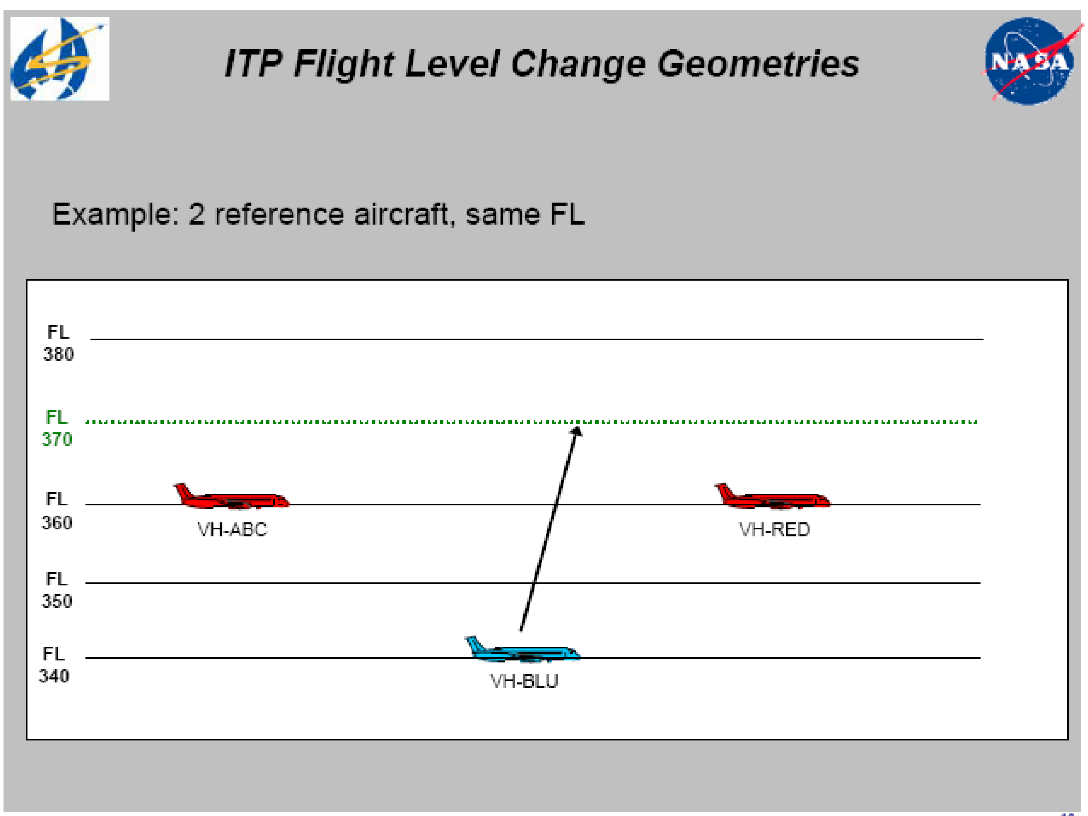

ITP Flight Level Change Geometries
Example: Following descent
FL 380
VH-BLU
FL 370
VH-RED
FL 360
FL 350
VH-XYZ
FL 340
VH-ABC
10


ITP Flight Level Change Geometries
Example: Leading climb
FL 380
VH-RED
FL 370
FL 360
FL 350
VH-ABC
FL 340
VH-BLU
11


ITP Flight Level Change Geometries
Example: Leading descent
FL 380
VH-BLU
FL 370
VH-RED
FL 360
FL 350
FL 340

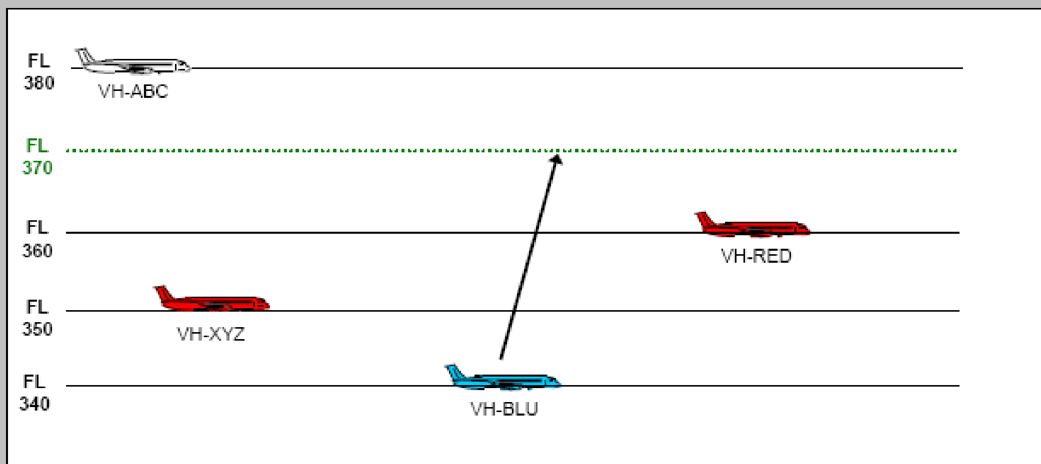
12


ITP Flight Level Change Geometries
Example: 2 reference aircraft, same FL
FL 380
FL 370
FL 360
VH-ABC
VH-RED
FL 350
FL 340
VH-BLU

13

ITP Flight Level Change Geometries

Example: 2 reference aircraft, different FLs



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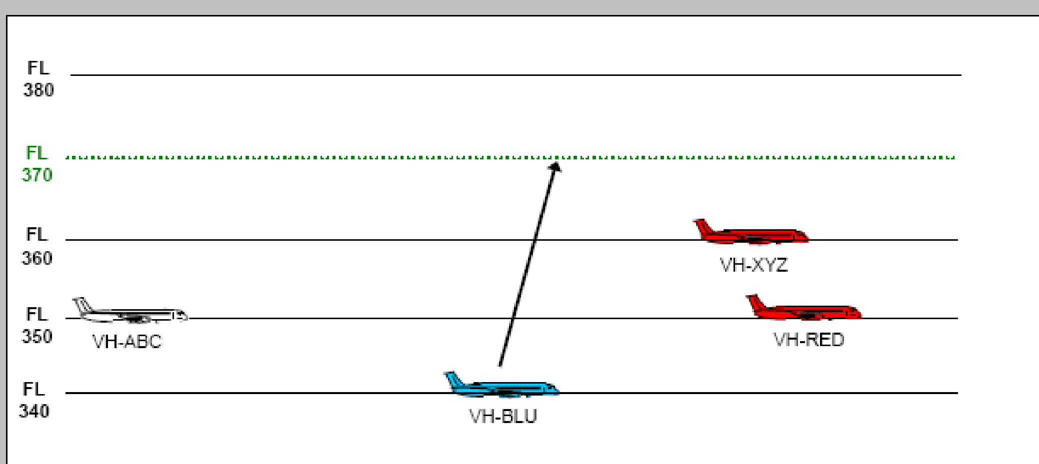
ITP Flight Level Change Geometries

Example: 2 reference aircraft, following both



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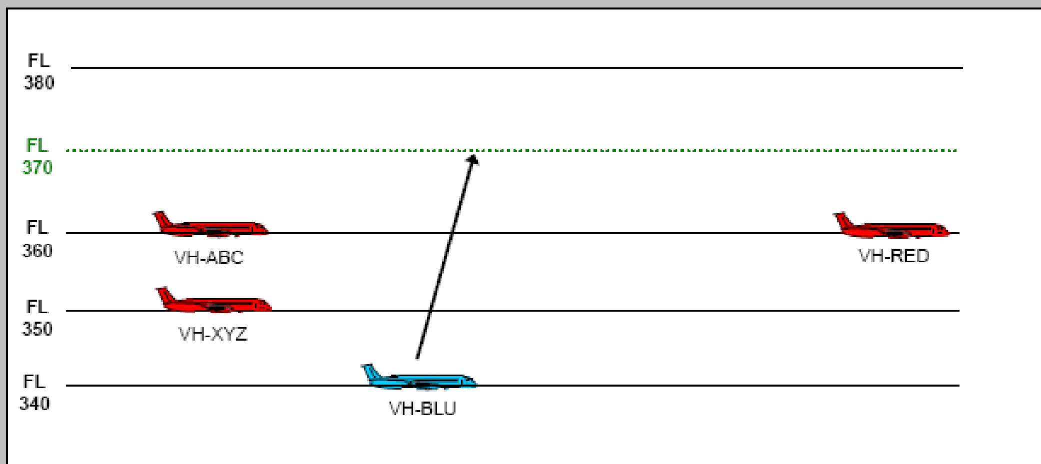
ITP Flight Level Change Geometries

Example: 3 reference aircraft



16

In-Trail Procedure (ITP)

Details of Procedure

An ITP has three parts:

1. **The crew's request:** Crew decides whether and how to make a flight level change, and if so sends the request
2. **ATC's reply:** Controller evaluates the request & sends a response
3. **The crew's response:** Crew reassesses situation, responds, and makes the flight level change as appropriate

17

In-Trail Procedure (ITP)
Crew Request

ITP request free text field examples

- ITP F/UAL123/65
- "ITP flight level change Following UAL123, 65 nm" (ahead of us)

- ITP L/DAL456/23
- "ITP flight level change Leading DAL456, 23 nm" (behind us)

- ITP F/UAL123/65 L/DAL456/23 ***-or-*** ITP L/DAL456/23 F/UAL123/65

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In-Trail Procedure (ITP)
ATC Considerations

- First check for conflicts other than the reference aircraft
  - If other conflicts exist, deny request, unless another form of separation can be achieved
- Then check conditions for a standard (non-ITP) flight level change
  - Reply with a standard FL change if possible
- Then check conditions for an ITP flight level change

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In-Trail Procedure (ITP)
ATC

- If reference aircraft checks are OK, then controller approves ITP flight level change
- Flight level change clearance includes:
  - The keyword ITP
  - One or both reference aircraft flight IDs
- Sample ITP clearance (CPDLC):

ELMT1:	**CLIMB/DESCEND TO nnn**	*PREDEFINED*
ELMT2:	**ITP F/L C/S (X2)**	*FREE TEXT*

20

ADS-B In-Trail Procedures
ITP Criteria – Controller Requirements

- Reported ITP distance between aircraft is at least 15 nm
- Maximum Flight Level (FL) change is 4000 feet
- Mach differential (between the two aircraft) is equal to or less than 0.04 Mach
- Reference aircraft is not manoeuvring and not expected to manoeuvre during the ITP
- ITP aircraft is on the same track as the reference aircraft
- ITP aircraft is not a Reference aircraft for another ITP
- No more than two Reference aircraft

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Questions?

22

Appendix H – ITP Post Training Questionnaire

<u>**ITP POST TRAINING QUESTIONNAIRE**</u>

AIRSERVICES AUSTRALIA

1. What are Reference Aircraft?

2. How many Reference Aircraft can be included in a valid ITP request? ______

3. What is the minimum valid reported ITP distance from a Reference Aircraft?

   _____ nautical miles

4. What is the maximum altitude change that can be made with an ITP? ______

5. What minimum aircraft performance must be maintained during an ITP flight level change?

   At least ______ feet per minute at _____________ Mach number

6. Given **ITP F/UAL123/65** in the free text field of a flight level change request:

   a. Is UAL123 ahead of the ITP Aircraft, or behind? ________________

   b. What is the ITP distance to UAL123? ________ nautical miles

7. Given **ITP L/QFA456/23** in the free text field of a flight level change request:

   a. Is QFA456 ahead of the ITP Aircraft, or behind? ________________

   b. What is the ITP distance to QFA456? ________ nautical miles

8. If an ITP flight level change clearance is received from ATC, what must first be done by the pilot before starting the flight level change?

9. What must be considered before approving an ITP request?

10. What messages would you expect from an aircraft after an ITP has been approved?

Appendix I – Observer Data Collection Sheets

The Observer Data Collection Sheets for Exercise 1131 is reproduced for reference. All Observer Data Sheets are similar:

<table>
<tr><td>Ex 1131</td><td>West P</td><td colspan="2">ITP #1 (pass)</td><td></td></tr>
<tr><td rowspan="3">@ 0005
ASY387 via
CPDLC</td><td colspan="2">Details
ITP Aircraft: ASY387
Ref aircraft: ASY385
ITP: climb to FL320</td><td colspan="2">Speed: ASY387 M.71
FL290
ASY385 M.71
FL310</td></tr>
<tr><td colspan="4">Syntax
Request: ITP F320 F/ASY385 31
Response: CLIMB TO F320
ITP F/ASY385</td></tr>
<tr><td colspan="4">Additional considerations</td></tr>
<tr><td colspan="2">OBSERVATIONS
☐ Level change approved
☐ ITP used
☐ Controller syntax incorrect
☐ Restrictions/requirements included in ITP clearance
☐ Speed interactions</td><td colspan="3">COMMENTS</td></tr>
</table>

<table>
<tr><td>Ex 1131</td><td>West P</td><td colspan="2">ITP #2 (fail)</td><td></td></tr>
<tr><td rowspan="3">@ 0009
QFA1040 via CPDLC</td><td colspan="2">Details
ITP Aircraft: QFA1040
Ref aircraft: QFA276, SIA45
ITP: climb to FL390</td><td colspan="2">Speed: QFA1040 M.81
FL360
QFA276 M.86
FL370
SIA45 M.86
FL380</td></tr>
<tr><td colspan="4">Syntax
Request: ITP F390 F/QFA276 40 L/SIA45 81
Response: UNABLE.</td></tr>
<tr><td colspan="4">Additional considerations
Mach check fails (controller may fix).</td></tr>
<tr><td colspan="2">OBSERVATIONS
☐ Level change approved
☐ ITP used
☐ Controller syntax incorrect</td><td colspan="3">COMMENTS</td></tr>
</table>

☐ **Restrictions/requirements included in ITP clearance** ☐ **Speed interactions**	

Ex 1131	West P	ITP #3 (pass)	
@ 0013 SIA456 via CPDLC	Details ***ITP Aircraft:*** **SIA456** ***Ref aircraft:*** **GIA226** ***ITP:*** **climb to FL380**	***Speed:*** **SIA456 M.85 FL350** **GIA226 M.85 FL370**	
	Syntax ***Request:*** **ITP F380 F/GIA226 45** ***Response:*** **CLIMB TO F380** **ITP F/GIA226**		
	Additional considerations **Separation with MAS125 may need to be considered.**		
OBSERVATIONS ☐ **Level change approved** ☐ **ITP used** ☐ **Controller syntax incorrect** ☐ **Restrictions/requirements included in ITP clearance** ☐ **Speed interactions**	COMMENTS		

Ex 1131	West P	ITP #4 (fail)	
@ 0018 QFA52 via VHF	Details ***ITP Aircraft:*** **QFA52** ***Ref aircraft:*** **GIA220** ***ITP:*** **descent to FL310**	***Speed:*** **QFA52 M.85 FL340** **GIA220 M.85 FL330**	
	Syntax ***Request:*** **Request ITP descent to F310 leading GIA220 89 miles** ***Response:*** **Unable due traffic.**		
	Additional considerations **The ITP works, but there is other conflicting traffic. Controller may clear aircraft to FL310 with time restrictions due crossing traffic.**		

OBSERVATIONS	COMMENTS
☐ **Level change approved** ☐ **ITP used** ☐ **Controller syntax incorrect** ☐ **Restrictions/requirements included in ITP clearance** ☐ **Speed interactions**	

<table>
<tr><td>Ex 1131</td><td>West P</td><td colspan="2">ITP #5 (pass)</td></tr>
<tr><td rowspan="3">@ 0022
GIA454 via CPDLC</td><td>Details
ITP Aircraft: GIA454
Ref aircraft: QFA73
ITP: descent to FL310</td><td colspan="2">Speed: GIA454 M.85 FL350
QFA73 M.85 FL330</td></tr>
<tr><td colspan="3">Syntax
Request: ITP F310 L/QFA73 30
Response: DESCEND TO F310
ITP L/QFA73</td></tr>
<tr><td colspan="3">Additional considerations</td></tr>
<tr><td colspan="2">OBSERVATIONS
☐ Level change approved
☐ ITP used
☐ Controller syntax incorrect
☐ Restrictions/requirements included in ITP clearance
☐ Speed interactions</td><td colspan="2">COMMENTS</td></tr>
</table>

<table>
<tr><td>Ex 1131</td><td>West P</td><td colspan="2">ITP #6 (pass)</td></tr>
<tr><td rowspan="3">@ 0027
MAS737via VHF</td><td>Details
ITP Aircraft: MAS737
Ref aircraft: QFA2060
ITP: climb to FL330</td><td colspan="2">Speed: MAS737 M.75 FL310
QFA2060 M.80 FL320</td></tr>
<tr><td colspan="3">Syntax
Request: Request ITP climb to F330 following QFA2060 16 miles.
Response: ITP climb to FL330 following QFA2060</td></tr>
<tr><td colspan="3">Additional considerations</td></tr>
</table>

OBSERVATIONS	COMMENTS
☐ **Level change approved** ☐ **ITP used** ☐ **Controller syntax incorrect** ☐ **Restrictions/requirements included in ITP clearance** ☐ **Speed interactions**	

Ex 1131	West P	ITP #7 (fail)	
@ 0032 QFA276 via CPDLC	Details ***ITP Aircraft:*** **QFA276** ***Ref aircraft:*** **SIA45** ***ITP:*** **climb to FL410**	***Speed:*** **QFA276 M.86 FL370** **SIA45 M.86 FL380** **QFA1040 FL390**	
	Syntax ***Request:*** **ITP F410 L/SIA45 127** ***Response:*** **UNABLE DUE TRAFFIC**		
	Additional considerations **Missing Reference Aircraft (ITP not required for separation from SIA45). Controller may need to check separation with QFA1040.**		

OBSERVATIONS	COMMENTS
☐ **Level change approved** ☐ **ITP used** ☐ **Controller syntax incorrect** ☐ **Restrictions/requirements included in ITP clearance** ☐ **Speed interactions**	

Ex 1131	West P	ITP #8 (fail)	
@ 0040 ASY385 via CPDLC	Details ***ITP Aircraft:*** **ASY385** ***Ref aircraft:*** **ASY387** ***ITP:*** **climb to FL370**	***Speed:*** **ASY387 M.74 FL320** **ASY385 M.74 FL310**	
	Syntax ***Request:*** **ITP F370 F/ASY387 32** ***Response:*** **UNABLE**		
	Additional considerations **Fails due excessive level change request. Controller may clear aircraft to FL350.**		

OBSERVATIONS	COMMENTS
☐ **Level change approved** ☐ **ITP used** ☐ **Controller syntax incorrect** ☐ **Restrictions/requirements included in ITP clearance** ☐ **Speed interactions**	

NOTES

Appendix J – Group Debrief Material

Following the completion of the ITP simulation sessions, all participants were invited to take part in a group debriefing session. The session was structured according to the following agenda, with allowance for free-flowing discussion:

ATC ITP Experiment Debrief Agenda

1. **Introductions**
2. **NASA project background / overview**
3. **Capacity Takes Flight DVD**
4. **Discussion intro**

Communications

- Voice communications in general
- Thoughts on using HF for the procedure
- Third party call sign issues (VHF)
- Preformatted CPDLC messages – any thoughts on what messages are required and how they should look?

Discrepancies

- How, or at what point, or when would you trust information provided by a pilot over the information on your screen? (Both in the context of ITP and more generally.)
- At what point would a difference between a pilot request and your display cause you concern…
    - When you are working with ADS-C tracks?
    - With Flight plan tracks?
    - What steps would you take to resolve any discrepancy?
- What is the controller's minimum separation during an ITP procedure? What if you saw an ADS-C report showing a distance of 9 miles between the ITP and REF aircraft during a climb? On flight plan tracks?

Level of Effort / Workload

- Was it obvious to all that the controller was responsible for separation throughout an ITP?
- ITP level of effort versus level of effort for a single climb request
    - Think of addressing workload in terms of doing two ITPs in an 8 hour shift rather than eight ITPs in 50 minutes. When discussing items like speed check or CPDLC interface.
- Given that you might only see an ITP once a month or once a shift, do you think that the requirements could be distracting? Could ITP requirements cause a reduction in your situational awareness or is it about the same as any other regular operation? Do you think this could be an implementation problem?
- Do you have any thoughts on the kind of training that might be required when this is introduced – simulators, classroom training, nothing?

Speed checks

- We saw a lot of comments about the Mach check requirement, and we thought it might be helpful to provide a bit more background on this …
- Mach check requirement, alternatives (frame of reference: 2 ITPs per shift).
- We saw several comments about how easy it is to forget speed checks. Does anybody want to expand on this?

Future expansion work

- Same track: Use of ITP on flex tracks beyond point of divergence.
- Further reduced separation …
- In trail following (ADS-B based separation at the same flight level).

Do you have ANY other comments, concerns, inputs that you'd like us to take away with us?

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

In August 2007, Airservices Australia (Airservices) and the United States National Aeronautics and Space Administration (NASA) conducted a validation experiment of the air traffic control (ATC) procedures associated with the Automatic Dependant Surveillance-Broadcast (ADS B) In-Trail Procedure (ITP). ITP is an Airborne Traffic Situation Awareness (ATSA) application designed for near-term use in procedural airspace in which ADS B data are used to facilitate climb and descent maneuvers. NASA and Airservices conducted the experiment in Airservices' simulator in Melbourne, Australia. Twelve current operational air traffic controllers participated in the experiment, which identified aspects of the ITP that could be improved (mainly in the communication and controller approval process). Results showed that controllers viewed the ITP as valid and acceptable. This paper describes the experiment design and results.

15. SUBJECT TERMS

Air Traffic Control; Controllers; In-Trail Procedure

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