出國報告（出國類別：其他）

赴美國參加
「第 53 屆美國飛航管制協會年會」
出國報告書

服務機關：民用航空局飛航服務總台
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派赴國家：美國
出國期間：97.11.01~97.11.07
報告日期：97.11.27

摘　　要

報告名稱：赴美國參加第 53 屆美國飛航管制協會年會出國報告書

出國地區：美國

出國期間：中華民國九十七年十一月一日至十一月七日

關鍵詞：ATCA（Air Traffic Control Association）：美國飛航管制協會

Annual Conference & Exposition ：年度大會及產品展示會

NAS（National Airspace System）：美國國家空域系統

NextGen（Next Generation Air Transportation System ）：未來航管系統

FAA（Federal Aviation Administration）：美國聯邦航空總署

ICAO（International Civil Aviation Organization）：國際民航組織

Eurocontrol ：歐盟飛航管制組織

內容摘要：「美國飛航管制協會」是由個人會員（包含執業飛航管制會員、軍人會員及學生會員）及相關機構會員所組成。該協會成立之宗旨在致力於飛航管制事業之進步，協會成立於 1956 年，至今已有 52 之歷史。該協會每年均依章程規定舉辦年度大會，分別在全美不同的地方舉行，本年度舉辦年度大會的地點為華盛頓 D.C.。

今年度，美國飛航管制協會設定的會議主題是『Winds of Change』，主題一語雙關。一般而言，「風向」對飛航管制的意義很大，因為航機需要逆風起降，當風向轉向時，塔臺管制員就必須「改變」使用的跑道；另一方面，本次會議期間（11 月 2 日至 11 月 5 日），恰逢美國第 56 屆總統大選，民主黨的歐巴馬與共和黨的馬侃正選得如火如荼，雙方廝殺得難分高下，選舉結果將於 11 月 4 日揭曉，也就是說當會議進行到最後 1 天時，美國政壇就已經變天了，屆時將選出新的領導人。在這次總統大選中，雙方陣營都強調未來改變的必要性及改變的重要，「Change」也變成雙方爭取選票的重要政見。

赴美國參加
「第 53 屆美國飛航管制協會年會」
出國報告書

目　　錄

壹、前　言

十月中旬，忽奉上級指派於十一月初赴美國華盛頓 D.C.，參加美國飛航管制協會舉辦的第 53 屆年度大會；所幸手邊的美國簽證尚有三個月之效期，儘速訂妥航空公司機位及預訂旅館後，總算順利啓程。

「美國飛航管制協會」（ATCA：Air Traffic Control Association）是由美國相關飛航管制之個人及機構所組成，成立於 1956 年，至今已有 52 年之歷史。該協會每年均依章程規定舉辦年度大會，分別在全美不同的地方舉行，本年度舉辦年度大會的地點為華盛頓 D.C.。

美國飛航管制協會係為一獨立、非營利之機構，其成立之宗旨為：

一、 維持並提昇飛航管制的重要性，並適切的維持飛航管制與航空界之合諧。

二、 鼓勵相關的個人及企業關心且促進有關航空業及飛航管制之升級與改進。

三、 利用各種機會及工具，儘可能推廣且宣揚飛航管制之理念及其重要性。

而在具體作為上，美國飛航管制協會則採取以下之作法：

一、 提供討論之論壇，以作為全球空域及飛安等議題得以交換及討論。

二、 扮演觸媒之角色，將全球有關使用空域、管理空域、發展裝備、維護裝備等行業及人員聚集一起。

三、 維持公關的角色，與傳播界及其他各種相關的組織、航空站及訓練單位等，保持良好的互動關係。

四、 透過持續招募新人，以維持操作及技術人員之專業技能。

五、 提昇飛航管制技術及服務之發展，加強有關飛航安全、飛行效率及空域容量等之研發。

六、 密切注意使用系統客戶之需求，並確保這些需求能被考量並發展至未來新一代的系統。

七、 協助贊助廠商能招募優秀人才以航管為志業。

八、　尊重對飛航管制有興趣的個人及機構，並協助與提昇婦女、少數及弱勢團體於飛航管制及航空業領域之參與。

今年度，美國飛航管制協會設定的會議主題是『Winds of Change』，主題一語雙關。一般而言，「風向」對飛航管制的意義很大，因爲航機需要逆風起降，當風向轉向時，塔臺管制員就必須更換跑道來提供給起落的航機使用；另一方面，本次會議期間（11 月 2 日至 11 月 5 日），恰逢美國第 56 屆總統大選，民主黨的歐巴馬與共和黨的馬侃正選得如火如荼，雙方廝殺得難分高下，選舉結果將於 11 月 4 日揭曉，也就是說當會議進行到最後 1 天時，已經知道未來 4 年美國的領導人是誰了。在這次總統大選中，雙方陣營都強調未來改變的必要性及改變的重要，「Change」也變成雙方爭取選票的重要政見。美國飛航管制協會配合總統競選的熱門話題，「Change」也成了本次年度大會之主軸。

茲摘錄美國飛航管制協會發表本次年度大會之主題如下：

“目前，國家正處於「改變」的轉捩點，「改變」的競選承諾處處可聞，經濟與環境不斷的變化，國家領導人也即將要換上新面孔。第 53 屆 ATCA 年會將順應潮流，以深入的角度研判未來的飛航管制，本次 ATCA 年會將延續慣例做爲首要的論壇，年會將於 2008 年 11 月 2~5 日於華盛頓 Marriot Wardman Park Hotel 舉辦。

Peter Dumont, ATCA 總裁說：「我們預見 FAA（Federal Aviation Administration）的領導權將發生變動。」新的管理者即將產生，FAA 組織在許多層面即將改組。由於資深管制員陸續退休，FAA 人力資源正快速轉換爲通過多方位技術訓練的新進人員。原先設定於 2025 年檢視的「未來航管系統」（NextGen：Next Generation Air Transportation System），已提前至 2008 年就需要來撿視了，因此，如何開發現有科技與創新思考以迎合「未來航管系統」的需求，實乃當務之急。今年的 ATCA 年會有數十家廠商展示最新的科技發展，並提供航管精英開放式論壇，希望藉此研討出成功導入「未來航管系統」的各項需求。

本次 ATCA 年會重點是討論建置「未來航管系統」的實現策略。會議特色是以整體的觀點討論在「未來航管系統」的機場角色、網路架構作業模式、擴增的空運量、環境責任與有效作業、以及許多針對「改變」的深入的主題。本

次會議的最後一日（11/5）我們就可以揭曉美國的新領導人。我們將有一場座談討論面對新領導人的轉形過程，此外，我們也將討論這項「改變」對於 FAA 資金來源、員工配置及專案計劃的衝擊。以往的會議與研討會已討論過如何引導我們到達目前的境界。我們對於「未來航管系統」是正確且必行的方向已有共識，但是，現在我們應該採取什麼步驟？採行後的結果是什麼？成功的定義是什麼？本次會議將為未來設定一套新議程，它將囊括未來 ATM 系統的各個層面，包含科技面與制度面，範圍將擴及世界各角落。

同時，在本次 ATCA 年會會場的展示設施是許多公司行銷計劃的主軸，藉由年會（北美最大規模的飛航管制會議）/展覽會、ATCA 科技年會等，可以將飛航管制的最新觀念、研發、產品與服務等產品，展示並提供給與會代表，以作為未來之參考。”

貳、目　的

美國飛航管制協會年會為美國民航界最重要的年會之一，國際間重要民航機構及主管均會出席，另有許多設計與製造航管系統的廠商與會，會議期間並展示各類先進航管系統。出席本年會除可與美國及其他國家負責民航政策及執行之政府官員接觸，彼此可交換工作經驗及心得，並得以保持聯繫以擴大本國民航與國際之接軌與交流；此外，亦可趁此年度盛會，了解國際上有關民航之觀念趨勢，同時掌握民航裝備之發展與未來之走向，藉該會議認識並了解國際上重要民航裝備廠商之發展，以上各種資料，均可做為未來國家發展民航及購買裝備之重要參考。

參、過　程

本次會議民航局指派飛航服務總臺副總臺長錢元琳參加，由於會議地點在華盛頓 D.C.舉行，國內並無直飛之航班，必須先搭乘國籍航機後再轉搭美國內陸之航機。

職搭乘十一月一日淩晨自桃園國際機場起飛之長榮航空公司第 028 號班機至美國舊金山國際機場後再轉搭聯合航空第 074 號班機，到達華盛頓 D.C.為當

地十一月一日上午 0630 時，隨即搭乘機場巴士轉赴旅館，所幸旅館體諒，雖是上午時間抵達，仍然同意辦理入住手續。

次日早上，美國飛航管制協會召開理事會，參加年會來賓開始辦理報到手續，除繳交註冊費用外，並領取了會議資料及參加會議証件。正式年會於十一月三日上午 0800 時開始，至十一月五日下午 1600 時結束會議議程，當天晚上 1900L 至 2100L 主辦單位舉行正式晚宴，宴請所有參加的來賓與廠商。

年會結束後，因個人私事乃以休假方式停留 2 日後，搭乘十一月九日長榮航空公司第 017 號班機，於十一月十日上午底達桃園國際機場。

本次會議共歷時三日，於十一月三日上午 0800 時，由美國飛航管制協會理事長 Peter Dumont 主持開幕式，隨後邀請來賓致詞，致詞的來賓有美國聯邦航空總署代理署長 Rober A.Sturgell 及歐盟飛航管制組織執行長 David McMillan，開幕式結束後，緊接著就開始為期三天的年會（會議議程如附件一）。本次會議參加的廠商約有七十九家（如附件二），而註冊參加的來賓約有八百二十人，規模龐大且熱鬧。

今年美國飛航管制協會年會的主題是『*Winds of Change*』，三天的會議分為 8 個議程，分別是：

一、 What Does Tomorrow Look Like？

二、 Network Enabled Operations（NEO）

三、 Airports and Their Changing Roll in the NAS

四、 Environmental Responsibility & Operational Efficiency

五、 Increase Capability Through Airborne Operations

六、 NextGen/SESAR Harmonization not Competition

七、 What Now？New Administration and Transition

八、 Five Things We Can Do Now

經過三天的報告及討論，年會於十一月五日下午 1600L 結束。

肆、心得與建議

一、會議辦理得井然有序：

每年一度的飛航管制協會年會是一大規模且國際性的會議，由於職下榻的旅館即是本次會議舉行的地點,職特地抽空觀察主辦單位處理年會的報到情況，在十一月一日下午，會場仍在布置，只見人進人出，顯得非常熱鬧忙碌，到了十一月二日下午辦理報到時，所有的會場都已經整理就緒，由於職於事前就已傳真報名表格，並與主辦單位聯繫確認，且告知主辦單位會於報到時再辦理註冊繳費，因此當職赴櫃臺報到時，只花幾秒鐘櫃檯人員就將個人的會議資料及識別證件交給本人，順利完成了報到手續。雖然是八百多人及七、八十家廠商參加的超大型會議，但工作人員作業井然有序，並未見到堵塞情況；其後，在三天的會議中，也都按照議程順利進行，甚至連一般會議時最常見的麥克風出問題的情形都未出現。職個人分析其原因，一來可能因爲其爲英語系國家，目前國際性會議均使用英語，因此工作人員無語言溝通上的困難，也減少了許多溝通協調的問題及避免了許多無謂的誤會。其次可能因爲該協會經常舉辦類似的會議，因此辦理會議的經驗豐富，雖然協會的職員人數並不多，可是辦起國際性的年會仍然游刃有餘。以上的客觀因素，都是我們所欠缺且難以達到的，但是如果能夠分工妥當，事前準備充分，再加上有經費的支持，仍然可以克服困難而辦好國際會議的。例如我們的中華民國飛航管制員協會（ROCATCA）就曾於民國八十六年及九十五年，分別成功的在臺北及高雄舉辦「國際飛航管制員協會聯盟（IFATCA：International Federation of Air Traffic Controllers’ Associations）」年會，參加的國家多達八十餘國，參加的人數也都近達千人。

二、多參與國際性活動：

目前，地球村的觀念愈來愈普遍，國際的交流也愈來愈密切，尤其航空事業更是屬於跨國性、全球性的行業，無論是空運協議與航線談判、航

站管理與保安措施、航空管理與飛航安全、空域劃分與飛航管制等種種事宜，都需要參考國際標準並與國際接軌，絕不可能、也不應該關起門來，不管國際上的趨勢與變化而自己悶著頭做，那絕對是行不通的。在民用航空法第一條就載明：「為保障飛航安全，健全民航制度，**符合國際民用航空標準法則**，促進民用航空之發展，特制定本法」；另外在民用航空局組織條例第二條民用航空局掌理事項之第二款也明白指出：「國際民航規劃、國際民航組織及國際民航合作之聯繫、協商與推動事項」。上述引證只是要強調民航事業國際化之重要與必要性。而反觀我們目前的情況，可能受限於國家財力，出國協商、參訪及訓練等項目，逐年減少。行政院以下，不論機關性質為何，也幾乎不論原因，限制每年出國經費不得超過上一年度（或前三年之平均數），出國不看其原因及必要性，一律用數字取代。有時，即便今年出國事項少，但為了來年的預算，不得不勉強填報，避免下年度的預算不得超過今年。如此惡性循環，「出國」事項已經變質為數字遊戲，而不能真正反映出業務需要了。

三、 掌握國際趨勢了解未來航管系統之規劃

美國是世界上民航事業最發達的國家，不論是民航業的觀念或理論，以至於裝備設施上，均屬於世界的龍頭角色，我們國家目前使用的航管系統即為美國上一代的 NAS（National Airspace System）系統。然而，科技日新月異，自當初的 NAS 系統至今，航管系統已經有長足地發展與嶄新的面目，國際民航組織（ICAO：International Civil Aviation Organization）於 1989 年提出了一套以衛星及數位化通信技術為基礎之通訊、導航、監視(Communications, Navigation, Surveillance, CNS)系統，來支援建立一個全球通行適用的飛航管理系統(Air Traffic Management, ATM)，此系統藉由先進科技與嶄新飛航程序，克服傳統飛航服務系統先天限制，可有效改善飛航服務效率與品質。

而美國國會於 2003 年通過一項法案（Public Law 108-176），法案同意成立一個單位，稱之為“Joint Planning and Development Office”，新單位就是要研發並整合出未來的航管系統“**NextGen**”（Next Generation Air

Transportaton System ）。

在這一次的美國飛航管制協會年會上，研討的內容已經不再是 CNS/ATM 系統，會議中明顯的跨越了 CNS/ATM，而開始討論更新、更進一步的未來航管系統 NextGen。未來的航管系統將是以網路作爲平台，將各種資料精確的、合諧的以網路提供給各使用者，不論在美國或是在歐盟、不論是民方或是軍方、不論是政府或是民間，大家必須協調合作、同心協力，來發展未來新一代的航管系統。本次 ATCA 年會討論的重點即在於建置「未來航管系統」的實現策略。會議特色是以整體的觀點討論在「未來航管系統」的機場角色、網路架構作業模式、擴增的空運量、環境責任與有效作業、以及許多針對「改變」的深入的主題。

從會議的進行中，個人大致體認到，目前美國及歐洲正在發展的未來航管系統將不再受限於以人爲中心的個人表現，而是利用系統爲中心；在未來的航管系統中，管制員不再僅是依據雷達及電腦的協助，透過無線電來管制航機並提供安全隔離，而是利用各種科技的整合，管制員透過選擇策略及裝備，即可充分的利用空域及跑道，同時也可以充分的達到節能減碳的環保目標。例如，目前美國聯邦航空總署對於繁忙機場的跑道利用爲每小時 55 架落地航機，未來利用 NextGen 的觀念與技術，可望每 45 秒鐘（正負 2 秒鐘）即可允許 1 架落地航機，如此，每小時幾可容納 80 架的落地航機。因此，美國聯邦航空總署寄望未來的航管系統將可充分的增加空域及跑道的容量。

目前我們正在建置新一代的 CNS/ATM 航管系統，但是也要關心國際上的趨勢與變化，隨時能掌握新的資訊，以作爲未來決策之參考。

四、產官學緊密合作

本次美國飛航管制協會年會，註冊參加的有八百多位來賓，另外約有八十家廠商參加展示，規模龐大熱鬧。參加的來賓隸屬於航空界各個不同領域，來自世界各地，包括歐洲、加拿大、紐澳、亞洲等各地區，據本人觀察來自亞洲地區的有新加坡、泰國、越南、韓國、臺灣等代表。至於參

加來賓的單位則涵蓋軍、民相關單位，其屬性則遍及產、官、學等各界。大家共聚一堂，利用這三天的會議，有些人互相寒暄，趁機做做社交關係，有些人則參觀展示，與廠商接洽產品事宜，至於 FAA 的官員也利用年會做爲政策說明與宣導，有些學者專家則依據大會設定的議題，趁機闡明自己的理念及研究成果。終究，航空事業是絕非少數人能掌控的行業，而是需要軍、民的協調，公、私機構的合作，產、官、學等各界緊密的結合，才有可能逐漸發展進步。

伍、附 件 資 料：

附件一：第 53 屆美國飛航管制協會年會議程

附件二：參加第 53 屆美國飛航管制協會年會之參展廠商

附件三：REGIONAL AIR TRAFFIC FLOW MANAGEMENT

（摘自第 53 屆美國飛航管制協會年會資料）

附件四：SYSTEMATIC SOLUTION FOR REDUCTION OF AIRSPACE CONGESTION DURING APPROACH AND LANDING PHASE

（摘自第53屆美國飛航管制協會年會資料）

附件一

53rd ATCA Annual Conference and Exposition
Winds of Change
Agenda

Sunday, November 2, 2008

9:00 am-4:00 pm Board of Director's Meeting

9:00 am-7:00 pm Registration Open - *Atrium*

Monday, November 3, 2008

7:00 am-5:00 pm Registration Open - *Atrium*

7:00 am-4:00 pm Moderators/Speakers/Coordinators Ready Room

7:00 am-8:00 am Welcome Coffee- Thurgood Marshall Ballroom Foyer
Sponsored by Crown Consulting, Inc.

8:00 am-8:30am **Opening Ceremony and Remarks**

President's Welcome: Peter Dumont, President, Air Traffic Control Association

Chairman's Opening: Neil Planzer, Chairman, Air Traffic Control Association

Acting FAA Administrator: Robert A. Sturgell

Director General, EUROCONTROL: David McMillan

8:30 am-9:45 am **Plenary Session 1- Topic: What Does Tomorrow Look Like?**

We live in a different world than we did even 5 years ago (fuel costs, concerns for global warming). How does this change our view of the future? Does it affect demand and where it will be located? Where will additional capacity be needed? Are demographic forecasts changing? Do we have different pictures of emerging aircraft types?

Moderator: Henry P. "Hank" Krakowski, COO, Air Traffic Organization, FAA
Speaker: Patrick Ky, Exec. Director, SESAR Joint Undertaking
Speaker: Kevin Brown, VP and General Manager of ATM, Boeing
Speaker: Jim May, President and CEO, Air Transport Association (ATA)
Speaker: Charlie Keegan, Program Manager ATCOTS, Raytheon

8:30 am-9:30am **Product & Miscellaneous Papers Presentations**
Exhibit Hall A

9:45 am-10:45 am **Coffee Break/Snacks with Exhibitors**
Sponsored by Sensis Corporation

10:45 am-11:15 am **Keynote Speaker: Hon. John G. Grimes, Assistant Sec. of Defense for Networks and Information Integration, Department of Defense Chief Information Officer**

11:15 am-12:30 pm **Plenary Session 2- Topic: Network Enabled Operations (NEO)**

Delivering the right information, at the right time, to the right place is a fundamental concept behind Network Enabled Operations (NEO). This session will explore existing NEO concepts, related questions, and possible paths to implementation.

Moderator: Sandra Samuel, VP of Aviation Solutions, Lockheed Martin
Speaker: Gene C. Hayman, Boeing Air Traffic Management
Speaker: Col Douglas Wreath, DOD Net Centric Ops, Dept. of Defense
Speaker: Michael Hritz, Systems Engineer, ATO Ops Planning, FAA
Speaker: Bo Redeborn, Director ATM Strategies, EUROCONTROL

12:45 pm-2:30 pm **Scholarship/Membership Luncheon**
Sponsored by The Boeing Company and Lockheed Martin

Luncheon Speaker: Ruth Leverenz, Acting Deputy Administrator, FAA

2:30 pm-4:00 pm **Product & Miscellaneous Papers Presentations**
Exhibit Hall

2:45 pm-4:00 pm **Plenary Session 3- Topic: Airports and Their Changing Role in the NAS**

Airports represent one of the most complex entities in the National Airspace system. This session will examine many of the best practices, demonstrations, and initiatives to mitigate airport inefficiencies while improving safety in the face of rising demand.

Moderator: James "Jim" E. Bennett, President and CEO of MWAA
Speaker: Peter Tomlinson, Managing Dir. Of ATC NATS, UK Heathrow
Speaker: Sarah Dalton, Director of Airspace and Technology, Alaska Airlines
Speaker: Lorne Cass, Managing Director, NW Airlines
Speaker: Kate Lang, Deputy Assoc. Administrator for Airports, FAA
Speaker: Mike Marsili, Director, Terminal, Surface, Flight Services and Airline Solutions, Lockheed Martin

4:30 pm – 6:00 pm **Welcome Reception– Exhibit Hal**
l

Official Programming ends for the day

<u>TUESDAY, NOVEMBER 4, 2008</u>

7:30 am-5:00 pm Registration Open - *Atrium*

8:00 am-4:00 pm Moderators/Speakers/Coordinators Ready Room

7:30 am-8:30 am Welcome Coffee- Thurgood Marshall Ballroom Foyer

8:00 am- 8:30 am **Keynote Speaker: Alexander ter Kuile, Secretary General, CANSO**

8:30 am-10:00 am **Plenary Session 4- Topic: Environmental Responsibility & Operational Efficiency**

With aviation continuing to grow at a record pace, aviation will continue to have a significant impact on the environment. There are many challenges facing the aviation industry in regards to that impact. What can air traffic controllers do to be more efficient at getting the aircraft to its destination? What can pilots do to help airplanes be more efficient? What can aircraft manufacturers do to reduce the carbon footprint of each aircraft? What can airlines do to reduce the carbon footprint but still maintain profitability?

Moderator: Carl E. Burleson, Director, Office of Environment & Energy, FAA
Speaker: Andrew Charlton, Aviation Advocacy
Speaker: Michael Lewis, Director, Boeing
Speaker: Carey Fagan, FAA, ATO Director of International Office
Speaker: Ashley Smout, CEO Airways New Zealand

8:30 am-10:00 am **Product & Miscellaneous Papers Presentations**
Exhibit Hall

10:00 am-11:00 am **Coffee Break/Snacks with Exhibitors**
Sponsored by BAE Systems

11:15 am-12:30 pm **Plenary Session 5- Topic: NextGen/Sesar Harmonization not Competition**

Moderator: Vincent Capezzuto, Director, Surveillance & Broadcast Services, FAA
Speaker: Mike Romanowski, Director of NextGen FAA Integration and Implementation, FAA
Speaker: Robert Pearce, JPDO, FAA
Speaker: Bernard Miaillier, Division Head, SESAR Contract Management, EUROCONTROL
Speaker: Alexander ter Kuile, Secretary General, CANSO
Speaker: James H. Washington, VP Acquisition and Business Services, FAA

11:30 am-12:30 pm **Product & Miscellaneous Papers Presentations**
Exhibit Hall A

12:45 pm-2:30 pm **Awards Luncheon**
Sponsored by ITT

2:30 pm–4:00 pm **Product & Miscellaneous Papers Presentations**
Exhibit Hall A

2:45 pm – 3:45 pm **Focus Sessions**

- **General Aviation**
  What are the top 5 needs of the GA community from NextGen and where can GA [manufacturers/users] have the most influence in supporting the NextGen goals and objectives – environmental, operational, flight deck, etc.

  Speaker: Mike Mena, Director, Advanced Cockpit Programs, Gulfstream

  Speaker: Peter Bunce, GAMA (invited)
  Speaker: Steve Brown NBAA

- **Weather**

  Moderator: Mark Andrews
  Speaker: Thomas Ryan, Program Manager for Next Gen Netcentric Enabled Weather, FAA
  Speaker: Steve Bran, NBAA
  Speaker: Representative from NOAA (invited)

- **UAS**
  Integrating UAS into the NAS – It's time to stop talking and start doing, but doing what?

  Top 5 areas where action needs to be taken to get started

  Speaker: John Page, FAA
  Speaker: John Walker, Naverus
  Speaker: Larry Smith, SWS Radar Group Program Manager and Technical Director, General Dynamics

- **Conference Proceedings Best Paper- 1st Place**
  Title: Regional Air Traffic Flow Management

  Authors:

  Dr. Pratic D. Jha, Lockheed Martin Transportation and Security Solutions
  Michael Balint, Lockheed Martin Transportation and Security Solutions

Dr. Phil Smith, Ohio State University
Ian Crook, ISA Software

3:45 pm – 4:30 pm **Ice Cream Break-Exhibit Hall**
Sponsored by MidWest ATC Services Inc.

4:30 pm-5:45 pm **Plenary Session 6- Topic: Increase Capacity Through Airborne Operations**

There is a great deal of work being done on specific applications that extend the use of existing separation standards (terminalization) or enable the use of new standards enough to address our future demand/capacity issues? If not, what are the key areas/applications that need to be addressed, and how will we start to address them?

Moderator: Dr. Agam Sinha, Senior VP, MITRE
Speaker: Steve James, General Manager European Dev., NATS
Speaker: Sid Koslow, VP and CTO, NAV CANADA
Speaker: John Kefaliotis, VP Next Generation Air Transportation Systems, ITT
Speaker: Mark Steinbicker, Manager, Performance Based Flight Systems Branch, FAA

Official Programming ends for the day

WEDNESDAY, NOVEMBER 5, 2008

7:30 am-2:00 pm Registration Open - *Atrium*

8:00 am-9:00 am Welcome Coffee- Thurgood Marshall Ballroom Foyer

8:00 am-4:00 pm Moderators/Speakers/Coordinators Ready Room

8:00 am -8:30 am **Keynote Speaker:** Dr. Wilson N. Felder, Director, William J. Hughes Technical Center

8:30 am-10:00 am **Plenary Session 7: Topic: What now? New Administration and Transition**

A discussion of the transition process from this day forward with a focus on planning for a new government, the transition timetable and setting expectations and how this will affect FAA funding, staffing, and projects?

Moderator: Donna R. McLean, President, Donna McLean Associates
Speaker: Norm Mineta, Former Secretary of Transportation
Speaker: Peggy Gilligan, Associate Administrator for Aviation Safety, FAA
Speaker: Langhorne Bond, Former FAA Administrator
Speaker: Sam Whitehorn, Executive VP, McBee Strategic

8:30 am–10:00 pm	**Product & Miscellaneous Papers Presentations** **Exhibit Hall**
10:00 am-11:00 am	**Coffee Break/Snacks with Exhibitors**
10:00 am-2:00 pm	**Student Program**
11:00 am-12:30 pm	**Product & Miscellaneous Papers Presentations** **Exhibit Hall**
11:15 am-12:15 pm	**Special Session: Transition from Program to Ops**
	Moderator: Neil Planzer, VP, ATM, Boeing Speaker: Vicki Cox, Senior VP, NextGen and Operations Planning, FAA Speaker: Peter Challan, VP, Harris Corporation Speaker: Rick Day, Senior VP, Operations, FAA
12:30 pm-2:00 pm	**Luncheon with Exhibitors**
2:00 pm	**Exhibit Hall Closes**
2:15 pm–3:45 pm	**Plenary Session 8- Topic: Five Things We Can Do Now**
	Moderator: Monte Belger, VP, Transportation Systems Solutions, LockheedMartin Speaker: Jeff Griffith, VP Aviation, Washington Consulting Group Speaker: Mark Runnels, ASDE-X and NextGen Air Portal Operations, Sensis Speaker: Alex Hendriks, Deputy Director ATM Strategies, EUROCONTROL Speaker: Dave Rhodes, Director, Advanced ATM Solutions, CSC Speaker: Lt. Gen (Ret.) Ron Kadish, Booz Allen Hamilton
3:45pm	**Closing Remarks** Speaker: Hank Krakowski, COO-ATO, FAA
6:00 pm- 7:00 pm	**Glen A. Gilbert Memorial Award Reception** ***Sponsored by The Boeing Company***
7:00 pm-9:00 pm	**Glen A. Gilbert Award Banquet** ***Sponsored by The Boeing Company*** **Honoree: John W. Crichton, NAV CANADA**

Conference Ends

附件二

參加第 53 屆美國飛航管制協會年會之參展廠商

Company	Booth
A3 Technology, Inc.	B1403
Adacel Systems Inc.	C154
Advanced ATC	A2501
Air Traffic Control Associatin Scholarsip Fund and ATCA Gear	Atrium
Air Traffic Technology International	B1312
All Weather, Inc.	B1308
Apptis	B1401
ATAC Corporation	B1310
ATC Global 09 - Expo and Conference	B1307
ATI Avionics Inc.	B1117
Aydin Displays, Inc.	B1316
Barco	B1005
The Boeing Company	C120
CGH Technologies Inc.	B1306
Crown Consulting	C222
CSC	C142
CSSI, Inc.	C152
Cyber Café (Sponsored by Sun Microsystems)	B1101
Daniel Webster College	A2604
Diamond Antenna & Microwave corporation	C208
Dowling College, School of Aviation	A2604
Emcor Enclosures	C216, C218, C220
EUROCONTROL	B1300, B1302, B1304
Evans Consoles	C214
FAA Center of Excellence for General Aviation Research (CGAR) Embry-riddle Aeronautical University	A2608
FAA First Federal Credit Union	B1019
FAA NextGen	B1110
FAA Surveillance& Broadcast Services	C160
FAA Managers Association (FAAMA)	B1405
FERNAU Avionics Limited	B1400, B1402
Formation, Inc	B1118
Frequentis USA Inc	C108
Gallium Visual Systems	C210, C212
General Digital Corporation	B1121
General Dynamics, C 4 Systems	C144
Harris Corporation	C130
HP	B1021
ITT	C132
Jane's Information Group	B1314
Kevlin Corporation- A Division of Cobham Defense Electronic Systems	C92
L-3 Communications	C156
Lockheed Martin Transportation and Security Systems	C134
Luciad	B1009
The Mitre Corporation	B1012
Motorola	A2508
National Center for Atmospheric Research (NCAR)	B1404, B1406
New Bedford Panoramex	B1000

Company	Booth
Northrop Grumman Corporation	C146
NTT Advanced Technology Corporation	B1016
Ohio University	A2602
Optimal Solutions and Technologies (OST, Inc)	C94
Oracle	B1018
Plantronics	C228
Raytheon Company	C122
RVA, Inc.	C224, C226
SAIC	B1015, B1017
Searidge Technologies Inc.	B1010
Selex Systems Integrati	C100
Sennheiser Aviation, Safety, Government Systems	B1020
Sensis Corporation	B1001
Serco Inc	C206
SolaCom Technologies	A2603, A2601
Sony Electronics	C90
SRA Air Traffic Systems, Era Corporation	C124
STR-SpeechTech Ltd.	B1120
Sunhillo Corporation	A2502, A2504
Sun Microsystems Federal Inc.	B1105
Systems Atlanta, Inc.	B1114, B1116
Tantus/OnPoint	A2605
Tech Source, Inc.	C114
Telegenix	B1108
Terma A/S	B1119
TKO's	B1022
U.S DOT/ RITA/VOLPE National Transportation Systems Center	B1301, B1303
UFA, Inc	B1004
Unisys	C204
Vaisala	A2607
Washington Consulting Group	B1318
WIDE USA	B1007

附件三 **REGIONAL AIR TRAFFIC FLOW MANAGEMENT**

Dr. Pratik D Jha and Michael Balint
Lockheed Martin Transportation and Security Solutions, Rockville, MD
Dr. Phil Smith
Ohio State University. Columbus, OH
Ian Crook
SA Software, Paris, France

ABSTRACT

Next generation air traffic management necessitates development of tools to generate strategic and tactical solutions for demand and capacity balancing. Forecasting system demand and capacity several hours out is challenging in itself because of uncertainties about weather and operational schedules. Therefore, the development of planning tools in support of demand capacity balancing poses some unique challenges. Of particular importance is the need to develop concepts that support adaptive approaches to planning in which a strategic traffic flow management plan serves as the starting point for progressive tactical modifications in order to adapt to emerging situations. Our previous research has demonstrated innovative planning algorithms using simulation-based planning and hybrid heuristic optimization approaches for strategic traffic flow management. In this paper we extend our approach to include tactical planning solutions that adapt to changing conditions over time. This extension makes it possible to support both strategic traffic flow planning by traffic flow managers, followed by tactical adjustments at a regional level by en route traffic managers. In this paper we provide a description of the operational concept using a weather scenario and results from a study aimed at exploring benefits of this concept.

1.0 Introduction

A threefold rise in the cost of fuel has made it imperative to enhance the efficiency of air traffic management system. A key objective of NextGen air traffic management is to ensure that airspace capacity is fully utilized and not overloaded. However, this is often not realized because of weather and operational uncertainties in the air traffic management (ATM) system. Weather alone can severely impact air traffic operations, accounting for much of the delay in the NAS. It is a general belief in the air traffic management community that, with the proper tools and communication infrastructure, although we might not be able to fully mitigate the impact of weather, we should be able to do a significantly better job of managing its impact. As a number of researchers have noted (DeArmon, Wanke, Greenbaum, Song, Mulugund, Zobell and Sood, 2006; Davidson, Krozel, Green and Mueller, 2004), current strategies are often overly conservative, resulting in excessive flight delays, because of a lack of decision support and communication tools for managing responses to weather events.

The development of such decision support systems poses some unique challenges, because of the complex spatial and temporal uncertainties associated with weather forecasts. A recent workshop report on weather forecasting accuracy for Federal Aviation Administration (FAA) traffic flow management by the National Research Council states that current forecasts for convective weather two to six hours in advance are very crude, and it is unlikely that the level of desired forecasting accuracy will be achievable in the foreseeable future. Weygandt and Benjamin (2005) note that the convective systems are composed of individual updrafts, that have a life cycle on the order of an hour and their predictability limit is very short. Therefore, the numerical models used for predicting convection can only capture general areas of thunderstorms with significant phase errors.

As with any planning process that involves time, this traffic flow planning process is dynamic. Because we plan for future, we need to make assumptions about the state of the system during that period, and if those assumptions do not materialize, we need to be able to adjust our plan accordingly. Therefore, the use of probabilistic decision making techniques has been proposed by a number of aviation researchers. Using this approach, instead of considering only a single scenario representing the "most likely" or "expected value" for a given weather situation, a range of possible alternatives are onsidered, reasoning about the associated uncertainties and outcomes. Equally important, this approach to decision making emphasizes the value of an adaptive planning methodology for dynamic scenarios where uncertainties change over time.

The planning process can be decomposed into a strategic planning phase and a tactical planning phase. The objective of strategic planning would be to look for predicted imbalances in demand and capacity over longer planning horizons (2 to 8 hours), and often involves large-scale responses. Tactical planning is more focused on optimizing flow of traffic at a regional level. While we view strategic planning process as a function of national traffic flow management, the tactical adaptation process can be best accomplished at a regional level by en route traffic managers in coordination with broader continuous planning at the national level.

Our previous work (Jha, Suchkov, Crook, Tibichte, Lizzi and Subbu, 2008) has focused on demonstrating strategic planning solutions using simulations and hybrid heuristic approaches for traffic flow management. The service provides an integrated traffic flow management solution as it combines rerouting solutions along with time based strategies. The process starts with finding the optimal routes for a given set of flights such that congestion is minimized and airline operating preference is maximized. Experiments using these traffic flow management algorithms have shown promising results in terms of demand capacity balancing. In this paper we extend our approach to include tactical or regional planning solutions that adapt to changing conditions over time. In this paper we provide an illustration of the operational concept using a weather scenario.

2.0 Regional Traffic Flow Management

The FAA's Collaborative Decision Making(CDM) program has developed two new concepts for dealing with uncertainties in weather and traffic constraints, Integrated Collaborative Rerouting (ICR) and System Enhancement for Versatile Electronic Negotiation (SEVEN) (Klopfenstein, et al., 2005). Both of these procedures improve coordination between traffic management and the flight operators, and provide flight operators with greater influence over the routing of their aircraft. In contrast with today's rerouting process, which can be manually intensive and often involves a one size fits all approach, ICR and SEVEN procedures aim at providing a more collaborative rerouting process that involves customers early in the process and allows them to indicate preferences for reroutes. FAA traffic managers (regional and national) coordinate with customers to define the constraint and provide more information to the flight operators (in the form of planning advisories and route guidance) than they do today. In response to this the flight operators, who know their own business needs and aircraft capabilities or limitations, have the opportunity to either file around the constraint (ICR) or submit a prioritized list of alternative route preferences (SEVEN).

Figure 1 shows a Flow Evaluation or Constrained Area (FEA/FCA) that has been created in Indianapolis (ZID) and Memphis (ZME) to indicate a forecasted weather event that is expected to result in a number of high, mid and low sectors operating at reduced capacity. Under SEVEN, given such a forecast, flight operating centers (FOCs) would be given an opportunity to submit alternative routes for a flight (such as north and south of the FEA/FCA, as well as a route through it in case the weather does not develop to the extent predicted). Based on the options submitted by the FOCs, traffic managers with automation support would then allocate flights to routes as the weather actually develops.

Jha et al., (2008) have developed heuristic optimization techniques that can support this process of allocating flights to routes based on the alternatives that have been submitted for each individual flight. These techniques search for the best combination of flight plan options (portfolio) in order to obtain a solution that provides both efficiency and equity to all concerned, while maintaining demand and complexity at acceptable levels. Using this approach, most of the flights are typically assigned to one or more of the alternative routes submitted by the FOC without any departure delay. When necessary, departure delays are assigned to hold a flight on the ground until one of its associated routes is available.

The planning algorithm evaluates various combinations of reroute options and employs a greedy heuristic that analyzes the FEA/FCA which impacts flights in conjunction with each sector's level of congestion to generate an optimal portfolio containing the set of flight reroutes that most benefit the entire system (for example, by minimizing overall system delay). Flight reroutes can be produced in our prototype either automatically (using internal re-route algorithms) or via our pseudo flight dispatcher operational positions (i.e. by FOC actors). Once registered, the service provider (regional TFM manager) is able to execute the optimizer as an on demand service. Through the advanced simulation techniques available in the platform, the impact of the various reroute choices can be instantly evaluated. Once a portfolio is selected, all participating flight operators are immediately informed of the outcome, with indication of the 'optimized' reroute selected for each impacted aircraft.

As part of initial experimentation we used a 4-hour period between 2100Z to 2359Z on from August 24, 2007. Approximately 500 flights were affected by the FEA/FCA and had to be rerouted around the area. Figure 2 shows the route allocations for the impacted flights. Further experimentation is currently underway to validate the efficacy of this approach.

3.0 Traffic Complexity

Another important dimension of this problem is to develop an approach for minimizing complexity of the sector to maximize sector throughput. In today's practice, the sector overload is represented by a single variable: the number of aircraft in a given sector (aircraft count). However studies performed by a number of researchers (Kopardekar and Magyartis, 2003; Kopardekar, Schwartz, Magyartis and Rhodes, 2007) have demonstrated that aircraft count might not be the best measure for determining an overload situation, as a controller's capacity to safely handle aircraft is dependent on many other factors. A two-stage framework is currently being developed to estimate sector complexity and opportunities to maximize throughput.

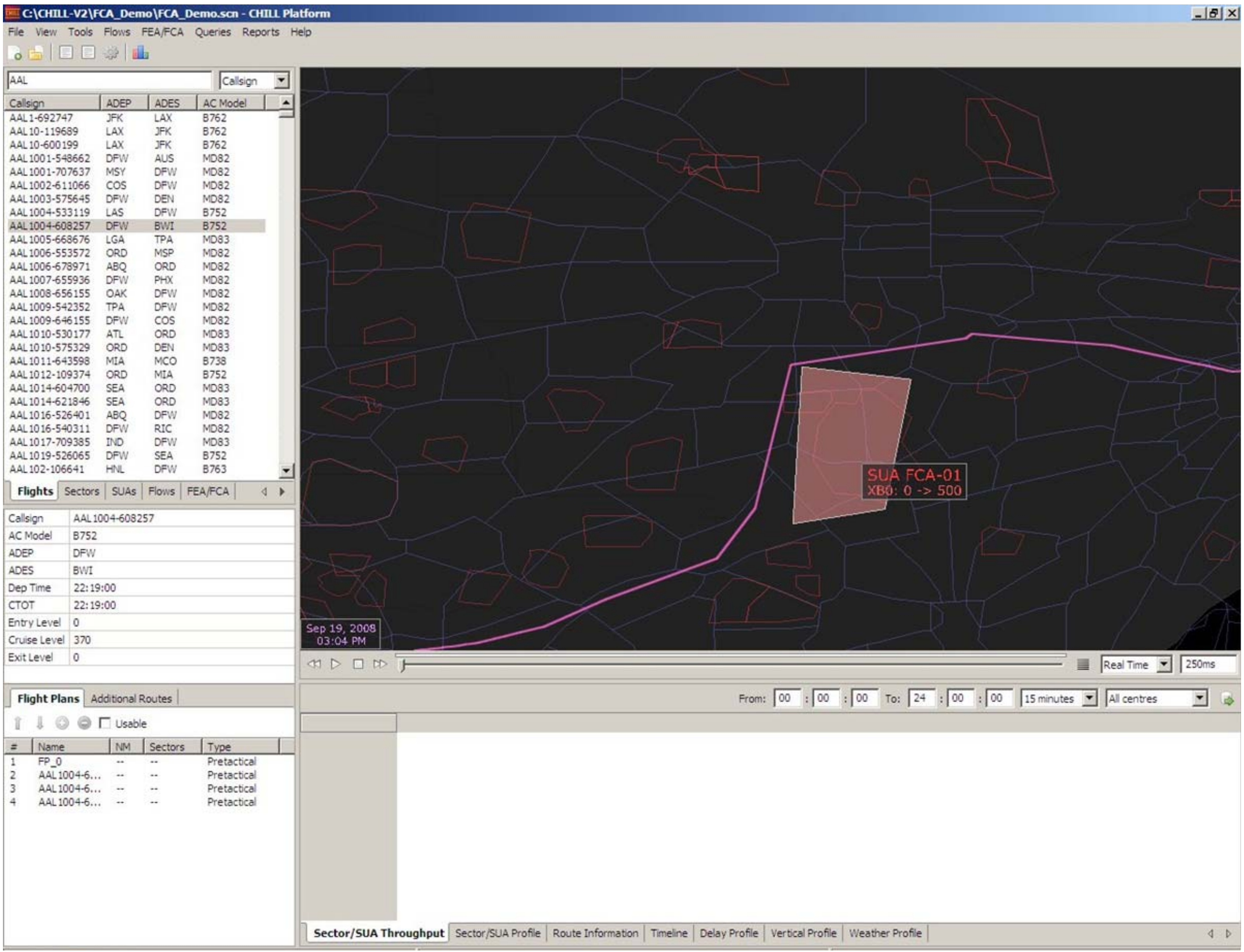

Figure 1: Regional Air Traffic Management Prototype

Figure 3 shows a prototype for complexity management in which the sector state (complexity) is displayed by showing the trends for variables that add to complexity over a two hour forecast window. The prototype uses a fast-time simulation capability for computation of complexity variables. This information could be used by regional air traffic managers to asses' sector throughput while analyzing traffic flow management initiative. An optimization capability has also been developed that uses a heuristic algorithm to reduce complexity for sector overload situations without reducing demand.

4.0 Probabilistic Decision Making Framework

In the scenario described above we focused on finding optimal rerouting solution around a known constraint, as represented by an FEA/FCA. The above concept can be further developed to support a probabilistic decision making framework for the ATM system. Below, we provide an illustration. Assume that a weather model is used to produce probabilistic weather forecasts for a frontal storm over the course of the day,

making predictions 1 to 3 hours in advance. These are not simply forecasts for a single point in time, but provide predictions that show how uncertainty regarding the weather is expected to evolve over time. Furthermore, that uncertainty is represented using the approach similar to that found in the National Center for Aviation Research (NCAR's) National Convective Weather Forecast – 2 (NCWF-2) product as can be seen in Figure 4.
Using such forecasts as input, a probabilistic ATM approach is outlined in the following steps:

Step 1: Assume a forecast similar to that provided by the NCWF-2 provides probabilistic point forecasts for every 15 minutes during the next 3 hours. Assume further that the traffic manager has the ability to graphically annotate this display to add additional constraints based on his or her knowledge.

Step 2: The next requirement is for FOCs to develop a set of alternative flight plans for each of their flights after considering the probabilistic weather forecasts. For each flight, these flight plans indicate a set of trajectories that the FOC considers to be viable alternatives for that flight, along with relative preferences based on time and/or fuel considerations. This conceptual approach, in which each flight has an associated list of prioritized, pre-approved flight plans to deal with uncertainties in the weather is consistent with SEVEN as described earlier. Thus, this approach requires the flight operator to generate a discrete set of alternatives. In essence, the flight operator is saying: "Here's an alternative set of trajectories that I am willing to fly if weather and traffic constraints make it necessary to fly something other than my "preferred" trajectory (the "preferred" trajectory being the trajectory that is "best" if that flight is the only aircraft in the sky and there is no convective weather)."

It would also require a more sophisticated flight planning system that has a depiction of system constraints and is able to generate the alternative trajectories for flight. Also, flight operators might want to have some richer language for prioritizing these trajectories beyond simply providing an ordered list. For instance, they might indicate that a particular, more extreme deviation away from the "preferred" trajectory would only be acceptable if it reduced departure delay by more than 30 minutes relative to an on-time departure on the "preferred" trajectory.

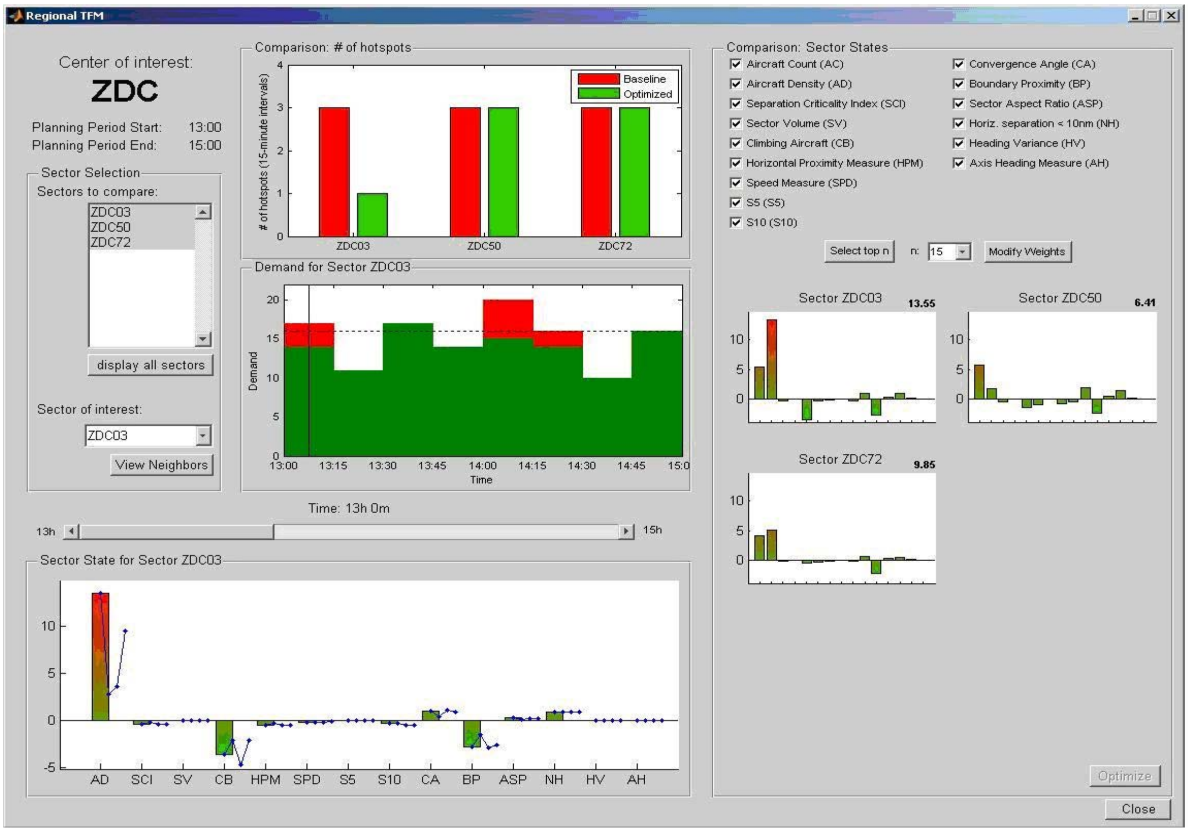

Figure 3: Complexity Management Decision Support Prototype

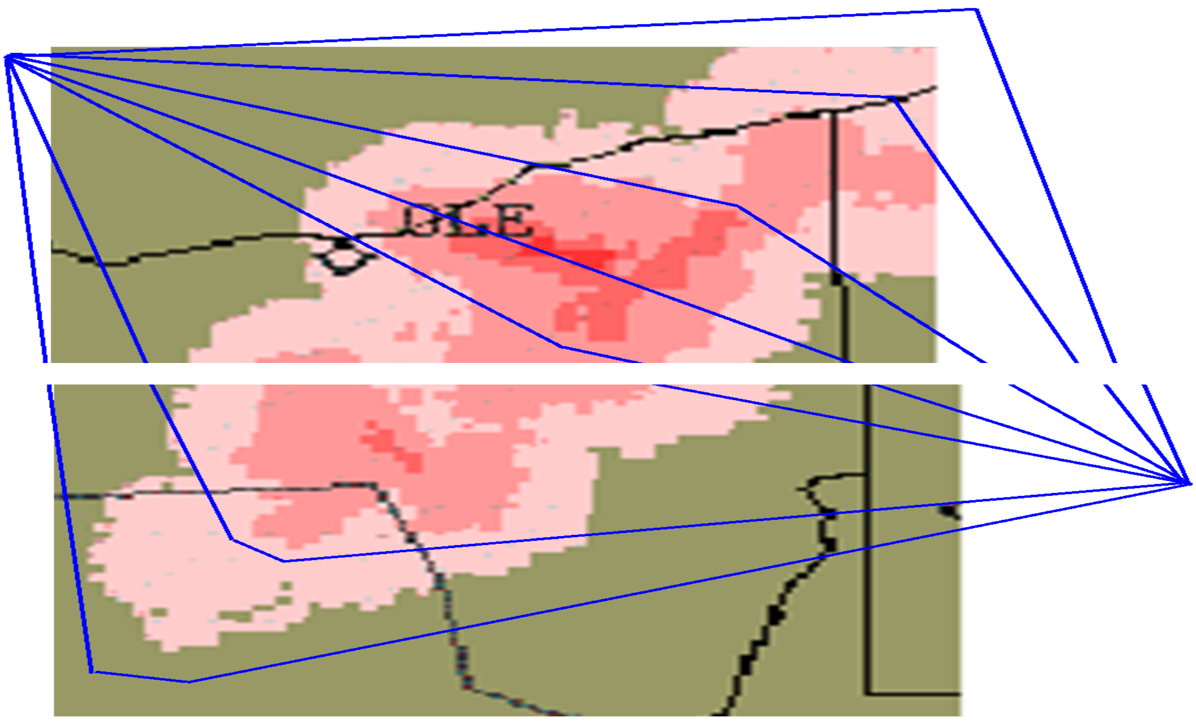

Figure 4: NCWF -2 convective forecast product with overlay of available routes

Finally, finding the set of alternative trajectories would actually be more complicated than described above. We would actually have a series of probabilistic weather forecasts, one for each 15-minute time interval. Furthermore, probabilities across such 15 minute-intervals would not be independent, so we would have to calculate the probabilistic weather data in a manner that captured dependencies (perhaps making it necessary to develop a branching weather forecast tree). Then we would need to deal with path probabilities within this tree, and decide which paths to include in generating alternative trajectories for a flight.

Step 3: A planning algorithm such as that described in Jha et al. (2008) for strategic planning could then be used to support probabilistic traffic flow management, with another layer superimposed on this search algorithm to reason about how to deal with the uncertainties represented in the weather forecast tree. (Note that the design of this extra layer of algorithms to deal with uncertainties remains a complex challenge for future research.) The planning algorithm and associated uncertainty reasoning layer would use the current state of flights in the NAS, the probabilistic weather forecast tree and the prioritized list of alternative flight plans generated by the centralized flight planning system to generate route assignments and (if necessary) delays for individual flights. The concept would also require development of an algorithm that determines the capacity for each sector based on the forecast weather and its associated uncertainty and based on the expected flight trajectories, their uncertainties and the associated "complexity" associated with controlling the traffic as previously described.

5.0 Conclusion

Better decision support technology is a must to achieve efficient use of NAS. However, development of such technology is a nontrivial and multifaceted problem. Our research and development work to date has focused on demonstrating innovative planning algorithms for strategic and tactical traffic flow management, thus complementing other work in this area focusing on innovative new TFM concepts and the modeling of the uncertainty associated with a weather event. In this paper we presented an approach for tactical planning solutions and description of operational concept using a weather scenario. The traffic planning methodology outlined in this paper provides an adaptive mechanism to help maximize flow of traffic in NAS. Finally, we also laid out an approach for extending our approach to include probabilistic traffic flow management.

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附件四 SYSTEMATIC SOLUTION FOR REDUCTION OF AIRSPACE CONGESTION DURING APPROACH AND LANDING PHASE

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Introduction: NextGen Has A Choice

In many ways, the national airspace system (NAS) is like an ever changing, complex living organism, dynamically changed by influences both inside and outside the government. Pressures to accommodate the needs of NAS system users by adapting new technologies and procedures into the airspace infrastructure have been tempered by costs, bureaucratic inertia and even politics. Resolving the problem of increasing congestion, delays, and limited throughput continues to be a complex and elusive goal. Casting blame on any one element of the NAS or NAS user is obviously not constructive. Neither is sowing non-integrated technical solutions across the NAS with the hope of accumulating numerous small gains. Such an approach only leads to increased complexities, unmanageable dynamics, and unjustifiable costs.

Every NAS improvement program of the past 30 years began with system level goals, but evolved into a patchwork of technology implementation programs. It is time to return to a true systematic approach to improving the performance of the NAS.

One often overwhelming aspect of the problem is that we have to keep the old systems and procedures running while we implement the new ones. This need has driven a technology-centric systems approach that is ill suited for a system that is functionally driven. Rather than organize implementation around the typical technology groupings of communication, navigation and surveillance, we should focus on designing integrated technology and procedural aspects of air traffic management segmented by functional flight phase. At the highest level, these functional areas are separation and traffic flow management during the flight phases of takeoff/departure, cruise, approach/landing and surface operations. From this perspective it is easier to recognize where developmental emphasis should focus.

The approach and landing phase of flight is, and will continue to be, the bottleneck of NAS throughput. It is this phase of flight that has the greatest variability throughout the day, and proportionally affects all other functional areas. What are the principal contributors to terminal congestion? Non-optimized flow control, aircraft spacing requirements, and low visibility landing and runway operations are a few that come to mind. There exist today new advances that address each of these constraints. This paper describes an integrated systems approach for the approach and landing phase based on demonstrated technologies in the areas of goal-based aircraft selfmerging and spacing; aircraft wake detection and avoidance management; and, enhanced flight vision category (cat) II and cat IIIa approach, landing and taxi operations. Operational benefits of these integrated technologies include improved airspace capacity, increased runway acceptance rates, more on-time flights, and reduced delays and diversions. Applying similar methodologies for NAS modernization to takeoff/departure and cruise flight phases could also greatly simplify NAS modernization and undoubtedly improve the evolution of the next generation air transportation system (NextGen).

Capability Driven NextGen Architecture

"What is the operational priority for implementation based on cost, benefits, and risk?" is the key question of a functionally driven architecture. The comprehensive NextGen implementation plan overview [1], the implementation plan solution set timelines [2] and the NextGen concept of operations [3], organize eight key capabilities or "transformative activities" in the three domains: (a) airport development; (b) air traffic operations; and, (c) aircraft & operator requirements. The air traffic operation domain contains the bulk of the transformative activities (solution sets). They contain a collection of programs, some of which have been around since the previous NAS improvement program. Others are conceptual, and a few others are mature technologies waiting to be employed. Nevertheless, these documents do not address operational priority.
The extraordinarily detailed and complex NextGen enterprise architecture [4] functionally allocates every domain and solution set activity to the NAS infrastructure interdependencies, but also fails to address the key question of operational priority. There is no doubt that NextGen's key capabilities are needed to transform the NAS; but which ones hold the greatest potential for gain? The stage is set once again for NextGen to evolve into a patchwork of technology projects, some of which may improve airspace capacity and throughput, while others are unnecessary and an expensive burden on the NAS.

Defining A Functionally Driven Architecture

NextGen's air traffic operations domain should be reorganized in to sub-domains based on phases of flight, as illustrated in Figure 1.
Reallocation of solution set programs and technologies to particular phases of flight will reveal interdependencies with bonds that are more tightly associated with their functional purpose. Those projects and interdependency technologies with the strongest bonds to the functional phase of flight (mission success), will have the highest priority. Others will have lower priorities, or will be removed altogether. The FAA's systems engineering approach [5] would more effectively assess the investment decision based on benefits and cost of technologies associated with each sub-domain and would establish implementation priorities.

Phase Of Flight Domain Architecture

Phases of flight more accurately represent the functional operations of the NAS. Strong interdependencies of airborne and ground-based required capabilities are more readily apparent and more easily defended. More importantly, phases of flight are directly associated with measurable system performance such as capacity, delay, throughput, and cost. This should set priorities for R&D, demonstrations, implementation schedule, and, of course, funding.

A high level notional example of a phase of flight domain architecture is shown in Figure 2. This model has been used many times and is still valid. It is generally accepted that constraints to capacity and throughput are highest in the approach and landing phases, and less for departure and en route. However, there are exceptions to these rules. Weather is the biggest uncontrollable factor, as its ripple affect of landing and departure delays at one airport will impact other airports as well.

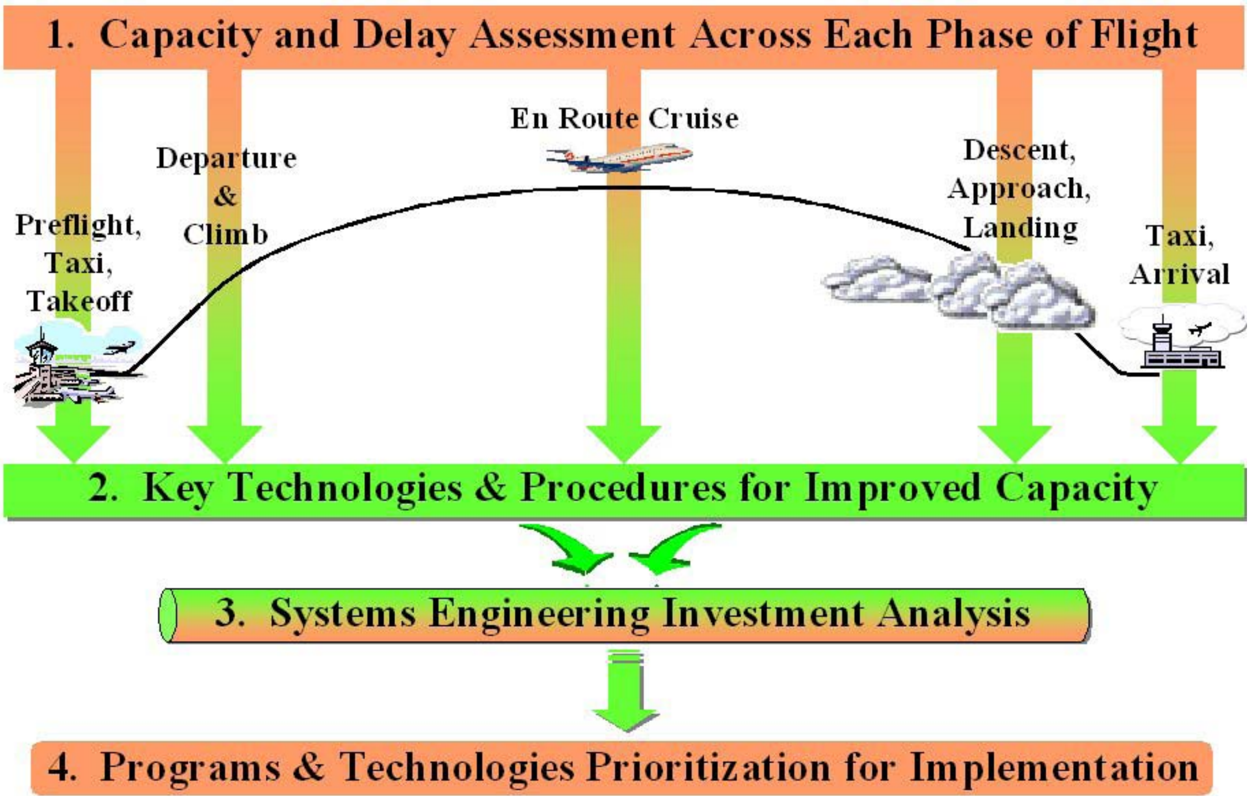

Figure 1. Priority Architecture Implementation By Phase Of Flight

A systematic approach toward implementation of advanced technologies and procedures first for the approach and landing phase of flight could produce early success for the NAS and cost savings to taxpayers and system users. Key to this approach is the FAA's systems engineering and investment analysis process, but it is only optimally achieved when using a phase of flight domain architecture.

Implementing A Functionally Driven Architecture

As a thought experiment, let us examine a functionally driven architecture of technology and procedural solutions for the approach and landing phase of flight domain as seen in Figure 3. Three technology areas with associated flight and ATC procedures are discussed that may produce substantial improvements to NAS capacity and safety.

Goal-Based Aircraft Self-Merging And Spacing

A number of factors affect today's terminal area delay and runway throughput performance. Among these are the speed profile of aircraft during descent and the achieved spacing between aircraft. Even small variations above legal spacing minima accumulate to result in major reductions in throughput. Self-merging and spacing offers a potential solution. It represents a shift from controller-based vectoring and speed control to aircraft-based merging and spacing to ATC – designated time or distance criteria. This concept, with flight trials performed by NASA, FAA and UPS, is based on a principal that on-board computer-generated speed guidance yields greater spacing precision than conventional control techniques. Given an aircraft to follow and/or arrival time to a fix, the pilot will make small adjustments to aircraft course and speed to produce a precise spacing interval. Variability is then reduced and airspace and runway capacity is increased. Technology interdependencies include: ADS-B for aircraft position determination; cockpit moving map display with traffic (enhancements are being evaluated); airline ATO tools for generation of path and speed guidance (also in trials); and data link communication of self-merging and spacing goals to aircraft (exists with need for minor enhancements). Risk assessment is low for early demonstration and implementation.

Aircraft Wake Detection And Avoidance Management

Wake turbulence separation criteria applied by ATC represent a major constraint to runway throughput. Normal advection of the vortices below and away from the path of a following aircraft negates the requirement for the added separation applied by ATC, but no system is presently installed to predict and confirm this transport of the vortices. FAA conducted extensive measurements to approve reductions in the separation of parallel wake independent runways when crosswind strength is sufficient. A more comprehensive wake vortex avoidance system has been proposed to address the issue in all airport operations and throughout the terminal area. Wherever separations less than standard wake criteria are applied, wake vortex behavior is predicted and compared to the flight path projections of following aircraft.

Guidance is provided as necessary to resolve any predicted intersections. Real time vortex monitoring is provided to validate the predictions at the critical locations, which are the stabilized approach point and the landing and departure runway thresholds. In the default mode, standard radar separation is applied by ATC among all aircraft which provides the same capacity as if all aircraft were classified as small. If weather conditions will preclude this, the system advises controllers whenever wake separation will need to be applied.

Technology interdependencies include: ADS-B for accurate aircraft position tracking; weather parameter measurement; wake vortex detection system (existing); wake vortex prediction, alerting and management system (prototype trials); display integration for ATC; and, alternatively, cockpit interface via electronic flight bag and ground-air data link. Risk assessment is low for early demonstration and implementation.

Enhanced/Synthetic Vision CAT II And CAT IIIa Approach, Landing And Taxi Operations

Low visibility landing is the "last mile" for increasing runway and taxiway utilization. Current procedures permit descent to as low as 100 feet above touchdown for cat I approaches. While these procedures open up many more airports, there are still conditions that may prevent completion of the approach. Recent technology advances in synthetic vision have prompted the FAA and RTCA to draft requirements for use of enhanced vision with synthetic imagery [6]. Although no additional landing credit is expected initially, improved acuity of the landing area, taxi operations and gate utilization could improve safety and efficiency with enhanced/synthetic vision systems. The largest constraint to utilization of EFS is equipage, as the high cost of head-updisplays and sensors discourage fleet equipage.

The benefit-to-cost for air carriers would be much more favorable with assured landing in cat I, and with landing credits for cat II and IIIa visibility conditions as well (the "holy grail"). Meteorological testing of ultraviolet (UV) sensor technology in cat IIIa conditions for enhanced flight vision system operations has demonstrated the capability to exceed low visibility obscuration by a factor of three times that of approved infrared sensors [7, 8].

Technology interdependencies include: integrity monitor for synthetic vision systems (other than GPS); and, ultra-violet emitters (exits with need for runway integration). Risk assessment is medium for early demonstration and implementation due to expanded fleet equipage and federal approval of operational credit.

Closing Remarks

A redirection of the NextGen architecture is needed to assure implementation of technologies and procedures with early and large improvements to NAS capacity and economic benefits. A functional domain architecture based on the phase of flight, with emphasis on systems engineering and investment analysis will avoid increased complexities, unintended dynamics, and unjustifiable costs.

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