出國報告（出國類別：其他）

# 民用飛航服務組織(CANSO)
# 亞太區飛航作業
# 第 2 次工作小組網路會議視訊報告

服務機關：交通部民用航空局飛航服務總臺
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張主任管制員子修
派赴國家／地區：臺灣（視訊會議）
出國期間：**110** 年 **11** 月 **8** 日─**11** 月 **9** 日
報告日期：**110** 年 **12** 月 **14** 日

# 壹、摘要

本次民用飛航服務組織(Civil Air Navigation Services Organization, 以下簡稱CANSO)亞太區飛航工作小組(Operations Workgroup)會議因受新冠肺炎疫情影響，採網路視訊方式辦理。本次會議主題除例行性報告飛航作業常務委員會轄下各工作小組與任務小組於過去一年之工作項目與飛航作業工作小組之未來展望外，亦廣邀各飛航服務業者與航空產業相關業者透過講座介紹專精：中國四維航空器(i4D)路徑管理計畫的測試飛行成果報告、香港導入之進階機尾亂流隔離(eWTS, Enhanced Wake Turbulence Separation)經驗分享，以及由流量管理工作小組主講之飛航流量管理(ATFM)與機場協同合作(A-CDM)之現況和未來發展。

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# 參、會議內容紀要

## 一、目的

亞太區飛航工作小組旨在透過 CANSO 平臺讓各會員能進行資訊分享與經驗交流，並定期舉辦研討會與工作會議等共同商討航空產業之新興議題與科技趨勢；以致力提升各國飛航服務品質並增進亞太地區區域性發展。

## 二、過程

### (一) 會議第一天 (11 月 8 日)

#### 1. 開場致詞

**主講： Poh Theen Soh 先生 (CANSO 亞太區事務主席)、苗旋先生 (CANSO 亞太區作業工作小組主席/中國民航局空管局副局長)**

新任主席苗旋先生指出，各飛航服務業者在疫情影響下仍致力維持服務水平與確保飛安的同時，亦面臨財務上的挑戰；根據 IATA 資料顯示，2020 年僅有 18 億旅客人次(相較 2019 年的 48 億)，收益上則減少 69%。然而，CANSO 的角色更突顯其重要性，讓飛航服務業者分享經驗以共享跨國界的資源與創新。主席亦認為，各會員應趁國際運輸趨緩之餘，強化自身之制度、設備、導入新技術並竭力加強作業韌性。

隨著各國疫苗普遍接種，可預期國際運輸將有發散式復甦(divergent recovery)，亞太地區無疑會是首當其衝的區域之一；以中國為例，2021 年上半年總航行量已達 433 萬架次(較 2020 年同期增加 49%)，幾乎恢復疫情前的航行量。亞太地區歷年航行量的顯著成長亦充分展現出產業的活躍特性與潛力，飛航服務業者更應掌握地域性之優勢而力求提升服務品質。主席歡迎更多組織的加入，以共享資源並導入企業界(如波音、空中巴士、THALES 等公司)的新科技與創新經驗外，工作小組將持續擔任合作與交流的橋樑，以增進亞太地區的飛航服務。

## 2. 飛航作業常務委員會辦況更新

**主講：Scott Leis 先生 (CANSO 飛航作業專案經理)**

**概要：飛航作業常務委員會(Operations Standing Committee, OSC) 於飛航服務管理作業與技術層面扮演著領導的角色，負責提倡飛航產業中最佳作為(best practice)之交流與資訊分享。OSC 今年增設了飛航流量管理資訊交換網絡任務小組(CADENCE TF)，並總計已有 11 個工作小組(WG)及任務小組(TF)，工作項目與目標更新如下：**

(1) 無人機管理任務小組(UAS/ UTM TF)：

持續提供 ICAO 無人機管理建議、與無人機系統/新興科技工作小組(ET WG)整合新興科技與傳統飛航管理之角色與責任、加強機場周遭無人機偵測、探討無人機飛航服務成本回收機制之可能性，並持續推廣 CANSO 網路平臺的使用率。

(2) 無人機系統/新興科技工作小組(UAS/ ET WG)：

分享更多資訊與輔助指引(目前已發布 ANSP 應注意之 UAS 作業事項與建議)予飛航服務業者並強化與 CANSO 無人機管理任務管理小組、各地區工作小組的協同合作。

(3) 泛系統資訊管理工作小組(SWIM WG)：

完成發表 SWIM 白皮書、研發 SWIM Kit(已完成計畫大綱)並將由印尼 AirNav 等負責測試驗證，及持續與其他工作小組合作。

(4) 數位塔臺任務小組(SDT TF)：

更新輔助指引資訊(將包含案例探討與導入經驗)、介紹新技術的應用、輔助飛航管制員的安全機制、探討數位塔臺生命週期與環境衝擊，並探討改變管理與人為因素。

(5) 性能導航工作小組(PBN WG)：

協助導入性能導航並檢視過往案例、探討性能導航與噪音問題的 KPI，明年將全力發展計畫 Minimum Operational Network (MON)以探討 GNSS 故障時傳統地面助導航設施的適當密度與地理分散度等。

(6) 作業效益工作小組(OP WG)：

分析不同區域間的諸多關鍵績效指標(KPI)並持續檢視飛航容量、效率與預測性指標，並將與不同工作小組共同研擬發展各項計畫。

(7) 環境工作小組(ENV WG)：

持續研擬環境認證計畫以改善環境效率，除評估環境管理各項程序的成熟度外，亦提供減少環境衝擊的方針與企業化管理資訊等。

(8) 資料鏈建置任務小組(DLI TF)：

研擬資料鏈導入檢查項目表、發布問卷並協助飛航服務業者導入飛航管制員ー航空器駕駛員資料鏈通訊(CPDLC)或約定式自動回報監視(ADS-C)並強化導入的效益、籌備線上研討會與研擬區域性研討會的相關議題。

(9) 飛航流量管理資訊交換網絡任務小組

ATFM Data Exchange Network for Cooperative Excellence 任務小組(CADENCE TF) 為三月新成立的任務小組，今年主要向各會員推廣該小組的工作內容與表達協助意願，並積極輔助非洲地區導入流量管理。

(10) 飛航流量管理工作小組(ATFM/A-CDM WG)：

發展長程 ATFM 概念計畫書與特殊活動計畫書(如軍演、奧運、大型會議等)，並積極與各地區聯繫以合作舉辦 A-CDM 線上研討會。

(11) 航空情報管理工作小組(AIM WG)：

本工作小組之會員今年翻倍成長，故今年主要進行現有工作與計畫的推廣與說明，並期望能盡速展開協助航空情報各項服務管理之推動。

## 3. 飛航作業工作小組的期許與展望

**主講： Poh Theen Soh 先生(亞太區事務主席)**

**概要：說明飛航作業工作小組(Operations Workgroup)目標與工作方法，並指出未來展望之契機，以期達成亞太區域飛航服務整體水平的提升。**

(1) 亞太區域的現況與轉機

根據 ICAO 全球安全監督查核計畫(Universal Safety Oversight Audit Program, USOAP)，亞太地區目前對飛航服務的安全督查能力(Effective Implementation)為 67.5%，主席希望能從區域性的角度出發探討飛航服務發展，而非獨立聚焦於飛航服務業者的個體發展。全球疫情險峻雖

使各產業紛紛精簡作業以節流，但亦帶來值得飛航服務業者思考的轉機：

A. 協同合作的重要性：亞太地區有許多資深的 CANSO 會員(如AeroThai)能分享實務經驗，以增進區域整體的飛航服務作業效能而讓本區保有全球性競爭力。

B. 數位化發展：新興技術與數位變革能提供較具經濟效益的解決方案，對未來系統規劃與飛航服務提供上，都極具發展潛力。

(2) 工作目標

A. 協助會員們建構完善的基礎能力並擔任資訊與經驗的分享平臺，除發起區域性的協同合作外，亦能推動模擬與試行計畫，並發想、擬出與業界廠商互動的最佳方式。

B. 工作小組將持續透過定期與會及線上討論，不侷限於資訊的交流而致力拓展各種作業示範與模擬，並期能共邀研究機構與實驗室的跨界合作。

(3) 未來展望

A. 建構未來天空的藍圖：探討空域設計與靈活運用、相關驗證工具的使用經驗分享、飛航管理(ATM)與無人機管理(UTM)的整合與共生、與發射外太空之飛航活動等。

B. 產業的永續發展：聚焦氣候變遷與環保議題，並探討如何減少航空油耗、自由航行空域(Free Route Airspace, FRA)、使用者偏好航路(User Preferred Route)外，持續研擬 CANSO 環境認證計畫。

C. 提高飛航服務產業的水平：凝聚產業各方合作，並向會員分享飛航服務系統更新與升級經驗以期增進區域性發展。同時，亦將對新一代系統能力進行測試與模擬，並請業界企業分享科技趨勢。

(4) 結論：致力促使亞太地區的所有會員能共同成長，並能及時投入創新的飛航服務與管理技術及能力。

## 4. 小型研討會─四維航空器路徑管理 i4D 經驗分享

**主講：康南 (中國民用航空局交通管理局空管部副部長)**

**概要：中國分享四維航空器路徑管理(i4D)之成果，試行天津至廣州與北京至烏魯木齊兩條航線之飛航，藉由陸空交換航空器之預期四維飛航路徑，使航管單位及早獲悉動態，促進協同合作。**

(1) 飛航系統區塊式提升(Aviation System Block Upgrades, ASBU)基於軌跡之作業(Trajectory Based Operations, TBO)：中國於 2020 年 5 月導入 TBO，旨在透過共同的路徑預測作為飛航管理協同發展之基礎以達三大效益：

A. 協同合作：利害關係方(機場、航管、航空公司)之間透過技術方案得以密切協同合作，包括陸空、陸陸等資訊系統的整合以提升作業流暢度。

B. 路徑預測：機載系統與地面航管系統的緊密連結不但能提升各方之狀況警覺，進而及時避免、消弭或改善潛在航情衝突或壅塞情形。

C. 精準、經濟化作業：四維路徑預測能使飛航管理更準確並提升空域使用效益。

(2) 基於軌跡之作業(TBO)簡介

A. 範圍：包含航程中每一階段之所有利害關係方(包括機場、航空公司、飛航管制、空域和流量管理等)。技術支援方面則涉及系統廣泛資訊管理(SWIM), 協同環境下之飛航資訊流通(Flight and Flow Information for a Collaborative Environment, FF-ICE), 飛航管理系統，陸空數據鏈等。

B. 七大元素：空域組織與管理(Airspace Organization Management)、需求與容量平衡(Demand and Capacity Balance)、機場作業(Aerodrome Operations)、航情同步(Traffic Synchronization)、衝突管理(Conflict Management)、空域使用者作業(Airspace User Operations)、飛航管理服務提供管理(ATM-Service Delivery Management)。

(3) 四維航空器路徑管理(i4D)飛行測試

A. 歷程：2015 開始規劃四維航空器路徑管理(i4D)飛行計畫、於 2017 設立工作小組，並於 2019 年列為年度重點工作項目。2019 年 3 月 20 日首次試飛：以空中巴士 A320 進行天津至廣州的測試飛行(經廣州區管中心與近場管制)，主要驗測 CPDLC,ADS-C,CTA 與 Extended Projected Profile(EPP)等功能。

B. 由民航總局、系統商、航空通訊服務商、研究單位、南方航空共同合作，耗時近 5 小時，經 6 個航管單位(超過 12 個管制席位)，並總飛行 3800 公里，完成規劃之 24 種情境及 21 項 i4D 的測試。

C. 地對空的四維路徑傳輸：天津到廣州共經 42 個航點，試飛過程中每五分鐘穩定下載 EPP 資料(共收到 152 份回傳資料)。

(4) 雙機飛行測試

A. 計畫於 2022 年實施，自烏魯木齊機場至北京大興機場，經 3 區管中心(烏魯木齊、蘭州、北京)。

B. 驗測焦點將有三：地面系統、地空通信網絡及機載系統，並可分為四階段：(1) CPDLC, ADS-C；(2) EPP, ATFM, AMAN；(3) 狀況警覺與隔離、維修協助；(4) 航管與航空公司的協同作業。

(5) 未來展望：針對前述之 7 大元素，按飛行測試、大型展演、實際運作等三階段擬訂 TBO 導入策略，並計畫實施跨洲際的飛行測試。

## (二) 會議第二天 (11 月 9 日)

### 1. 小型研討會─飛航流量管理的現況與未來

**主講：飛航流量管理工作小組共同主席：Sugoon Fucharoen 先生(Aerothai)、Stuart Ratcliffe 先生(Metron 公司)、Fredrik Lindblom 先生(Saab 公司)**

**概要：飛航流量管理的發展在本區受到眾會員的相當重視，本研討會主要說明 CANSO 所發布的 ATFM 與 A-CDM 整合指引外，亦探討兩者間之關聯與整合及未來展望。**

(1) 飛航流量管理(ATFM)與機場協同決策(A-CDM)整合：

A. ATFM 簡介：ATFM 透過時間、流量、航路與飛航資料來呈現航情量可能發生的供需失衡情形。主要目的除提升航管效率以增加空域

使用並減少延誤外，亦能提升預測性與產業的國際互通性與環境永續性。目前主流的兩大型式為歐美地區的集中式流量管理中心與亞洲地區的多節點式流量管理(Distributed Multi-Nodal ATFM)。

B. A-CDM(Airport-CDM,簡稱 A-CDM)簡介：有別於飛航管理過往之「先到、先服務」，A-CDM 係以「提供最好的服務給最佳規劃方」為新觀念。A-CDM 以撤輪擋時間(Target Off-Block Time, TOBT)、許可開車目標時間(Target Start-up Approval Time, TSAT)為基準，並須各利害關係方之合作(包含飛航管制、機場營運者、航空公司、飛航流量管理、地勤單位等)共同優化使用資源、增進預劃能力以提升航班週轉率與機場運作效能。根據 Eurocontrol 2016 年的報告，A-CDM 除降低航空器滑行時間、減少油耗與二氧化碳排放外，亦改善整體延誤情形。

C. ATFM 與 A-CDM 整合與資訊交換：協同決策為推動 ATFM 的關鍵之一，確保在資訊共享的原則下，及時作出共同決策。CANSO 於 2020 年 10 月發布 ATFM 與 A-CDM 的整合指引，探討整合概念與所能達到的效益。此指引文件的重點在於說明兩者之間的三種資訊交換：(1) 傳遞 ATFM 流管作業方式(額定起飛時間 CTOT) ；(2) 從 ATFM 傳遞最新飛航資訊至 A-CDM；(3) 由 A-CDM 傳送起飛資訊至 ATFM(傳送至所有飛航路徑上的 ATFM Nodes，其間不同的 ATFM Nodes 可能會有不同的流量管理對策)。

(2) 長程 ATFM(Long-Range ATFM)：

A. 長程 ATFM 旨在將航空器於到場階段(Arrival Phase)所遭遇的延誤提前至航路階段(En-route Phase)中均攤吸收，以合理化分配整體延誤，以達減少油耗與二氧化碳排放之效，並提升整體作業效能。

B. 相對於短程 ATFM 所使用的額定起飛時間(CTOT)，長程 ATFM 係以額定過點時間限制(CTO)為基礎，CTO 時間需經過可行性計算後以建議的方式提供給航空器及航管單位參考來進行流量管理。給予 CTO時間的流管方式有別於主動積極進行速度控制，可降低跨飛航情報區的交接管複雜度。CTO時間提供予在空航空器後，除需評估

可能影響該值的諸多因素、並考量該航空器是否能達成外，亦應考量其他流量管理機制的同步執行狀況(如與 AMAN 的整合情形)，始可達到平衡航情容量與需求之功效。

(3) ATFM/A-CDM 於 SWIM：

A. 系統廣泛資訊管理(SWIM)：飛航服務業者與利害關係方協同合作的首要條件便是資訊的有效流通。飛航管理系統中的資訊多元繁雜，包括監視資料、航空情報、氣象資訊、飛航與流量與機場運作等，應能跨系統正確、即時地傳遞；SWIM 便是為達此目的之資訊交換管理服務架構。

B. ATFM 的資料交換主要透過航空固定通信網路(AFTN)或電子郵件(有些情況甚至透過電話或是傳真)，整體傳輸仍仰賴人工、手動方式傳送； CTOT 的更新更無自動化發送機制。故，這些資訊如能於 SWIM 中進行資料交換，不同系統間便能以自動化、更靈活的方式傳遞，紓解原需仰賴的人力與工作負擔，提高整體作業效率。

(4) 未來將 A-CDM 及 ATFM 設備作為託管服務的可能性

A. 託管服務(Managed Service)定義：以持續、週期性的主動管理方式來提供服務與支援(如購買定期授權和訂閱制服務)。隨著資訊與科技的發達，航空產業許多新議題亦可評估發展為託管式服務。

B. A-CDM 能透過託管方式以雲端提供服務與管理，便可以脫離外在硬體的框架與減少維護成本，並能因地制宜於不同規模之機場進行設計與導入。又，如將 ATFM 作為託管服務，小型飛航服務業者能精簡化導入成本以善用資源，在區域性發展上較易建立共通之狀況警覺、準確的需求預測，進而培養區域性與國際性視野。

C. 限制與阻饒：委外策略、網路安全等風險與保安因素、系統繁雜不一的介面、各飛航服務業者對資訊分享的意 願程度也不盡相同(線上即時投票結果 48%認為 ATFM 能夠以託管服務提供，48%則表示尚不確定)，故要推行託管式的 ATFM 實仍面臨許多挑戰。

## 2. 會員分享─香港進階機尾亂流隔離導入經驗

**主講：John Wagstaff 先生**

**概要：香港分享其進階機尾亂流隔離之驗證經驗，由機尾亂流傳統之四類改分七類之分類法；驗測後發現在特定機型之機尾亂流組合下可縮減航空器隔離，以提升整體作業效能。**

(1) 背景：

為改善香港機場運量趨近飽和情勢，香港民航處於 2017 年進行容量提升研究以探討短期內增進作業效能之方法；該研究發現，航空器於最後進場階段(Final Approach)的隔離(需考量航空器間之機尾亂流)仍有作業效率改善的空間。

(2) 簡介：

傳統機尾亂流隔離於四十多年前根據當時航空器最大起飛重量擬定而成，隨著時代變遷與科技發展，現今航空器已產生顯著之變化。歐美地區近年便展開研究、模擬與測試以探討現今航空器大小及重量如何影響機尾亂流。ICAO 也於 2020 年導入進階機尾亂流隔離(Enhanced Wake Turbulence Separation, 似於歐洲的機尾亂流重新分類 Re-categorization, "RECAT-EU"及美國 FAA 的"RECAT1.5" ，以下簡稱 eWTS)，按航空器相關指標與特性(如，最大起飛重量、翼展、產生翼尖渦流之特性與對亂流之抵抗性)將傳統之四類機尾亂流隔離改為七類，以期提升跑道使用效率與到場管制效能，並減少飛行時間及改善航空器離、到場時間的準確度，以因應疫情後的產業復甦。

(3) 研究發展：

資料蒐集包含一年份的航管系統監視資料、飛行紀錄器數據與航空器駕駛員之機尾亂流報告；並在香港天文臺的協助下結合最後進場階段光達(LIDAR) 感測的機尾亂流形成與消散情形。在香港民航處、機場單位、系統商與國泰航空等各方合作驗測分析並評估風險後，與 RECAT-EU 結論相符合，於 2020 年 11 月 5 日完成 eWTS 的導入。機尾亂流隔離分類修正如後：

| 附表一、ICAO 頒布之進階機尾亂流(eWTS)最低隔離 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **前機 \ 後機** | **A 類** | **B 類** | **C 類** | **D 類** | **E 類** | **F 類** | **G 類** |
| **A 類** | **-** | 4 浬 | 5 浬 | 5 浬 | 6 浬 | 6 浬 | 8 浬 |
| **B 類** | **-** | 3 浬 | 4 浬 | 4 浬 | 5 浬 | 5 浬 | 7 浬 |
| **C 類** | **-** | **-** | **-** | 3 浬 | 3.5 浬 | 3.5 浬 | 6 浬 |
| **D 類** | **-** | **-** | **-** | **-** | **-** | **-** | 4 浬 |
| **E 類** | **-** | **-** | **-** | **-** | **-** | **-** | 4 浬 |

(4) 導入：

A. 訓練：飛航管制員須提升速度控制的精準度、落地許可的及時頒發、保持到場航情接近的警覺性，並適時採取必要修正措施。

B. 對外宣導：eWTS 的效益要能全然彰顯，除精進飛航管制技巧外，更須仰賴航空器駕駛員的高度配合(包含確遵飛航管制員指示之進場速度、落地後盡快脫離跑道、減少跑道佔用時間等)，故對機場從業人員、航空公司等利害關係方亦須進行宣導與說明。

C. 成效：導入後飛航管制員能較精準、穩定控制航空器最後進場階段的隔離。另，航空器駕駛員報告於最後進場階段遭遇機尾亂流，或因遭遇機尾亂流而執行誤失進場(重飛)的情況皆未見增長。

## 3. 會議結論

本次網路工作會議共有 16 個飛航服務業者參與，逾 80 位成員的線上收聽，主席苗旋先生向講者致謝並讚賞本次會議交流收穫良多外，更期許飛航作業工作小組能持續作為會員間分享、溝通與互助之平臺。

# 肆、 心得與建議

## 一、 協同合作

CANSO 為跨國界之組織，為會員間交流飛航服務經驗之良好平臺。飛航服務作業除須以安全為基石，更應精益求精、透過與各方組織的共同合作以提高效率與服務品質。本次工作小組會議所討論之諸多議題與本區飛航服務作業與未來發展關係密切，透過參與 CANSO 會議可汲取其他會員之經驗，作為導入相關作業或技術之參考。

## 二、 持續參與 CANSO 國際會議

本次工作會議雖透過網路視訊舉辦，但未影響參與人員彼此之資訊分享，充分體現 CANSO 各會員們間的互助與交流精神。藉由主持人和各議題講者之簡報，得以瞭解 CANSO 對各項飛航服務議題的觀點外；更能探得亞太地區之趨勢脈動與未來發展，進而帶來新觀念。

建議本總臺未來持續參加飛航作業工作小組相關會議，保持靈敏度以長期耕耘各項議題，並持續掌握飛航服務之國際脈絡與亞太區域作業現況、蒐集相關訊息與新知，從中探討適宜本區之議題與技術，作為我方未來之參考與借鏡，以期能順應趨勢與潮流，提升飛航服務作業效益與飛航安全。

**(附錄)**

本次會議講者簡報資料如下：

1. CANSO Operations Standing Committee Overview
2. Discussion of Expectations, Approach and Work Programs for OWG
3. Mini-workshop: TBO Activities in China
4. Mini-workshop: the Frontier of ATFM and A-CDM
5. ANSP Sharing: Implementation of eWTS at Hong Kong International Airport

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# CANSO Operations Programme Overview

Presented to the APAC Ops Workgroup

**08 NOV 2021**

# CANSO Operations Programme

## Manager:

- Scott Leis
  - Former FAA:
    - AIM Specialist and VFR Chart Cartographer
    - Air Traffic Specialist for the Caribbean Region
    - Airspace and IFR Procedure Specialist
    - National Airport Data Collection Program Manager
  - Email Address: scott.leis@canso.org

# CANSO's work

**3** Work Programmes

- Safety
- Operations
- Strategy and Integration

**20** Workgroups

# Operations Programme Overview

## 11 Task Forces/Workgroups:

- Unmanned Aircraft Systems (UAS) Traffic Management Task Force (UTM TF)
- UAS and Emerging Technologies Workgroup (UAS/ET WG)
- System-Wide Implementation Management Workgroup (SWIM WG)
- Smart Digital Towers Task Force (SDT TF)
- Performance-Based Navigation Workgroup (PBN WG)
- Operational Performance Workgroup (OP WG)
- Environmental Workgroup (ENV WG)
- Data Link Implementation Task Force (DLI TF)
- CANSO ATFM Data Exchange Network for Cooperative Excellence Task Force (CADENCE TF)
- Air Traffic Flow Management/Airport-Collaborative Decision Making Workgroup (ATFM/A-CDM WG)
- Aeronautical Information Management Workgroup (AIM WG)

# UAS Traffic Management Task Force (UTM TF)

## Leadership:

- Co-Chair – Ms. Angela Kies
  - Head of the Unmanned Aircraft Systems program for DFS Deutsche Flugsicherung GmbH
- Co-Chair – Mr. Larry Ley
  - Senior Portfolio Manager, Airspace & Operational Efficiency for Boeing

## Related Guidance Material:

- ANSP Considerations for RPAS Operations
- 3-Part, Regional Focus Webinar on the Emergence of Remotely Piloted Aircraft Systems Integration, Benefits and Hazards in Africa
  - Located at myCANSO → Resources: https://canso.org/insight/regional-focus-emergence-of-remotely-piloted-aircraft-systems-integration-benefits-and-hazards/

## Results of 2021 TF Meetings:

- Agreed to provide input (such as Best Practices) to 2022 ICAO Drone Enable Event submitted on behalf of CANSO
- Look at UTM/ATM Integration Roles/ Responsibilities based on collaboration with RPAS/Emerging Technologies TF
- Lessons Learned – Need to meet at least twice/yr
- Increase use of CANSO Web and TF Portal to share and disseminate information
- Moving forward, increase focus on drone detection on and around airports
- Cost-recovery mechanisms for UTM services/UTM development from ANSP perspective

# UAS/Emerging Technologies Workgroup (UAS/ET WG)

## Leadership:

- Co-Chair – Mr. John Page
  - FAA – UAS Policy Team
- Co-Chair – Mr. Lance King
  - Northrop Grumman Corp.

## Related Guidance Material:

- ANSP Considerations for Unmanned Aircraft System (UAS) Operations
- 3-Part, Regional Focus Webinar on the Emergence of Remotely Piloted Aircraft Systems Integration, Benefits and Hazards in Africa
  - Located at myCANSO → Resources: https://canso.org/insight/regional-focus-emergence-of-remotely-piloted-aircraft-systems-integration-benefits-and-hazards/

## Results of 2021 WG Meetings:

- Updated TORs
- Updated Work Plan
- Developed approach to provide more information/guidance to ANSPs:
  - Updated UAS Training Packet
  - Developing plan for virtual UAS training session (In Progress)
  - Developed Regional Training Sessions
  - Updating ANSP considerations for UAS Operations Document (In Progress)
- Increased coordination with:
  - UTM TF
  - CANSO Safety Programme
  - CANSO Regional Directors

# System-Wide Implementation Management Workgroup (SWIM WG)

## Leadership:

- Co-Chair – Mr. David Leow
  - Head of ATM Software Engineering, CAAS
- Co-Chair – Mr. Mark Libant
  - Manager, Flight and ATM Services, Nav Canada
- Co-Chair Mr. Wayne Osse
  - Chief Architect, Global Aviation and Transportation, Solace

## Related Guidance Material:

- CANSO White Paper on System Wide Information Management (SWIM)

## Results of 2021 WG Meetings:

- SWIM Kit Concept Development
  - Outline has been developed
  - Must be digestible in size and scope (10-15 pages)
  - Objective is to provide ANSPs with the minimal information necessary to make decisions regarding the implementation of SWIM
  - Once in final draft form, the Kit will be validated by ANSPs including AirNav Indonesia
- Increased coordination with:
  - CANSO ATFM/A-CDM WG
  - CANSO AIM WG
  - ANSPs

# Smart Digital Towers Task Force (SDT TF)

## Leadership:

- Co-Chair – Ms. Elizabet Pavlova
  - Think Research Limited
- Co-Chair – Mr. Niclas Gustavsson
  - SAAB

## Related Guidance Material:

- CANSO Guidance Material for Remote and Digital Towers
- 3-Part, CANSO Academy Webinar Series on Remote Towers
  - Located at myCANSO → Resources: https://canso.org/insight/canso-academy-improving-efficiency-through-remote-and-digital-towers-part-3-2/

## Results of 2021 TF Meetings:

- Updating guidance material for remote and digital towers that was published in December 2020. Target date is June 2022.
  - Present new implementation use cases
  - Discuss new lessons learned
  - Introduce new technological advances and applications
  - Expand discussion on safety improvements to support controllers
  - New section on digital tower lifecycle
  - New section on environmental impacts
  - New section on change management and human factors

# Performance-Based Navigation Workgroup (PBN WG)

## Leadership:

- Co-Chair – Mr. Dieter Guenter
  - Senior Vice President, Aerospace, Tetra Tech AMT
- Co-Chair – Vacant
  - Formerly Mike Hornby from NATS UK. He is now on the CANSO Operations Steering Committee (OSC).

## Related Guidance Material:

- Use of PBN for Noise Management
- PBN for ANSPs: Concept 2030
- Performance-Based Navigation – Best Practice Guide for ANSPs

## Results of 2021 WG Meetings:

- Reviewed PBN implementations to identify new lessons learned
- Continue support for regional PBN projects
- Evaluate V-RNP development
- Renewed interest in application of various PBN navigation specifications – possible topic for new high-level guidance material
- Discussed Key Performance Indicators (KPIs) for PBN
  - Increase coordination with CANSO Operational Performance Workgroup (OP WG) to identify KPI for noise impact assessment
- Discussed Minimum Operational Network (MON) for NavAids
  - Agreement that MON planning will be the main task of this WG
  - Started development of CANSO Minimum Operating Network (MON) Document

# Operational Performance Workgroup (OP WG)

## Leadership:

- Chair – Mr. Valeriy Khavanov
  - Deputy Head of ASEC (Azeraeronavigation), Air Traffic Department, AZANS

## Related Guidance Material:

- Recommended KPIs for Measuring ANSP Operational Performance

## Results of 2021 WG Meetings:

- Completed an analysis of KPIs currently used in different regions
- Continued reviewing/identifying published KPIs relating to capacity, flight efficiency and predictability
- Released Report of Performance Metrics Survey to CANSO OSC
- Started to asses impact of other CANSO WGs on KPIs

# Environmental Workgroup (ENV WG)

## Leadership:

- Co-Chair – Mr. Pascal Hochstrasser
  - Skyguide
- Co-Chair – Mr. Paul Dunholter
  - Tetra Tech AMT

## Related Guidance Material:

- Measuring Environmental Operational Performance
- ANSP Carbon Footprinting: A Best Practice Guide
- Use of PBN for Noise Management

## Results of 2021 WG Meetings:

- Continued development of CANSO Environmental Accreditation Programme
  - Based on Standard of Excellence Model - focus is on measuring maturity of environmental management processes
  - Scope (i.e., enroute, terminal and surface movement ops, corporate governance, Flight Inspection and CNS infrastructure maintenance, facilities)
  - To be launched in 2022
- Continued Validation of Global Environmental Efficiency Goals
  - Identified Efficiency Studies
  - Reviewed and discussed uncertainty of past studies
  - Discussed Efficiency/Capacity Interrelations

# Data Link Implementation Task Force (DLI TF)

## Leadership:

- Chair – Ms. Lisa Bee
  - Director of Air Traffic Services, Inmarsat Aviation

## Results of 2021 TF Meetings:

- Developed a series of three (3) Data Link webinars that will be released in alignment with the 2nd Edition of the ICAO Global Operational Data Link (GOLD) Manual
- Developed a Data Link survey that was disseminated in August 2021
- Developed the CANSO Data Link Implementation Checklist
- 2022 Work Plan
  - Task 1: Assist ANSPs that have not yet implemented CPDLC and/or ADS-C
  - Task 2: Facilitate ANSPs in providing efficiency benefits through the use of data link
  - Task 3: Determine interest in and topics for regional webinars

# CANSO ATFM DATA EXCHANGE NETWORK FOR COOPERATIVE EXCELLANCE (CADENCE TF)

## Leadership:

- Co-Chair – Mr. Joe Hof
  - CGH Technologies
- Co-Chair – Ms. Midori Tanino
  - FAA, Air Traffic Organization (ATO)

## Existing Guidance Material:

- Regional Focus Webinar: Introducing the CADENCE Operational Information System in Africa
  - Located at myCANSO →Resouces: https://canso.org/insight/regional-focus-introducing-the-cadence-operational-information-system-in-africa/

## Results of 2021 TF Meetings:

- New TF, launched in March 2021
- Conducting outreach to regional and functional groups to inform them about the availability of CADENCE and the CADENCE Operational Information System (OIS) to support of ATFM/CDM needs
- TF will assist with regional deployment and development of associated procedures
- Conducted Regional Webinars
- Initiated support for CANSO Mombasa ATFM Implementation Plan in Africa

# ATFM/A-CDM Workgroup (ATFM/A-CDM WG)

## Leadership:

- Co-Chair – Mr. Sugoon (Kin) Fucharoen
  - Senior ATM Officer, AEROTHAI
- Co-Chair – Mr. Stuart Ratcliffe
  - Business Development Director, Specialist on ATFM/A-CDM, Metron Aviation
- Co-Chair – Mr. Fredrik Lindblom
  - Sales Director and ATM Specialist, SAAB ATM

## Related Guidance Material:

- CANSO Guide on ATFM/A-CDM Integration
- Guidelines on Airport-Collaborative Decision Making (A-CDM) Key Performance Measures
- Implementing Air Traffic Flow Management and Collaborative Decision Making
- Airport Collaborative Decision Making – Optimization through Collaboration

## Results of 2021 WG Meetings:

- Developing Long Range ATFM Concept
  - Q1, 2022 Target Pub Date
- Developing Case Studies Collection for Special Events Planning. Will include examples from:
  - Olympics
  - Air Shows
  - Military Exercises
  - World Cup
  - Multi-lateral Conferences
  - Large-Impact Weather
  - Industrial Actions
- Developed ATFM/A-CDM Work Plan
  - Main focus will be on finalizing the LR-ATFM Concept and Case Studies Collection
  - Determine desire for regional A-CDM webinars and begin development of those, if desired

# Aeronautical Information Management Workgroup (AIM WG)

## Leadership:

- Chair – Mr. Aleksandr Estrov
  - AZANS

## Related Existing Guidance Material:

- Aeronautical Information Management (AIM) Quality Management Development Guidance Material

## Results of 2021 WG Meetings:

- Membership experienced 100% turn-over in 2021
- Developed AIM WG Vision, which included:
  - Development of webinars for specific AIM needs
  - Development of KPIs for AIM
- Short term work plan
  - Review and update WG TOR
  - Discuss AIM implementation plans
  - Asked for status updates on AIM implementation from members
  - Facilitate group work by splitting into subgroups based on time zones
  - Identify co-chairs for subgroups
  - Identify ANSP regional AIM needs
  - Develop an action plan

# CANSO Outreach and Support Material

## Other CANSO Operational Guidance Material Not Previously Mentioned:

- Automation Interface Between Flight Information Regions: Best Practice Guide for ANSPs
- Best Practice Guide for Crossing Flight Information Region Boundaries
- ANSP Guidelines for Implementing ATS Surveillance Services Using Space Based ADS-B
- CANSO Emergency Response Planning Guide (Safety)
- Many other Safety related publications
- Many Strategy and Integration related publications

**All CANSO Publications are available at:**
https://canso.org/publications/

## CANSO Webinars and Presentations:

- Search for “CANSOcomms” on YouTube
- Or look under “Resources/Videos” on myCANSO

# QUESTIONS AND ANSWERS

# THANK YOU

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# Expectations and Approach for CANSO Asia Pacific Ops Work Group

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# WHY – NEEDS

- Challenges:
  - ANS EI for ICAO USOAP 67.5%
  - Under investment in future capabilities

- Opportunities:
  - COVID a burning platform
  - Experienced CANSO Asia Pac members
  - Digitalisation offers economic tech solutions

# HOW – OBJECTIVES

- Help Members:
  - Strengthen fundamentals
  - Build future ready capabilities

- OWG can:
  - Share experiences and best practices
  - Coordinate regional ATM initiatives
  - Experiment with new ideas, including conducting simulation and trials
  - Work together on vendor solutions

- Past successes: ADS-B sharing and ATFM

# HOW – PROCESS

- Frequency: Currently, meeting twice a year – potentially can have more virtual meetings for specific topics

- Membership size: Previously, for regular OWG members.  But we have different expertise and discussion topics are varied.  Can have different subject matter experts attend

- Interactive – ask “stupid” questions

- OWG should aim to go beyond sharing: e.g. demonstrators and simulation exercises.  Can involve ATM research laboratories or experimentation centres

# WHAT – AREAS OF FOCUS (1/3)

- Creating a blueprint for future skies:
  - Discuss how UTM and ATM can converge or do a demonstrator or simulation
  - Exchange views on FUA or space launch ops
  - Share on use of airspace design validation tools

# WHAT – AREAS OF FOCUS (2/3)

- Delivering a sustained future for aviation:
  - Exchange views on fuel saving measures
  - Exchange views on UPR and FRA
  - Implement CANSO ANS environment accreditation scheme

# WHAT – AREAS OF FOCUS (3/3)

- Raising the bar by connecting the ATM industry:
  - Share experience on fundamentals including system upgrading, renewal
  - Coordinate and assist on existing ATM development, e.g. ATFM, integration of AMAN, DMAN, XMAN, SMAN
  - Get companies to share on latest in digitalisation trends
  - Conduct simulations or trials on next generation ATM capabilities, e.g. SWIM, FF-ICE, TBO

# RESULTS

- No Members left behind - Timely realisation of ATM capabilities and innovations

- Tangible products:
    - Simulation and trial results
    - Assistance for Members including suggestions for vendor solutions

- Reports and briefings to APC3

- Contributions at ICAO - share our work

CANSO

SHAPING OUR FUTURE SKIES

# Updates of TBO Activities in China

Air Traffic Management Bureau . CAAC

Kang Nan

November 4, 2021

# Outline

1 Background

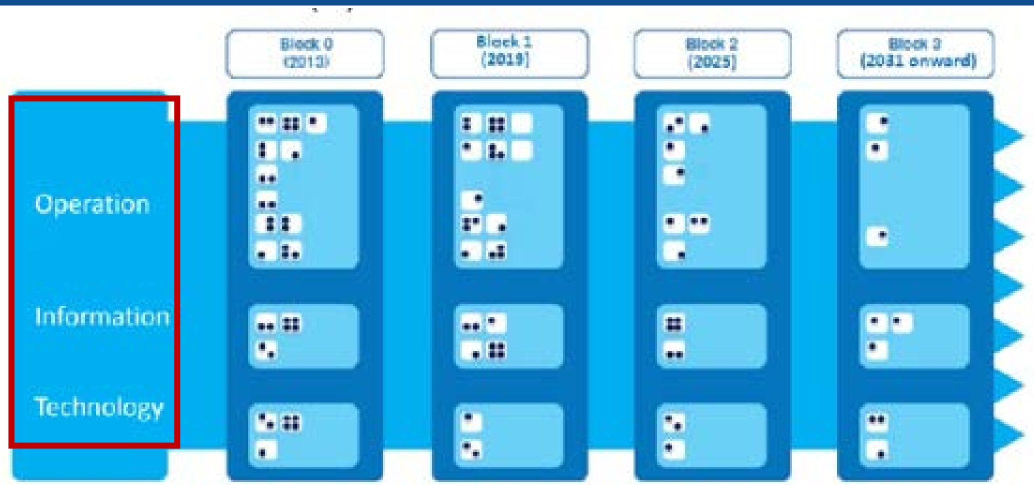
2 TBO Activities of CAAC

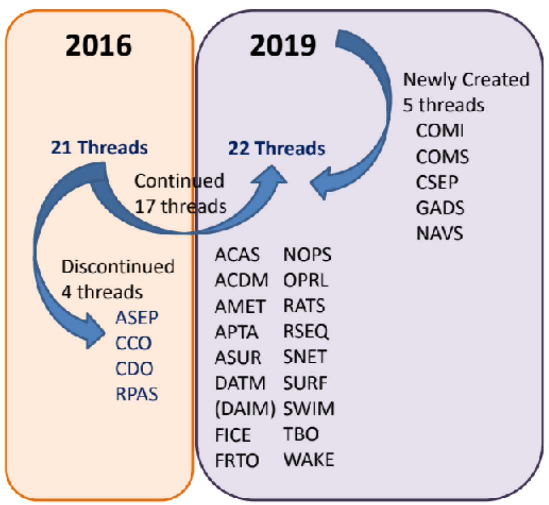
3 Next Step

# I Background

# ICAO GANP ASBUs(2019)
# The 6th ASBU Structure Evolution

- **ICAO AN-Conf/12 (2018.11)**
  - Revise new vision ASBU
- **Vital Structure Adjustment of ASBU**
  - **5th ASBU:** Blocks, Threads, Modules , Performance Improvement Areas (PIA)
  - **6th ASBU:** Blocks, Threads, Modules, Elements
- **Represent the PIA and thread in form of function type instead of KPI**
  - **Operation , Information, Technology**




PIA and Thread Changes

**The 6th Ed (2019)**
No concept of PIA
However 3 groups
(1) Operation
– 14 threads
(2) Information
– 4 threads
(3) Technology
– 4 threads

# ICAO GANP ASBUs(2019)
# The 6th ASBU Structure Evolution

- **The threads of the 6th ASBU is defined explicitly for function.**
  - **14 threads for operation; 4 threads for information; 4 threads for technology**
  - **The TBO thread has been updated based on TBO concept and as an integral concept, with its elements coming from the operational threads. The communication elements of the previous TBO thread are now in the COMS thread.**

### ASBU Operational Threads

- ACAS - Airborne collision avoidance system
- ACDM - Airport collaborative decision making
- APTA - Improve arrival and departure operations
- ASEP - Airborne separation
- FRTO - Improved operations through enhanced en-route trajectories
- GADS - Global aeronautical distress and safety systems
- NOPS - Network operations
- OPEL - Improved access to optimum flight levels in oceanic and remote airspace
- RATS - Remote aerodrome air traffic services
- RSEQ - Improved traffic flow through runway sequencing
- SNET - Ground-based safety nets
- SURF - Surface operations
- TBO - Trajectory-based operations
- WAKE - Wake turbulence separation

### ASBU Enabler Threads

- AMET - Meteorological information
- DAIM - Digital Aeronautical Information Management
- FICE - Flight & flow information for a collaborative environment
- SWIM - System wide information management

### ASBU Network / Infrastructure Threads

- ASUR - Surveillance Systems
- COMI - Communication Infrastructure
- COMS - ATS Communication systems
- NAVS - Navigation systems

# ICAO GANP ASBUs(2019)

## ASBU Trajectory-Based Operations (TBO) Thread

| TBO | Trajectory-based operations | Operational |
|---|---|---|

### CONCEPT OF OPERATIONS BY BLOCK

| Block | Description |
|---|---|
| Block 0 | Introduction of time-based management within a flow centric approach. |
| Block 1 | Initial Integration of time-based decision making processes. |
| Block 2 | Pre-departure trajectory synchronization within a flight centric and network performance approach. |
| | Extended time-based management across multiple FIRs for active flight synchronization. |
| Block 3 | Network performance on demand synchronization of trajectory-based operations. |
| Block 4 | Total airspace management performance system. |

### ELEMENTS

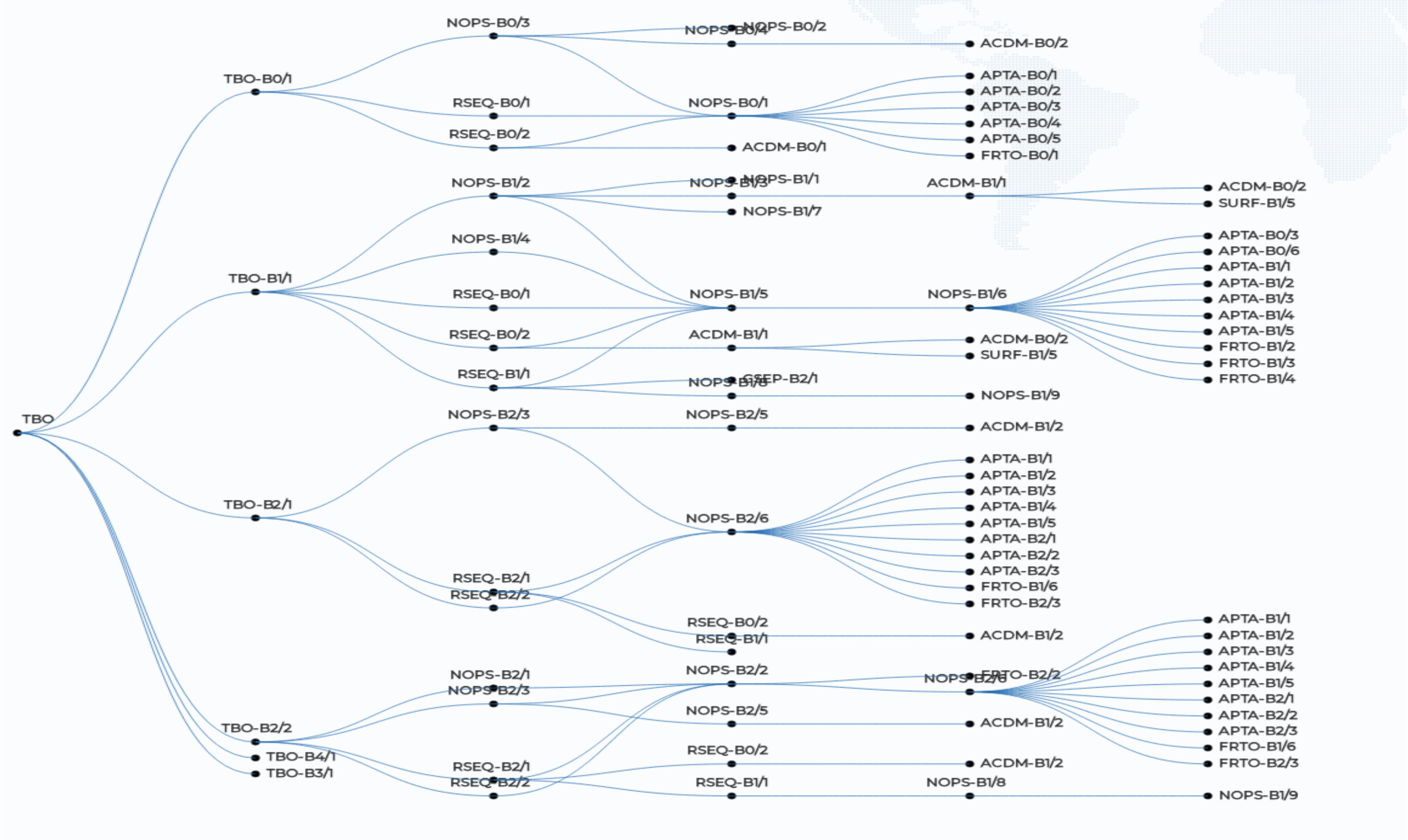
| Element ID | Title |
|---|---|
| TBO-B0/1 | Introduction of time-based management within a flow centric approach. |
| TBO-B1/1 | Initial Integration of time-based decision making processes |
| TBO-B2/1 | Pre-departure trajectory synchronization within a flight centric and network performance approach |
| TBO-B2/2 | Extended time-based management across multiple FIRs for active flight synchronization |
| TBO-B3/1 | Network based on-demand synchronization of trajectory based operations |
| TBO-B4/1 | Total airspace management performance system |

- **TBO thread Concept of Operation in ASBU**
- **TBO thread elements in ASBU**

# ICAO GANP ASBUs(2019)

## ASBU Trajectory-Based Operations (TBO) Thread

- **TBO thread**
  - **An integrated concept**
  - **Originated from the operational threads**
  - **Ultimate goal for threads in ASBU**



# 2 TBO Activities of CAAC

2.1 I4D Flight Trial

2.2 TBO Concept in China

2.3 Flight Trial with 2 A/C

# Initial 4D Flight Trial

## High Attention paid by CAAC

- 2015：The project of I4D Flight Trial is launched, funded by MOST
- 2017: A TBO Taskforce is set up
- 2019: The I4D project is listed as the annual focal task

民航空管明传电报

发往 见报头　　签发人 马 兵

等级 加急　　民航空发明电〔2017〕669 号

关于开展基于航迹运行研究与论证工作的通知

各地区空管局：

基于航迹的运行（TBO）是下一代空管运行的核心运行概念，也是国际民航组织航空系统组块升级（ASBU）实现的关键目标。欧美各国已陆续开展初始四维航迹（i4D）运行的试验验证。国际民航组织空中交通管理需求和绩效专家组（ATMRPP）近期将发布TBO运行概念手册，指导TBO的全球应用与推广。TBO运行概念的验证、实现与应用是一项覆盖面广、实施周期长、技术综合性强的复杂系统工程，不仅涉及飞行计划、流量管理系统、管制自动化系统、数据链系统以及机载航空电子系统等各类系统设备的升级与改造，更涉及到管制运行流程、流量管理策略方法、飞行与流量信息标准等的更新与应用。为把握国际民航空管的发展趋势，引领空管运行新

承办单位：空管部　联系人：丁磊　电话：01087786818　（共9页）

民航局空中交通管理局文件

民航空局发〔2019〕15 号

关于印发 2019 年民航空管系统工作会议暨安全工作会议文件的通知

各地区空管局，局机关各部门，各直属单位：

2019 年民航空管系统工作会议暨安全工作会议已于 1 月 10 日至 11 日在北京召开。会上，车进军局长作了题为《以"四强空管"建设为统领，努力开创民航空管系统高质量发展新局面》的工作报告，马兵副局长作了题为《始终把安全作为头等大事来抓，牢牢把握空管安全工作主动权》的安全工作报告。现将两个报告印发给你们，请结合本单位（部门）实际，认真学习领会、抓好贯彻落实，确保 2019 年全年工作任务顺利完成。

民航局空管局

2019 年 1 月 21 日

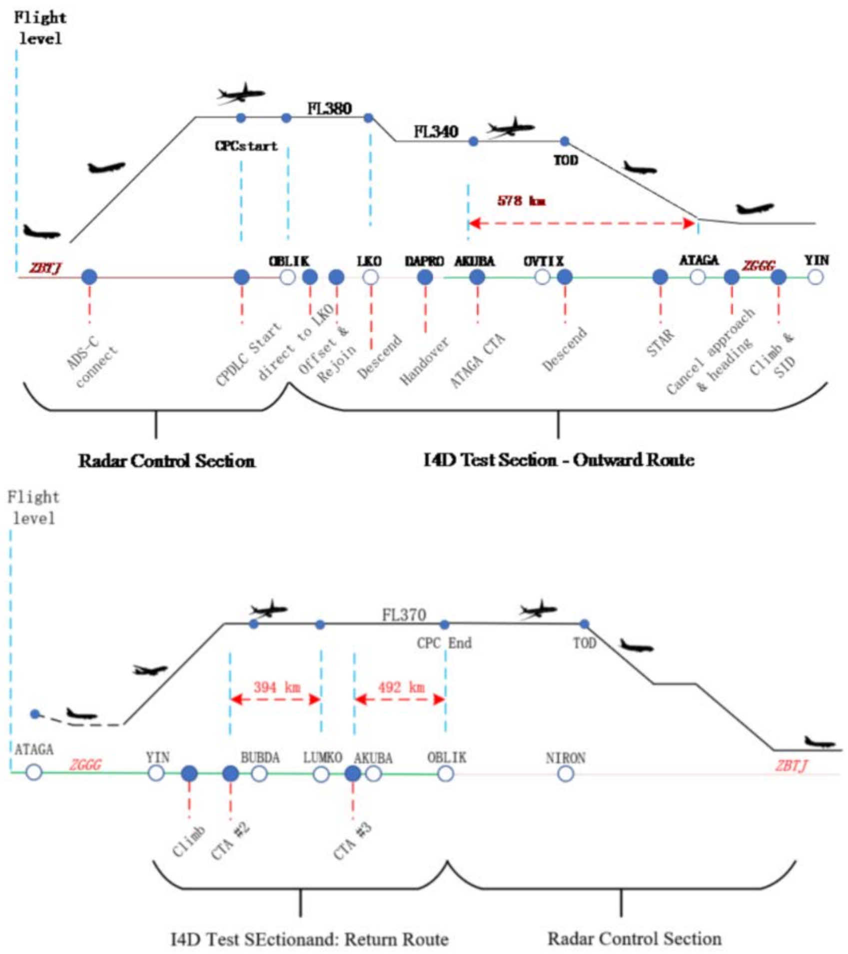
— 1 —

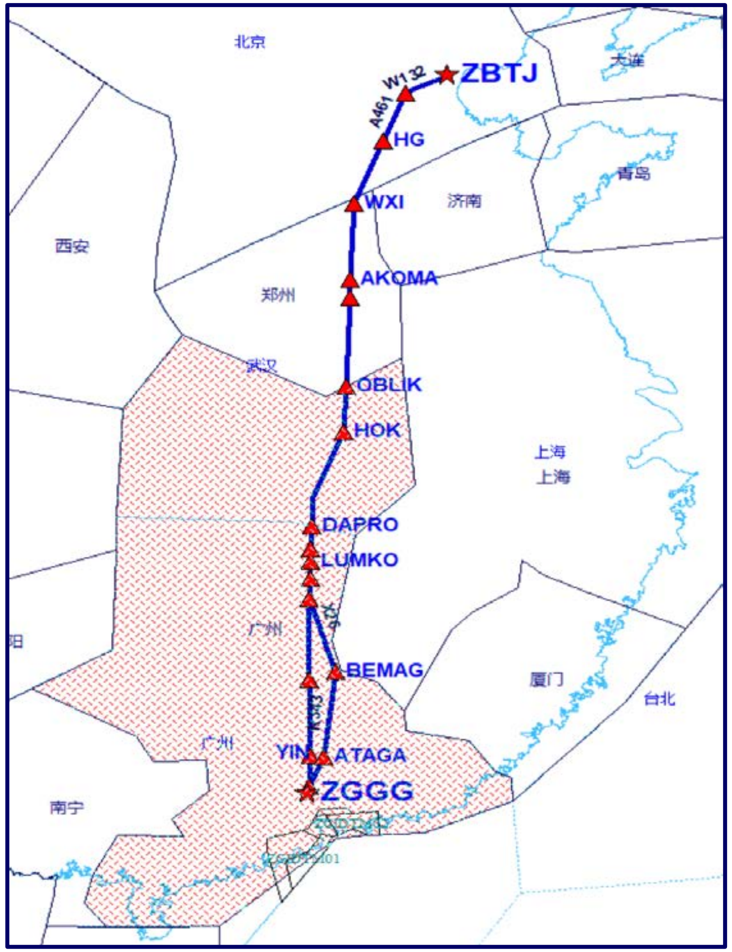
# Initial 4D Flight Trial

## Flight Trial Scenario

- **Test Date： 2019.03.20**
- **Test Scenario：**
  - Route: Tianjin-Guangzhou
  - Area: Guangzhou ACC & APP
- **Test Items：**

  **CPDLC/ADS-C**
  - CTA
  - EPP
- **Test Mode**
  - Shadow Mode / I4D

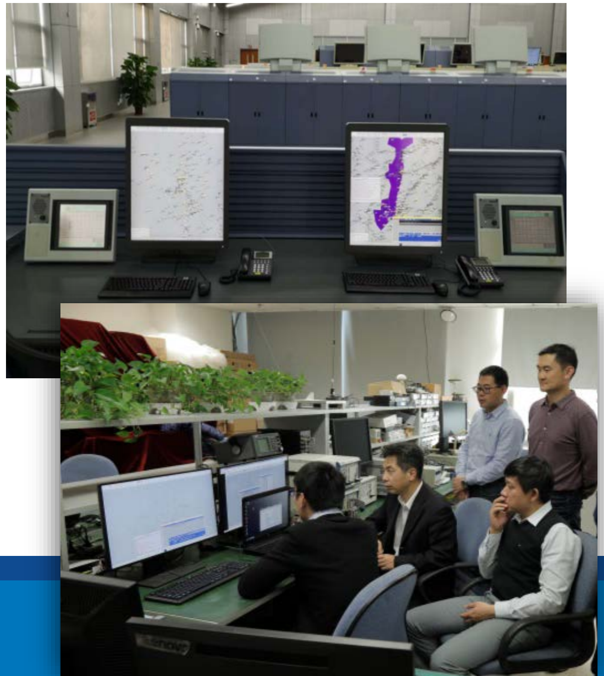


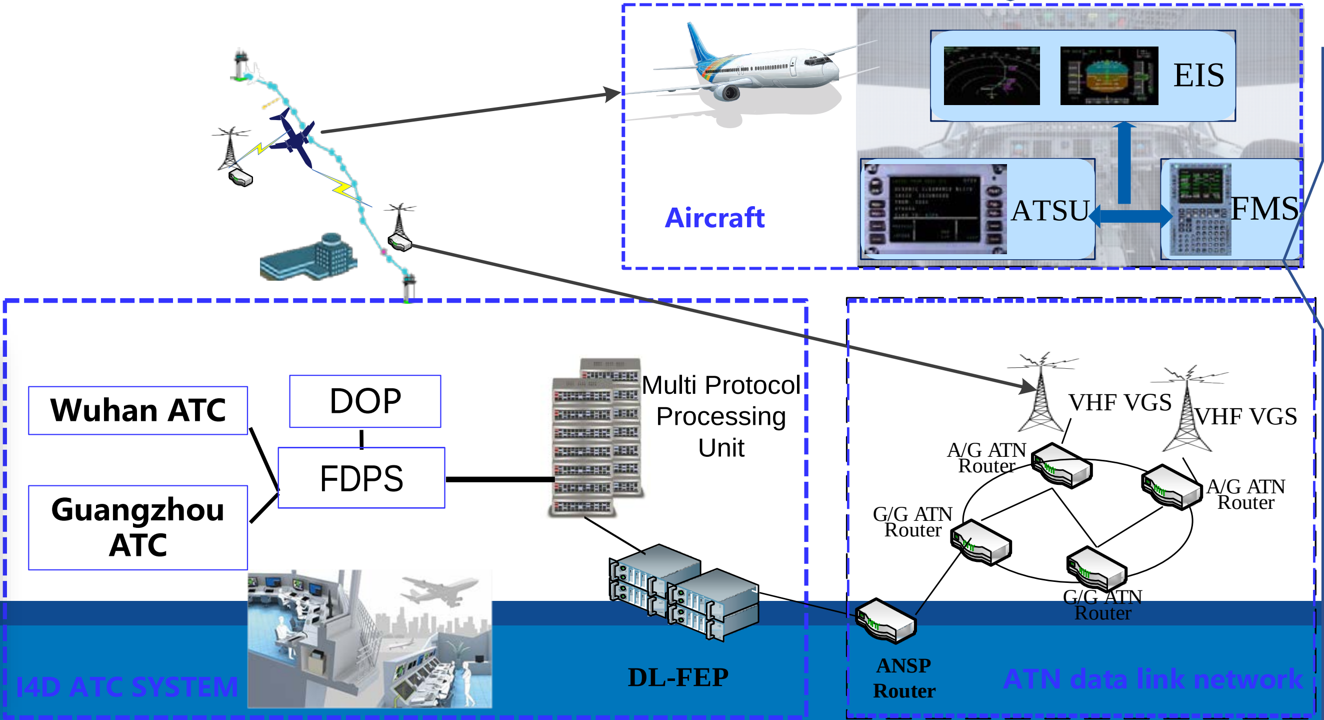



# Initial 4D Flight Trial

## I4D Test Systems

- **Test aircraft with I4D avionics**
- **I4D ATC automation system**
- **VDL M2 + ATN (Baseline 2)**

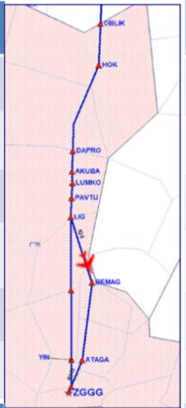


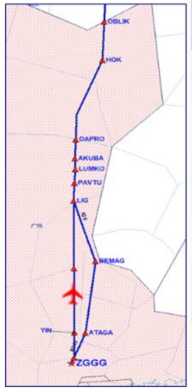



# Initial 4D Flight Trial

## Test Procedures

- 6 ATC units, more than 12 control sectors, a total mileage of more than 3,800 kilometers
- 24 test scenarios predefined
- 21 I4D instructions tested, covering ADS-C EPP reports, CPDLC communication, and CTA operation.

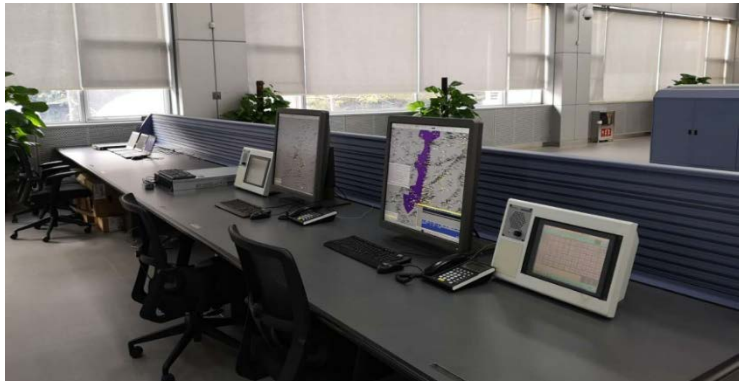





| 序号 | 飞行阶段 | 雷达管制席操作 | I4D测试席操作 | 机组操作 |
|---|---|---|---|---|
| 1 | ZBTJ→OBLIK | 北京管制中心正常管制指挥 | 武汉测试席：航空器开车后建立ADS-C连接，持续监视EPP | 确认ADS-C连接 |
| 2 | 过OBLIK | 武汉高扇1：管制移交，8400米进入 | 武汉测试席：建立CPDLC连接，建立ADS Event合同 | Cm logon，请求建立CPDLC连接 |
| 3 | OBLIK→HOK | 武汉高扇1：右偏置5NM | 武汉测试席：发送偏置指令 | 回复确认WILCO |
| 4 | HOK→LKO→DAPRO | 武汉高扇2：管制移交，直飞DAPRO，爬升至9800米 | 武汉测试席：发送直飞指令、爬升指令 | 回复确认WILCO |
| 5 | 过DAPRO前3min | 广州高扇1：管制移交，保持9800米 | 广州测试席：与武汉完成管制移交 | |
| 6 | DAPRO→AKUBA | 广州高扇1：ATAGA进场点RTA协商 | 广州测试席：获取航空器ETA窗口；获取RTA时刻 | 自动发送ETA窗口，回复RTA是否可达 |
| 7 | 过AKUBA | 广州高扇1：确认ATAGA点的RTA生效；指挥避让 | 广州测试席：确认ATAGA点的RTA生效 | |
| 8 | 过LIG点 | 广州高扇2：管制移交，保持9800米 | 广州测试席：持续监视EPP | |
| 9 | LIG→BEMAG | 广州高扇3：管制移交，保持9800米 | 广州测试席：持续监视EPP | |
| 10 | BEMAG→ATAGA | 广州高扇3：与广州进近进行管制移交，下降至4200米 | 广州测试席：持续监视EPP | 接收广州进近话音频率信息 |
| 11 | 过ATAGA前5min | 广州进近：发布标准进港程序 | 广州测试席：发送进港程序的指令，监视实际过点时刻 | 回复确认WILCO |
| 12 | ATAGA→FAF | 广州进近：指挥进港，雷达引导切盲降，飞至FAF终止进近 | 广州测试席：发布盲降许可、发布复飞许可 | 回复确认WILCO |
| 13 | FAF→YIN | 广州进近：正常指挥上升高度飞向YIN | 广州测试席：监视EPP更新数据 | |
| 14 | 过YIN点 | 广州高扇5：与进近管制移交 | 广州测试席：保持ADS-CCPDLC连接 | |
| 15 | YIN→BUBDA | 广州高扇5：指挥爬升至9500米，右偏置3nm | 广州测试席：发送爬升、偏置指令 | 回复确认WILCO |
| 16 | 过BUBDA | 广州高扇2：管制移交，保持9500米 | 广州测试席：监视EPP更新数据 | |
| 17 | BUBDA→P113 | 广州高扇2：HOK点RTA协商 | 广州测试席：获取航空器ETA窗口；获取RTA时刻 | 自动发送ETA窗口，回复RTA是否可达 |
| 18 | 过P113 | 广州高扇2：确认HKO点的RTA生效，指挥避让 | 广州测试席：确认HKO点的RTA生效 | |
| 19 | 过LIG点 | 广州高扇1：管制移交，保持8900米 | 广州测试席：监视EPP更新数据 | |
| 20 | LIG→DARPO | 广州高扇1：指挥周边航空器避让 | 广州测试席：监视EPP更新数据 | |
| 21 | 过DARPO前3min | 武汉高扇2：广州高扇1管制移交，指挥周边航空器避让 | 武汉测试席：与广州进行管制移交，发送移交指令 | |
| 22 | DARPO→HOK | 武汉高扇1：与武汉高扇2管制移交 | 武汉测试席：监视EPP更新数据，监视过HOK时刻 | |
| 23 | HKO→OBLIK | 武汉高扇1：正常管制指挥，准备移交 | 武汉测试席：监视EPP数据，过OBLIK断开CPDLC连接 | |
| 24 | OBLIK→ZBTJ | 北京管制中心：正常雷达管制指挥 | 武汉测试席：监视EPP更新数据 | |

# Initial 4D Flight Trial

## A great success



I4D Control Position In Guangzhou Control Center

Flight Trial Control

Flight Crew on Test Aircraft

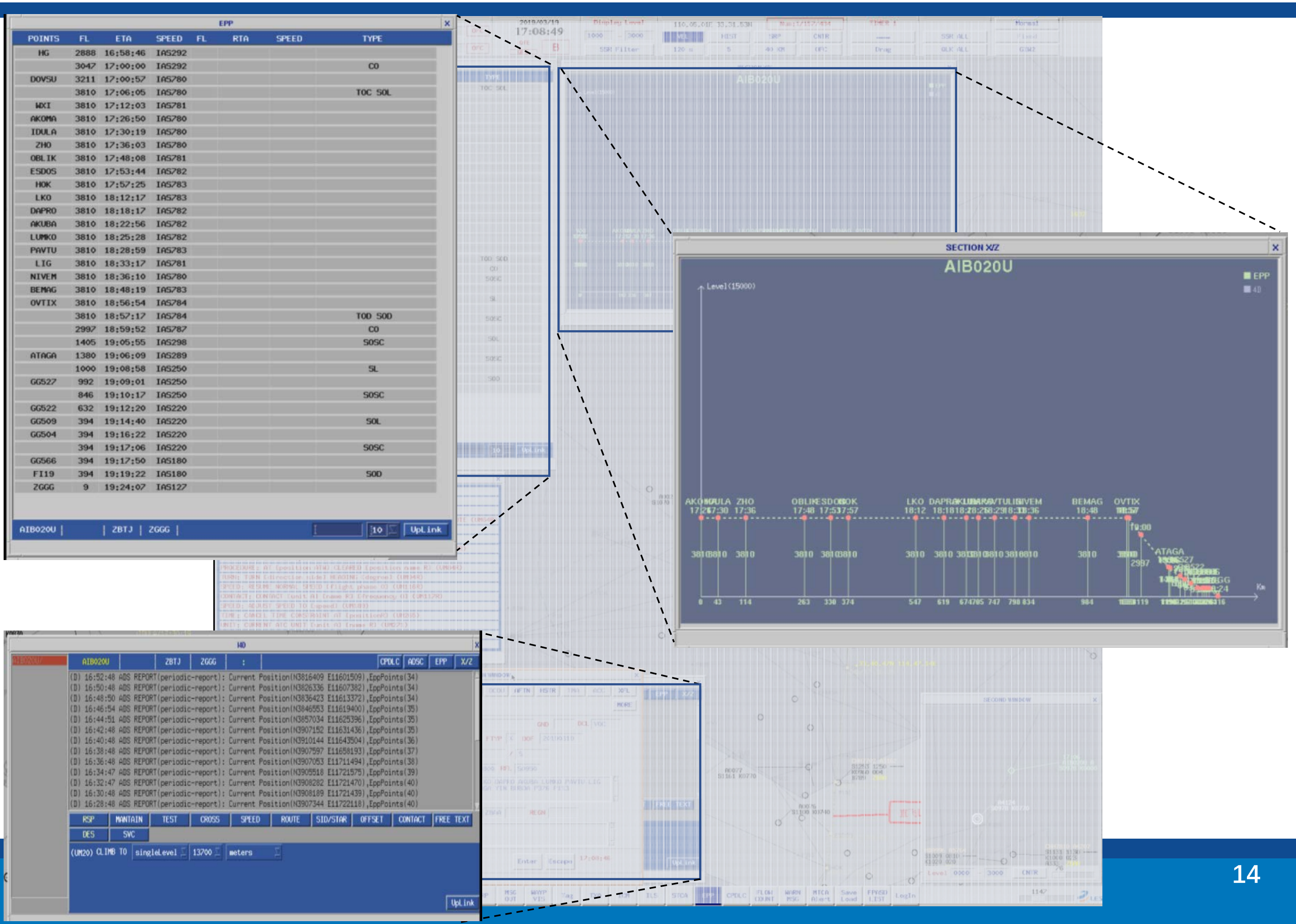

A320 Test Aircraft/ A320

# I4D Flight Trial Conclusions

## Air-ground 4DT sharing

- **42 waypoints from ZBTJ to ZGGG. The EPP data covered all items of future 4D trajectory.**

- **The aircraft downloads EPP data per 5 minutes , data quality is stable**

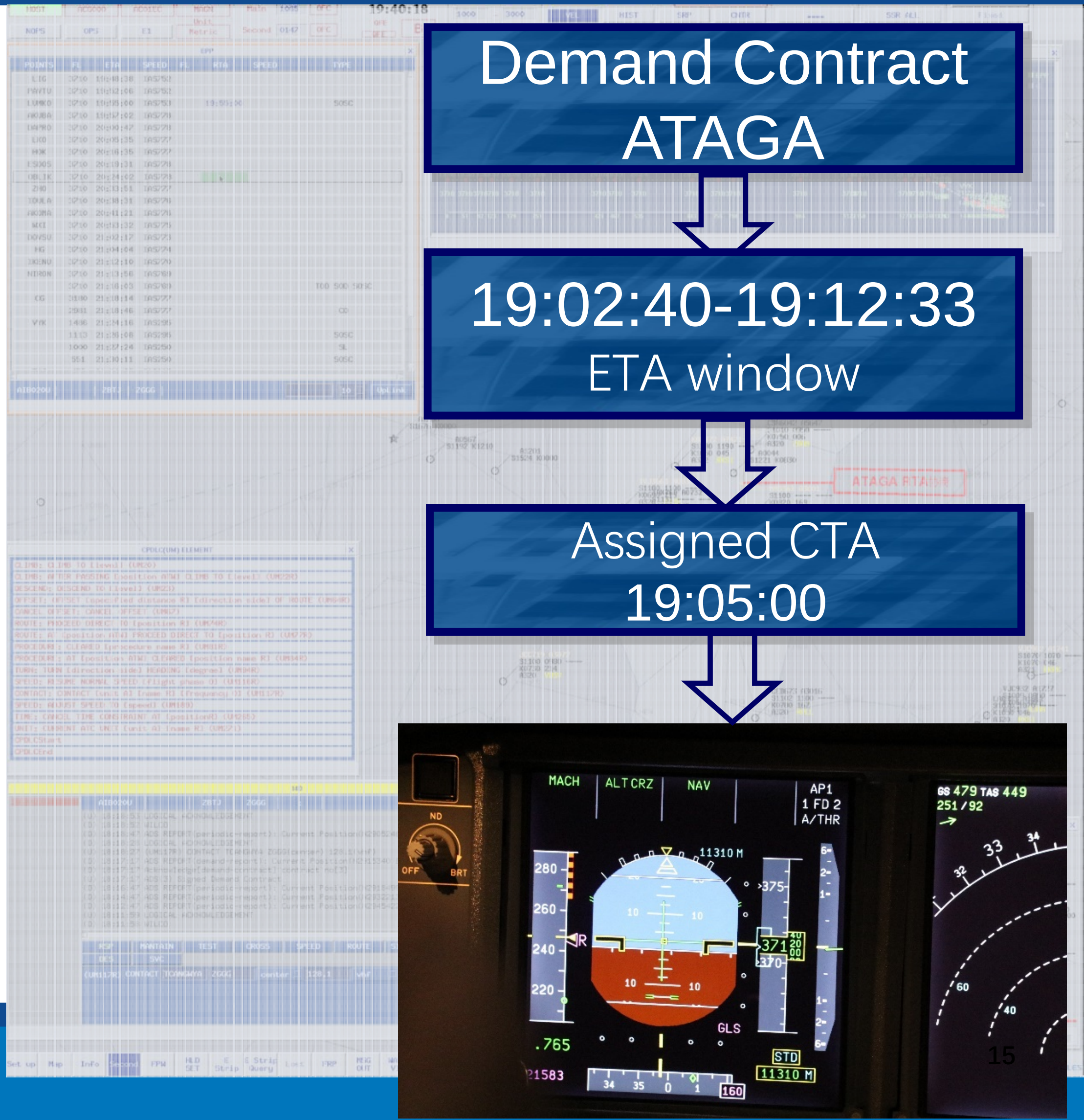


# I4D Flight Trial Conclusions

Air-ground trajectory negotiation

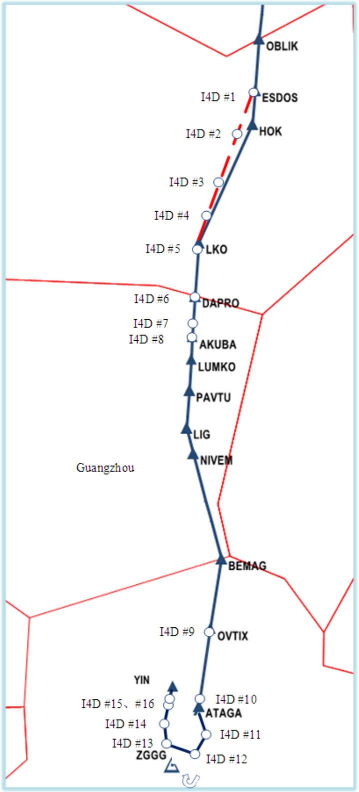
- **Obtained the ETA windows of ATAGA, LUMKO, OBLIK**
- **Uploaded CTA time from ATC for real-time trajectory negotiation**

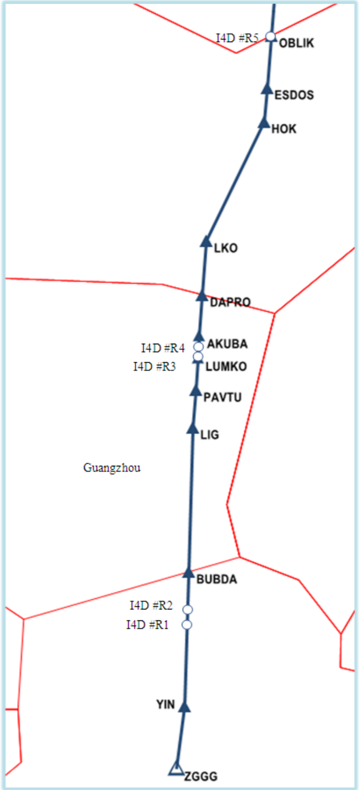
| Leg | RTA negotiation | | |
|---|---|---|---|
| | **Type** | **Metering Fix** | **Affiliation** |
| 1 | Enter TMA | ATAGA | Guangzhou TMA |
| 2 | Inside ENR | LUMKO | Guangzhou ENR |
| 2 | Transfer | OBLIK | Guangzhou ENR |



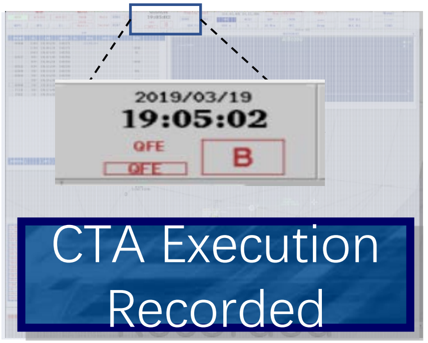
# I4D Flight Trial Conclusions

## Aircraft on-time arrival








| CTA Fix | CTA Execution (UTC 20th March) | | | | | |
|---|---|---|---|---|---|---|
| | *CTA Issued Distance to Fix* | *ETA window* | *CTA/ tolerance* | *Response Time to set CTA* | *Pilot Record* | *Radar Monitor* |
| ATAGA | 578km | 3:02:43-3:12:02 | 3:05:00 (10s) | 48s | +2s | -5s |
| LUMKO | 394km | 3:54:19-3:56:26 | 3:55:00 (10s) | 15s | 0s | -1s |
| OBLIK | 492km | 4:24:08-4:26:59 | 4:25:00 (10s) | 33s | +1s | -4s |

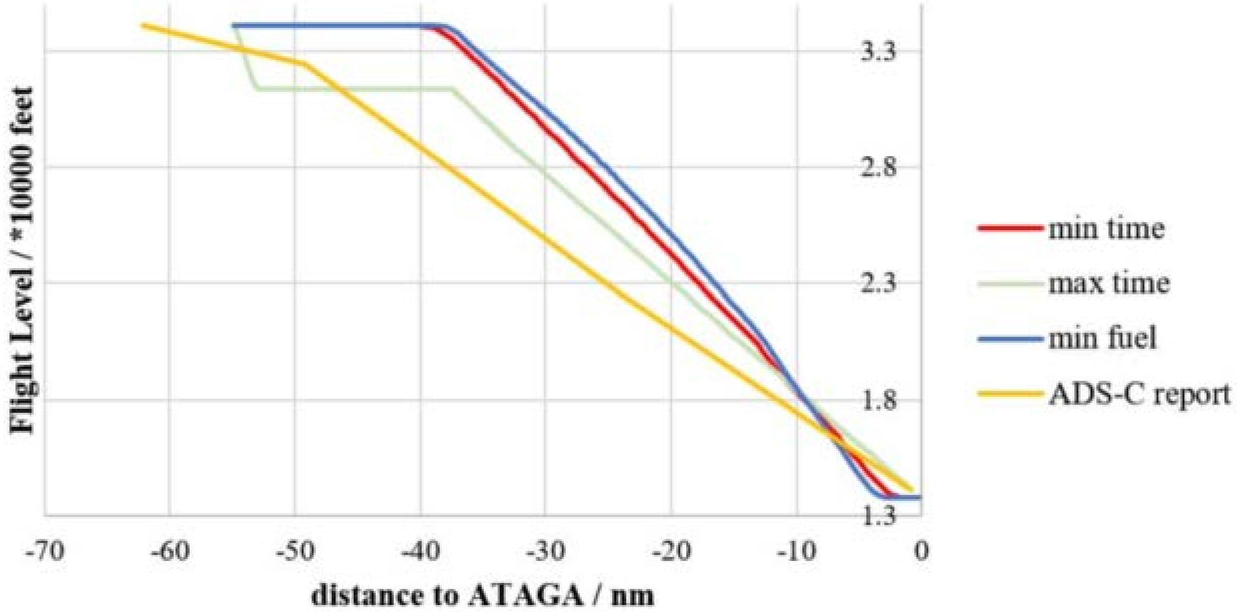
# I4D Flight Trial Conclusions

## Time consuming of the trial

- **The altitude profile comparisons of three optimal CDO trajectories under the approach scenario of trial.**

- **Regardless of the impact of wind and temperature, the trial time complies with the simulated window and validates the TOD information.**

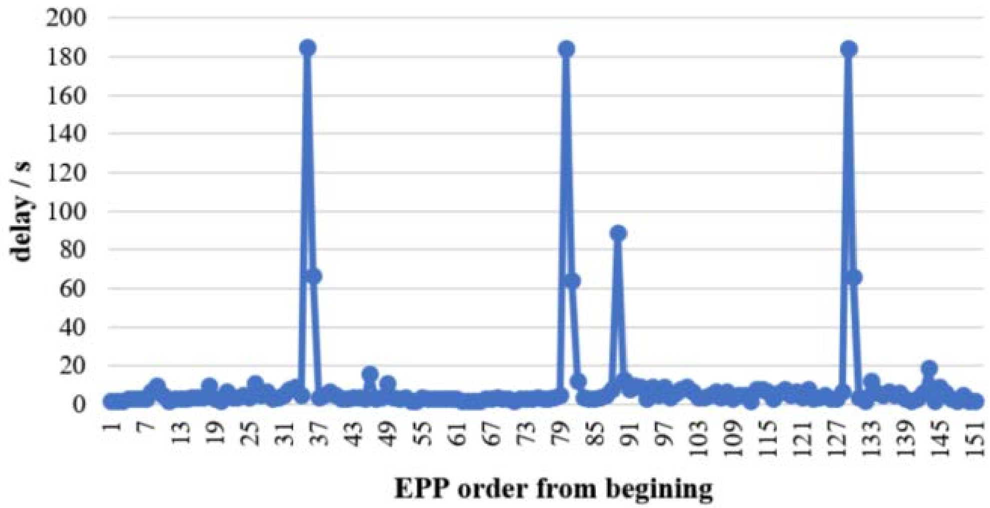
| Time Consuming | | | |
|---|---|---|---|
| *Trial.* | *Min Time* | *Max Time* | *Min fuel* |
| 544s | 502.5s | 555.4s | 504.7s |

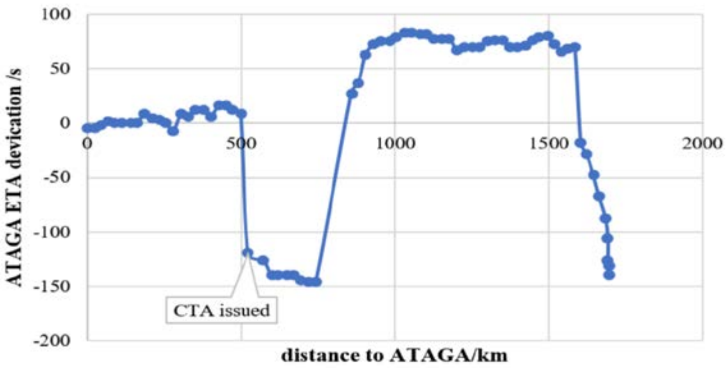


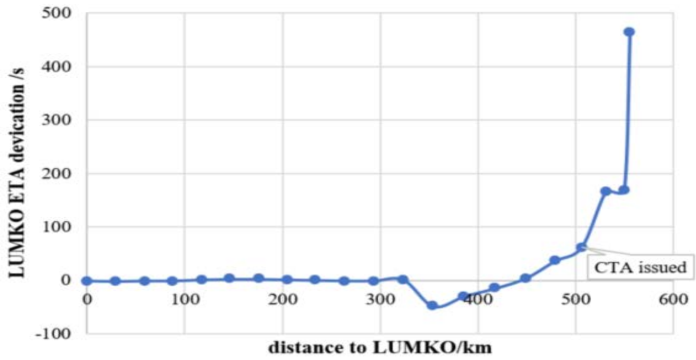
# I4D Flight Trial Conclusions

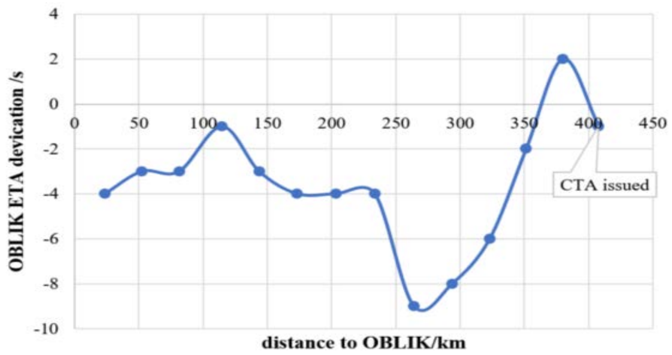
## EPP Performance

- 152 EPP reports were successfully received during nearly 5 hours test flight
- The ETA changes with instructions issued during the progress off light.
- There were 4 periods with high latency , and the ADS-C EPP delay reflected in VDLM2 log.



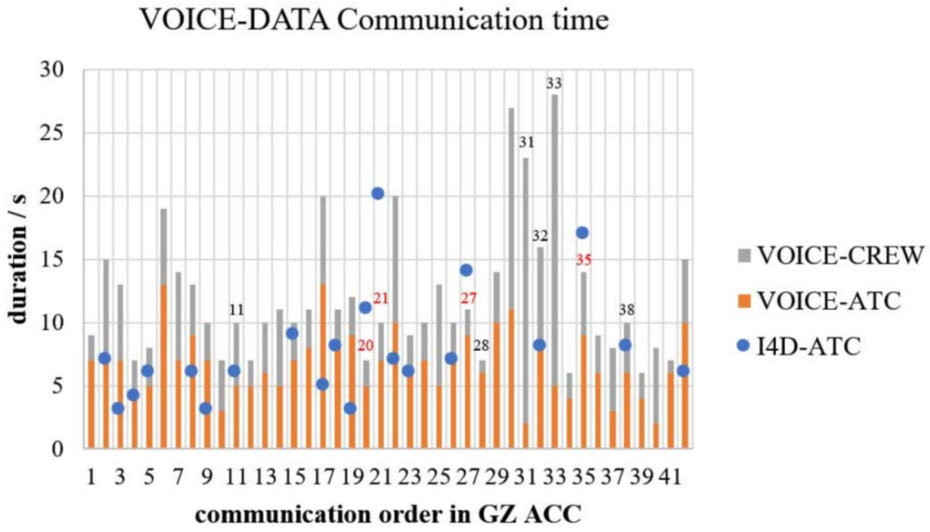



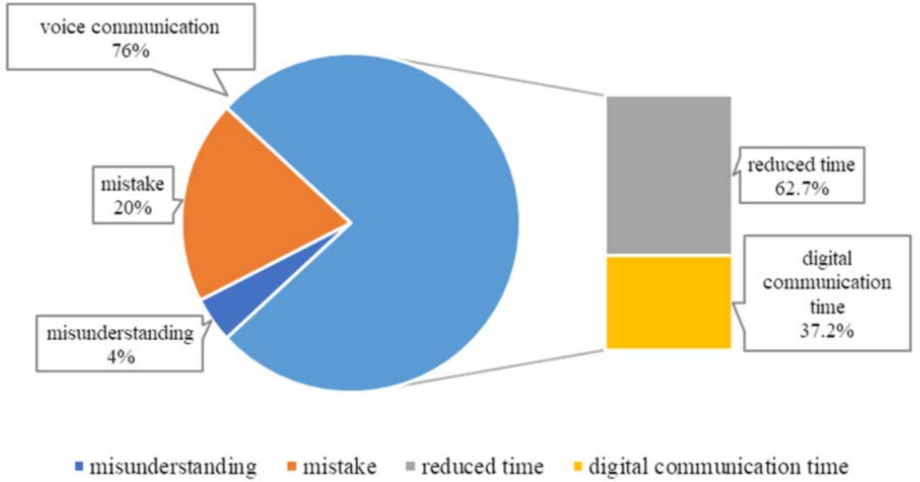



# I4D Flight Trial Conclusions

## CPDLC Service Performance

- 152 EPP reports were successfully received during nearly 5 hours test flight
- The ETA changes with instructions issued during the progress off light.
- There were 4 periods with high latency, and the ADS-C EPP delay reflected in VDLM2 log.



2

# TBO Activities of CAAC

2.1 I4D Flight Trial

2.2 TBO Concept in China

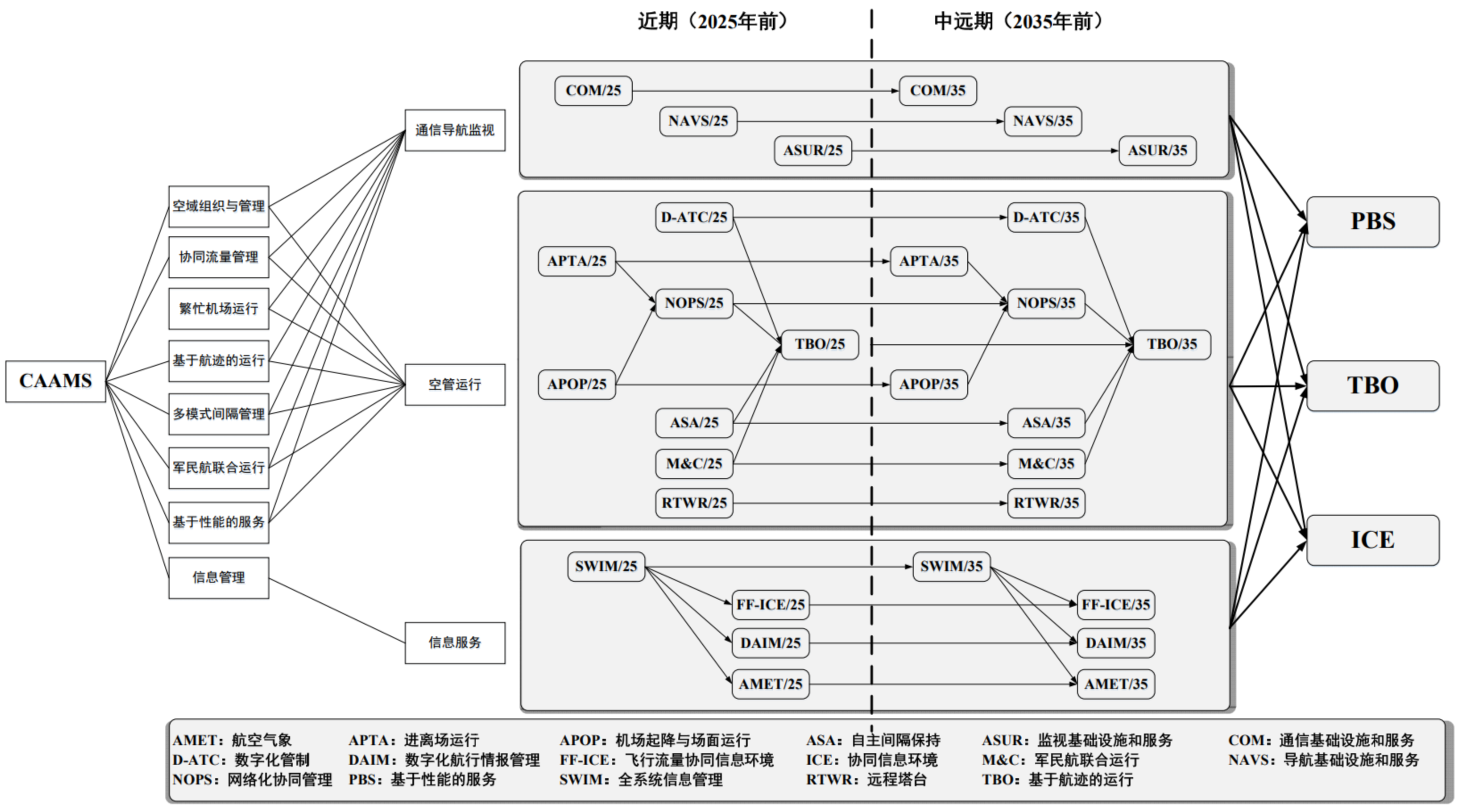
2.3 Flight Trial with 2 A/C

# CAAC ATMB TBO Concept

## CAAC TBO Concept in CAAMS

**To promote comprehensive application of TBO is one of the vital tasks in CAAMS:**

- **Plan to 2025: small-scale test and verification of TBO**
- **Plan from 2025 to 2035: Construction of FF-ICE, TBO environment covering all systems involving ATFM, AOC, A-CDM and etc.**




图：CAAMS 关键技术发展脉络

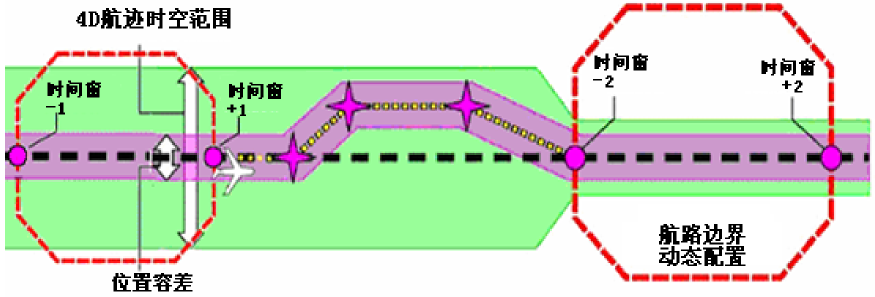
# CAAC ATMB TBO Concept

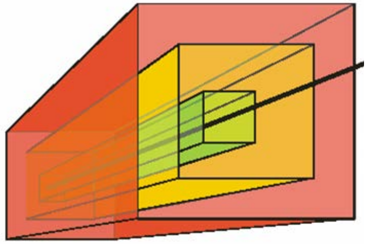
## CAAC ATMB TBO Concept Released May, 2020


中国民航空管基于航迹运行（TBO）
运行概念

中国民用航空局空中交通管理局

- **Trajectory-Based Operations (TBO) Concept:**
  Towards the use of a shared trajectory, collaboratively-developed as the basis for decision-making across the ATM system participants.
- **4DT:**
  a four-dimension (x, y, z, and time) trajectory of an aircraft from gate-to-gate, at the level of the required fidelity
- **Three major changes of TBO**
  - Common situation awareness
  - Collaborative management of trajectory thorough whole process
  - Precise operation

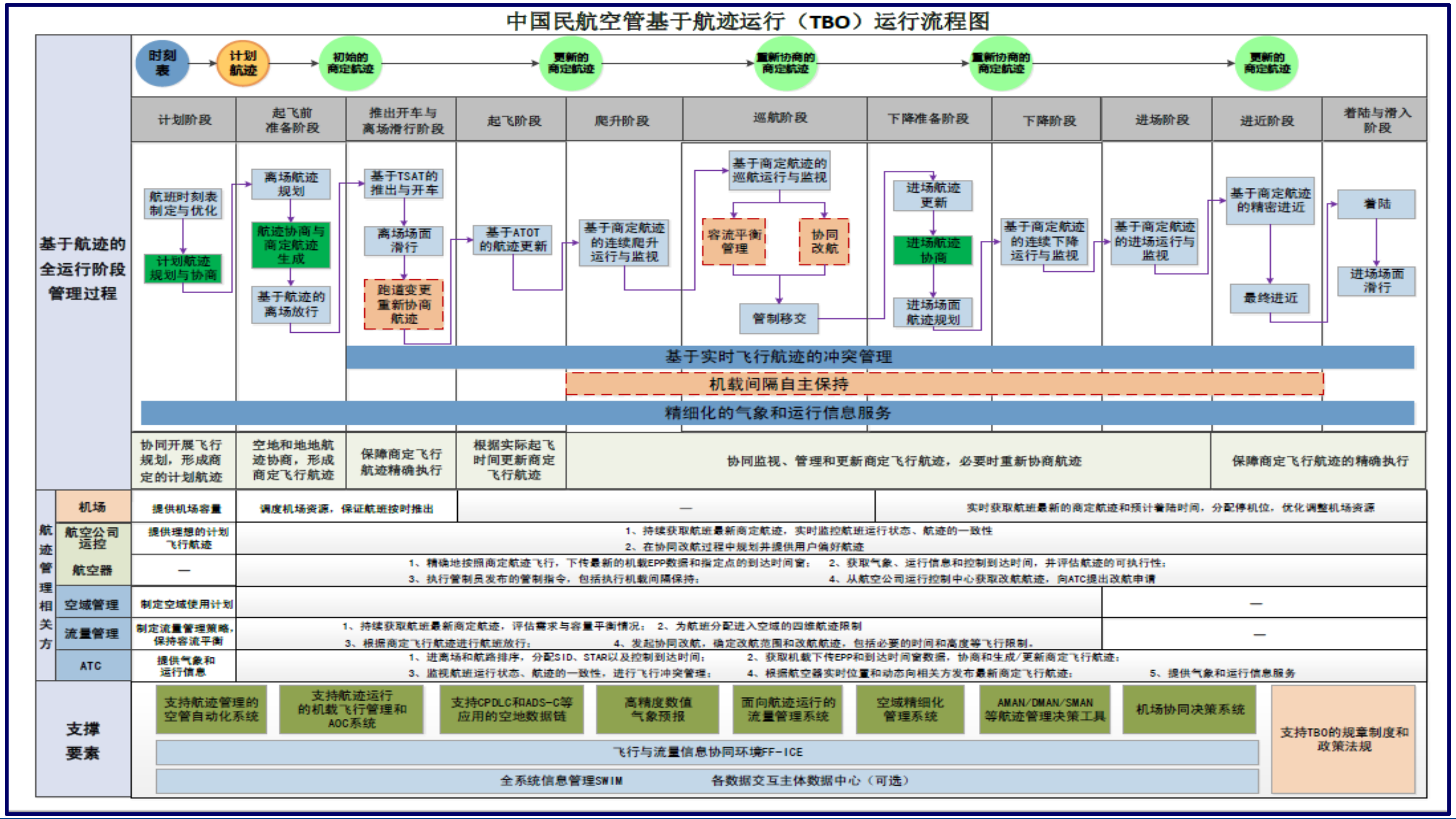


# CAAC ATMB TBO Concept

## Frame of the whole TBO Operation

- **Trajectory management** covering full life-cycle of the flight operation
- **Stakeholders** covering airports, airlines, airspace and flow management, ATC unit
- **Technical support** involving SWIM, FF-ICE, ATC automation system, FMS, A/G datalink and etc.



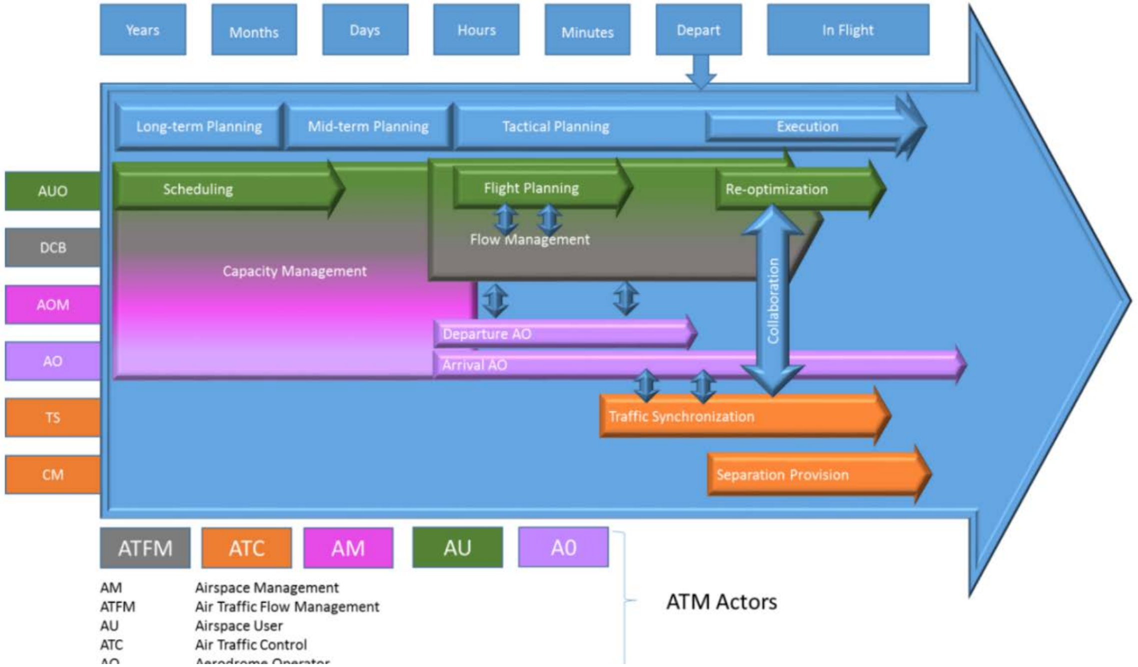
# TBO Concept

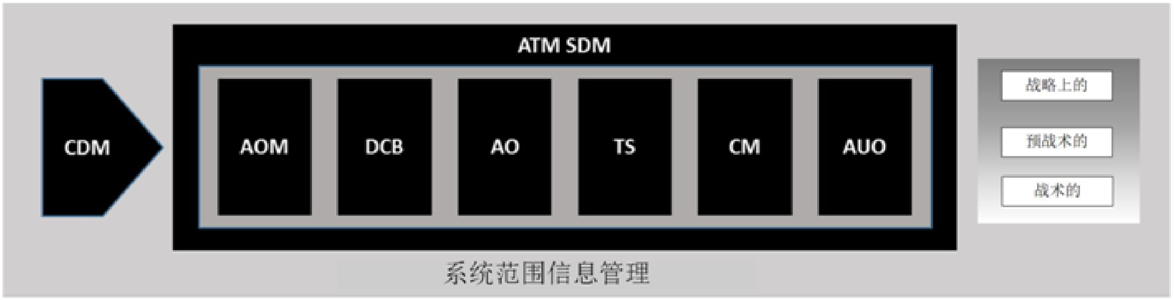
## TBO Trajectory Management Process

### Seven Components:

- AOM: Airspace Organization and Management
- DCB: Demand and Capacity Balancing
- AO: Aerodrome Operations
- TS: Traffic Synchronization
- CM: Conflict Management
- AUO: Airspace User Operations
- ATM-SDM: ATM Service Delivery Management

### Covering stratetic, pre-tactical, tactical phases



# CAAC ATMB TBO Concept

## TBO Capabilities and Technical Enabler

| | ADS-B | ADS-B | CPDLC | PBN | PBC | PBS | PBS | EFB | FF-ICE | SWIM |
|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Departure Trajectory Negotiation | | | | | | | | ↑ | √ | √ |
| Pre-Departure Trajectory Negotiation | | | ↑ | | | | ↑ | √ | √ | √ |
| Trajectory Parameter Exchange | | | | | | | | √ | √ | √ |
| TBO Clearances | | √ | √ | | | | √ | | | |
| Sharing of Aircraft–Derived Trajectory ADS-C | | √ | | | | | √ | | | |
| Sharing of Aircraft-Derived Trajectory A/G SWIM | | | | | | | √ | √ | √ | √ |
| Precise Clearance Execution | | | √ | √ | ↑ | ↑ | √ | | | |
| ATM Concept component Integration | | | | | | | | | √ | √ |
| ASP Coordination & Negotiation | | | | | | | | | √ | √ |
| Trajectory Prediction Accuracy | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | |

# 2 TBO Activities of CAAC

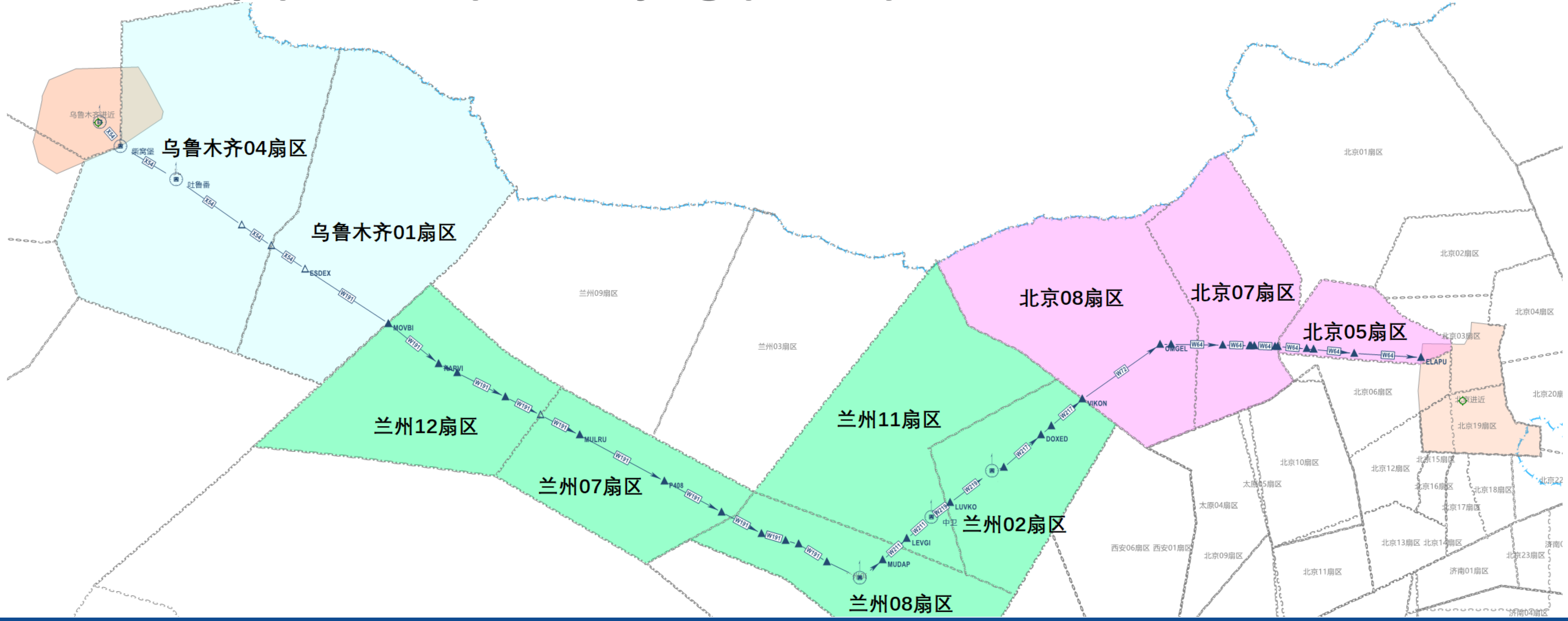
2.1 I4D Flight Trial

2.2 TBO Concept in China

2.3 Flight Trial with 2 A/C

# Flight Trial with 2 A/C

- 2021 CAAC Key Task : Flight Trial with 2 Aircraft
- From Urumqi (ZWWW) to Beijing (ZBAD)



# Flight Trial with 2 A/C

中国民航空管基于航迹运行(TBO)验证
双机飞行试验工作方案

牵头单位：中国民用航空局空中交通管理局
支持单位：北京航空航天大学
中国民航第二研究所
中国电科第 28 研究所
中国南方航空公司
民航数据通信有限责任公司
南京莱斯信息有限公司
空客(中国)有限公司
华北空管局
西北空管局
新疆空管局
2021 年 2 月 28 日

文件属性

| 文件名称 | 版本编号 | 发布日期 |
|---|---|---|
| 中国民航空管基于航迹运行(TBO)验证双机飞行试验工作方案 | 初稿 2.0 | 2021 年 2 月 |
| 中国民航空管基于航迹运行(TBO)研究论证与应用实施工作 | | |

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| 联系人 | 电话/邮箱 | 单位 |
|---|---|---|
| 丁磊 | dinglei@atmb.net.cn | 民航局空管局 |

- In February 2021, 《The project of flight trial with 2 A/C based on TBO》 was published.

# Flight Trial with 2 A/C

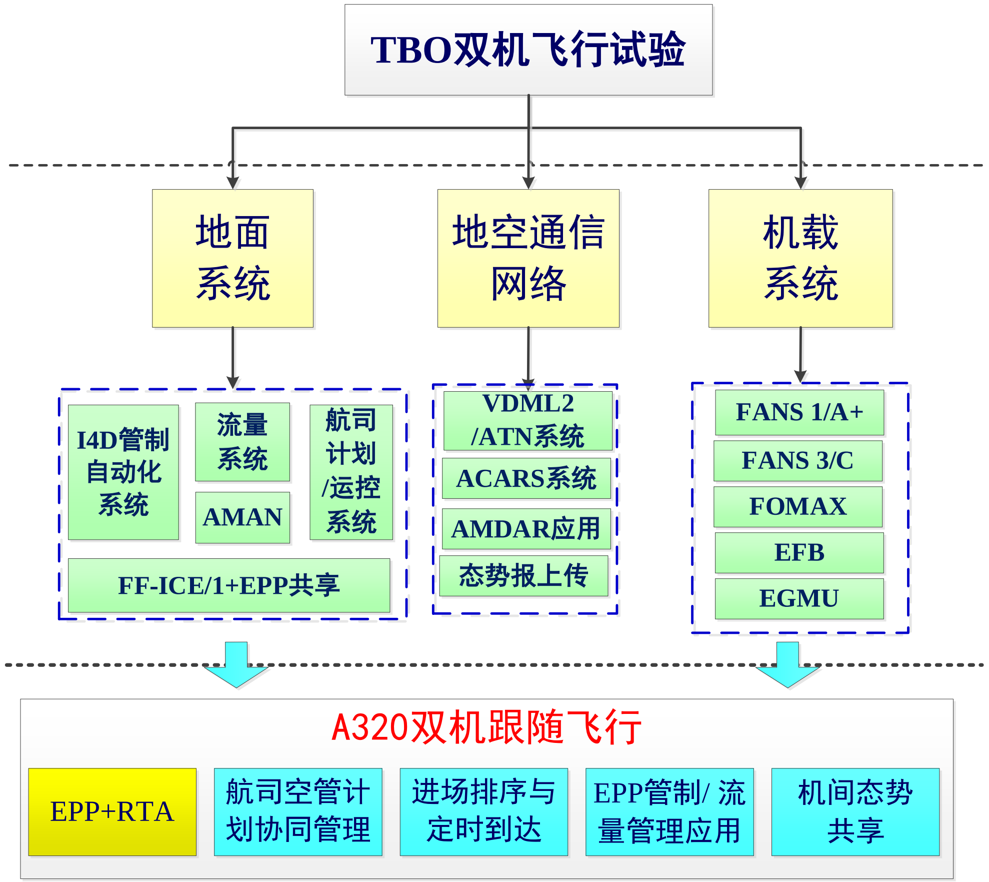
## Test Aircraft ：

- 2 test aircrafts chosen from China Southern Airlines in Urumqi
- Upgraded avionics system such as FMS、ATSU、DDCDU, enabling flight trial



# Flight Trial with 2 A/C

## Overall Technological Scheme

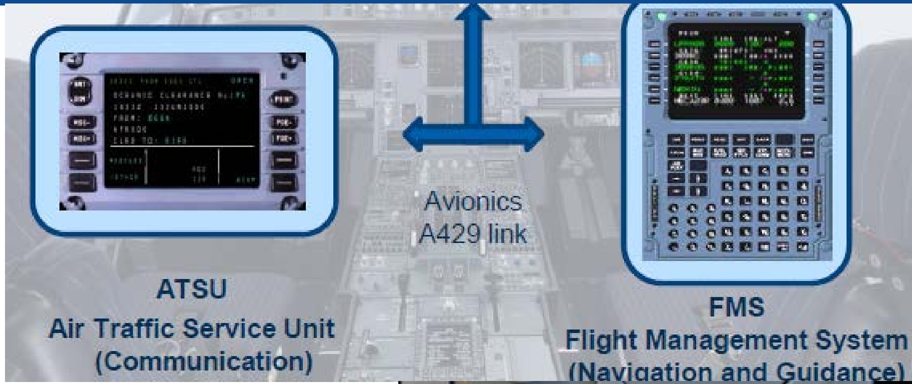


# Flight Trial with 2 A/C

## Objectives and Technical Requirements:

### Trial 1: CPDLC/ADS-C

- Airborne avionics：FANS1/A、FANS 3/C、EFB
- Ground-air network：ACARS、ATN B2
- Ground ATC system：FANS、I4D





### Trial 2: EPP in ATC， ATFM and AMAN

- ATC：I4D adds EPP-based conflict detection function
- ATFM：ATOM/CDM adds EPP-based track prediction function
- AMAN： RTA+AMAN

# Flight Trial with 2 A/C

## Objectives and Technical Requirements:

### Trial 3: Situation awareness and flight in-trail separation maintenance assistance

- Airborne avionics： FANS 1/A+， FOMAX+EFB,EGMU
- Ground-air network： ACARS, AMDAR weather data download, situation upload
- Ground ATC system： EPP/ weather message data extraction and integration

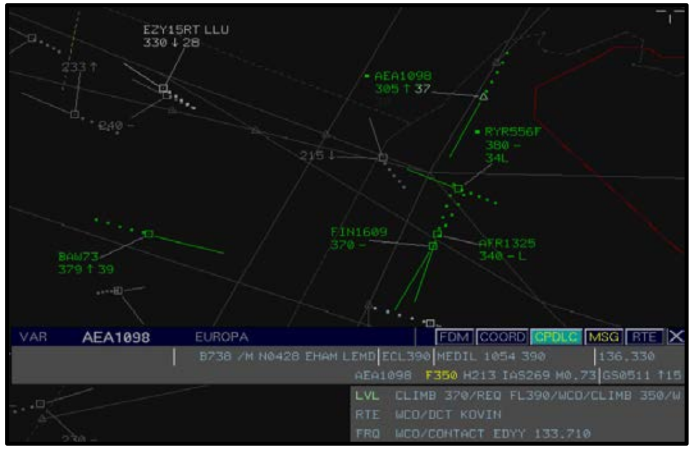
### Trial 4: Collaborative operation between ATC and Airline

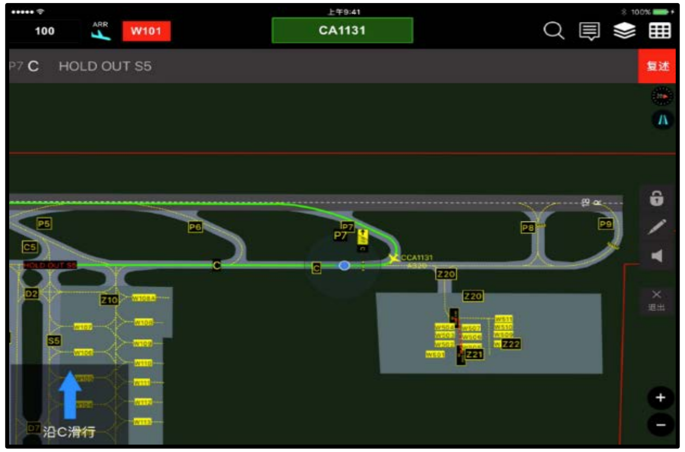
- Before flight：Flight plan filing/applied via FF-ICE/1
- In flight：EPP data sharing based on FIMX
- ATC/Airline FF-ICE/1 APP

# Flight Trial with 2 A/C

## Trial 1: Digital ATC

- Urumqi Airport : the tower DCL/D-ATIS
- Urumqi region: FANS 1/A-based CPDLC/ADS-C
- Lanzhou region : FANS 3/C-based CPDLC/ADS-C (I4D)
- North China: FANS 1/A-based DCL extended control command
- Daxing Airport : FANS 1/A-based field electronic taxi guidance

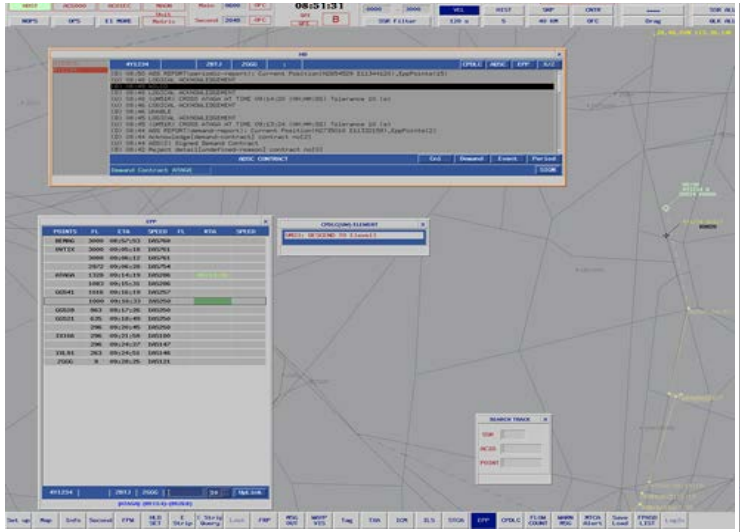



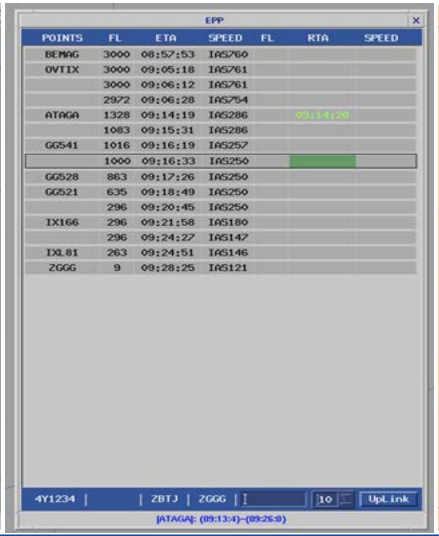



# Flight Trial with 2 A/C

## Trial 2: EPP in ATC， ATFM and AMAN

- **Air-ground trajectory integration and enhanced predication ：**
  - **Real-time EPP data distribution to ATOM/Regional CDM/automated ATC system**
- **Verification of EPP’s improvement on trajectory prediction capability**
- **Verification of EPP’s improvement on AMAN：**
  - **EPP distribution to AMAN system, scheduling 2 test aircraft in advanced**



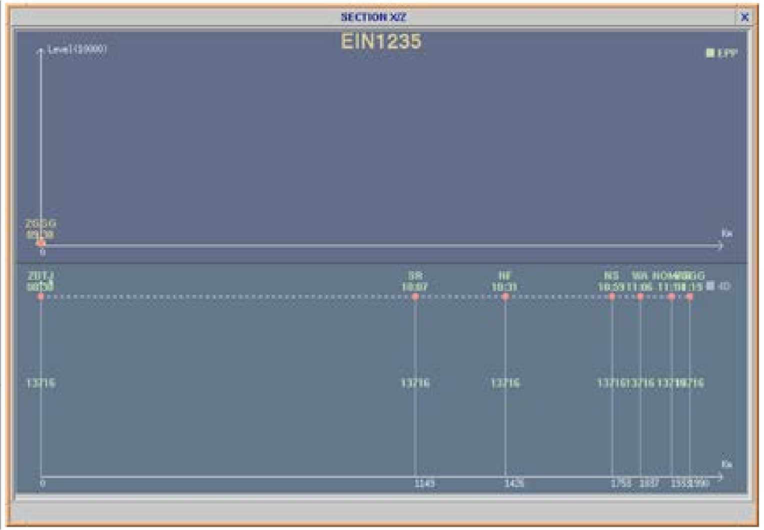


EPP

| POINTS | FL | ETA | SPEED | FL | RTA | SPEED |
|---|---|---|---|---|---|---|
| BEMAG | 3000 | 08:57:53 | IAS760 | | | |
| OVTIX | 3000 | 09:05:18 | IAS761 | | | |
| | 3000 | 09:06:12 | IAS761 | | | |
| | 2972 | 09:06:28 | IAS754 | | | |
| ATAGA | 1328 | 09:14:19 | IAS286 | | 09:14:20 | |
| | 1083 | 09:15:31 | IAS286 | | | |
| GG541 | 1016 | 09:16:19 | IAS257 | | | |
| | 1000 | 09:16:33 | IAS250 | | | |
| GG528 | 863 | 09:17:26 | IAS250 | | | |
| GG521 | 635 | 09:18:49 | IAS250 | | | |
| | 296 | 09:20:45 | IAS250 | | | |
| IX166 | 296 | 09:21:58 | IAS180 | | | |
| | 296 | 09:24:27 | IAS147 | | | |
| IXL81 | 263 | 09:24:51 | IAS146 | | | |
| ZGGG | 9 | 09:28:25 | IAS121 | | | |

4Y1234 | ZBTJ | ZGGG | 10 UpLink

[ATAGA]: (09:13:4)~(09:26:0)



# Flight Trial with 2 A/C

## Trial 3: Shared situation awareness and flight in-trail separation maintenance assistance

- Shared information between 2 test aircraft：
  - Downlink data to ground network (meteorological, flight situation, etc. )
  - Transmission of received data to the follower
- Autonomous separation maintenance assistance capability with flight in trail:
  - Obtain real-time aircraft flight state, maintain safe separation with the leader

# Flight Trial with 2 A/C

## Trial 4 :  Collaborative Operation Between ATC and Airline

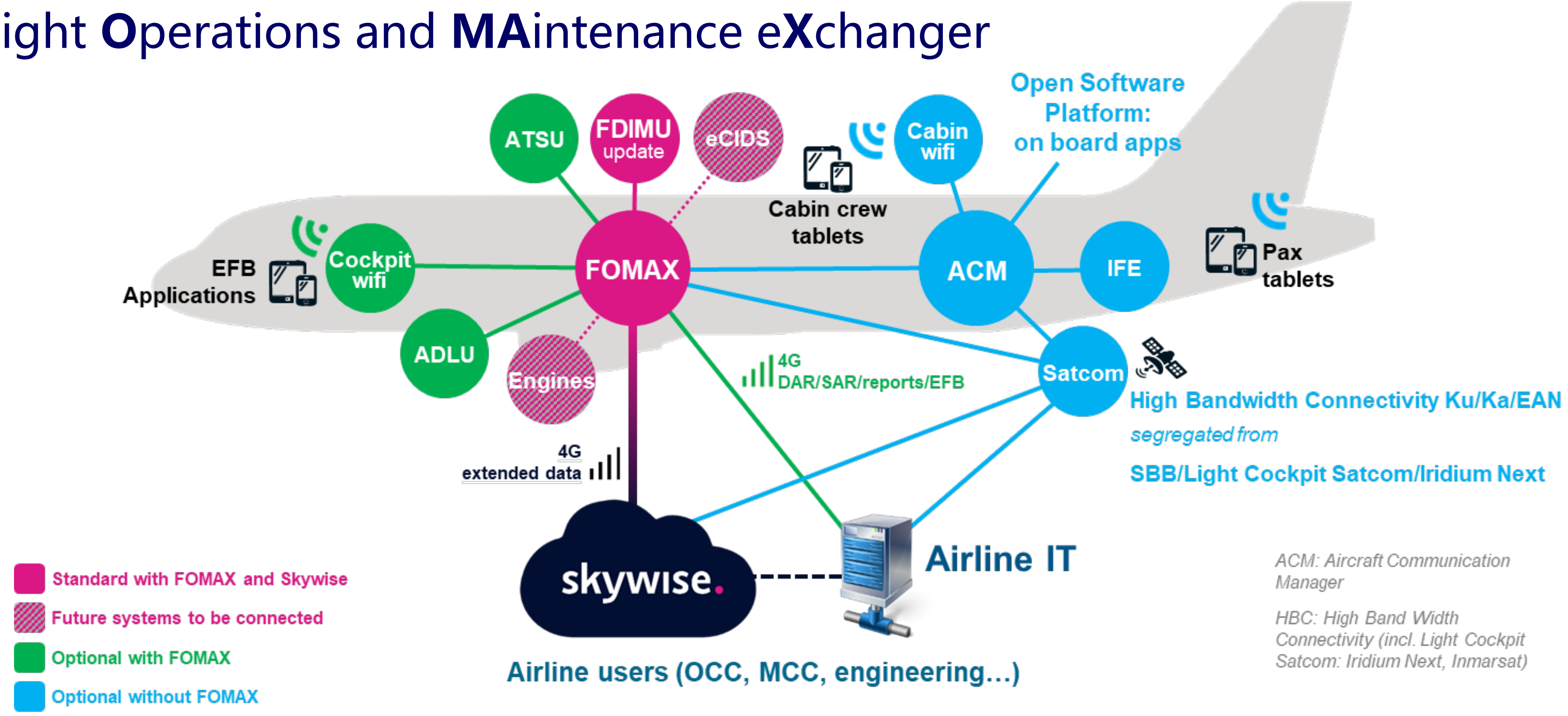
- **4D flight plan negotiating and filing via FF-ICE/1：**
  - Provide FF-ICE/1 flight plan cooperation service before flight
- **Verification of EPP’s improvement on flight operation monitor capability**
- **Transmission of EPP data to airline for carrying out flight guarantee service**

# Flight Trial with 2 A/C

## Aviation Airborne System Scheme

- **FOMAX**:

  **F**light **O**perations and **MA**intenance e**X**changer

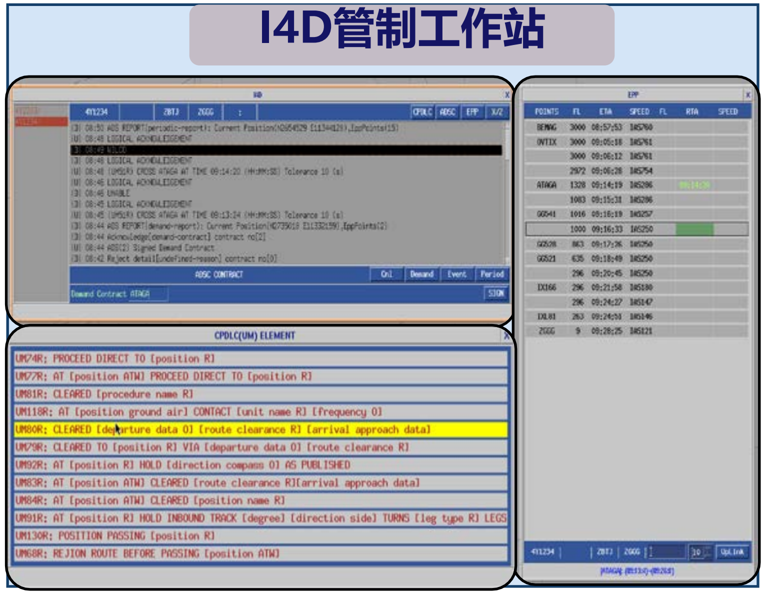


# Flight Trial with 2 A/C

## Ground System Scheme

### ■ The I4D ATC automation test system:

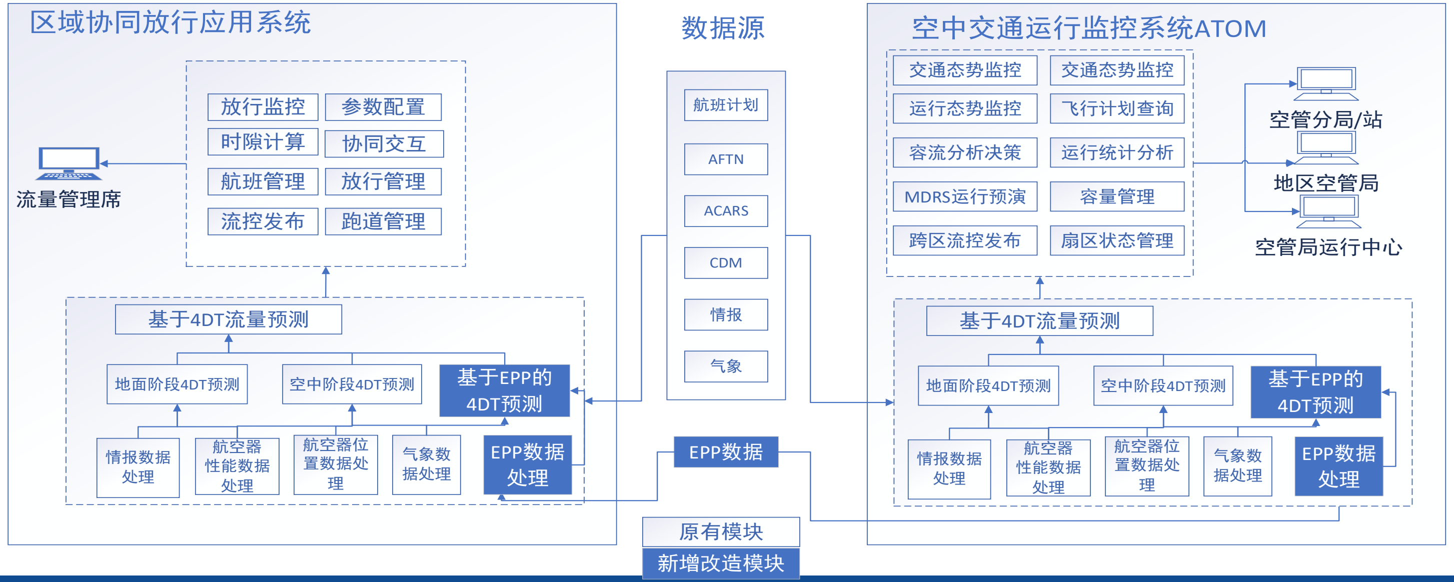
- Track operation control command set based on ATN: Basic + extended
- I4D Control workstation ： EPP、RTA
- Enhancements: EPP-based conflict management

# Flight Trial with 2 A/C

## Ground System Scheme

- **ATFM Development：**
  - Sharing of EPP data based on FIXM
  - Integration of EPP data and trajectory information
  - 4DT prediction based on integrated data

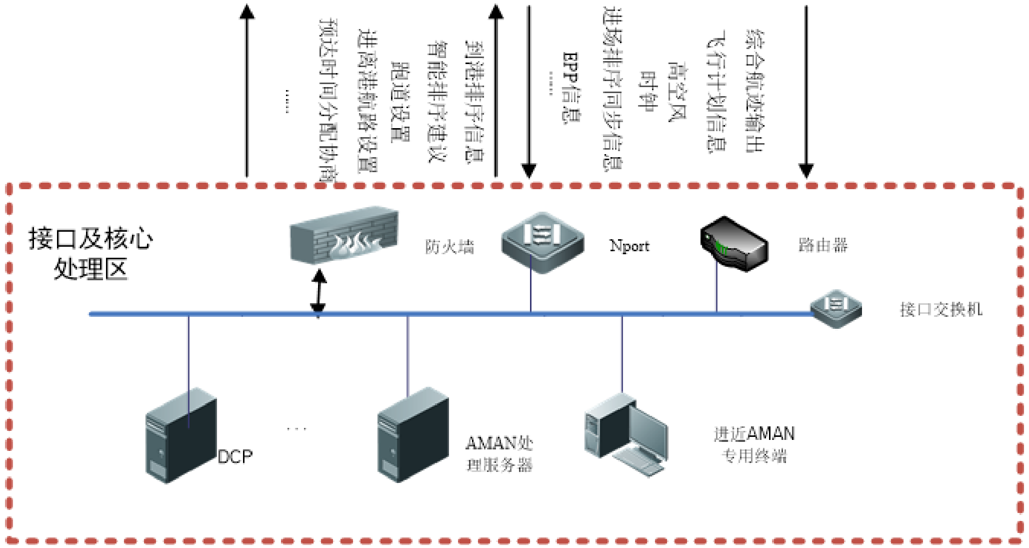


# Flight Trial with 2 A/C

## Ground System Solution

■ **AMAN arrival sequence application system:**

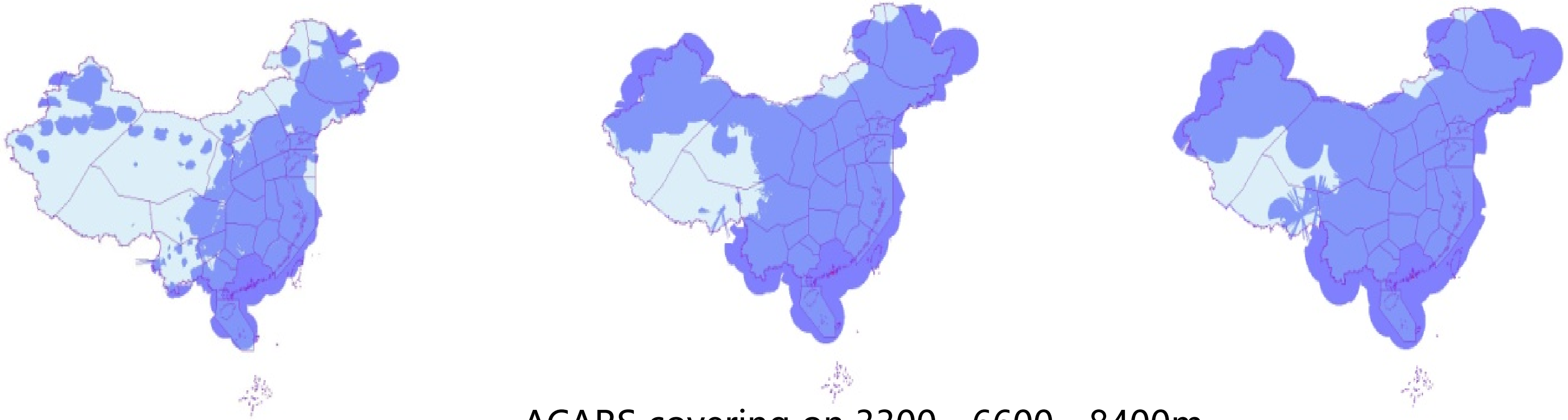
- Based on the existing AMAN prototype system
- Extension: support EPP data processing and enhance 4DT prediction
- Arrival sequence based on EPP data



# Flight Trial with 2 A/C

## Ground-Air Datalink Network Scheme

- **VHF ACARS**
  - 144 airports, 5 navigation stations, 192 ground stations
  - Cover most air routes and routes, including Hong Kong and Macau
  - 100% of the domestic fleet are capable of VHF data link communication



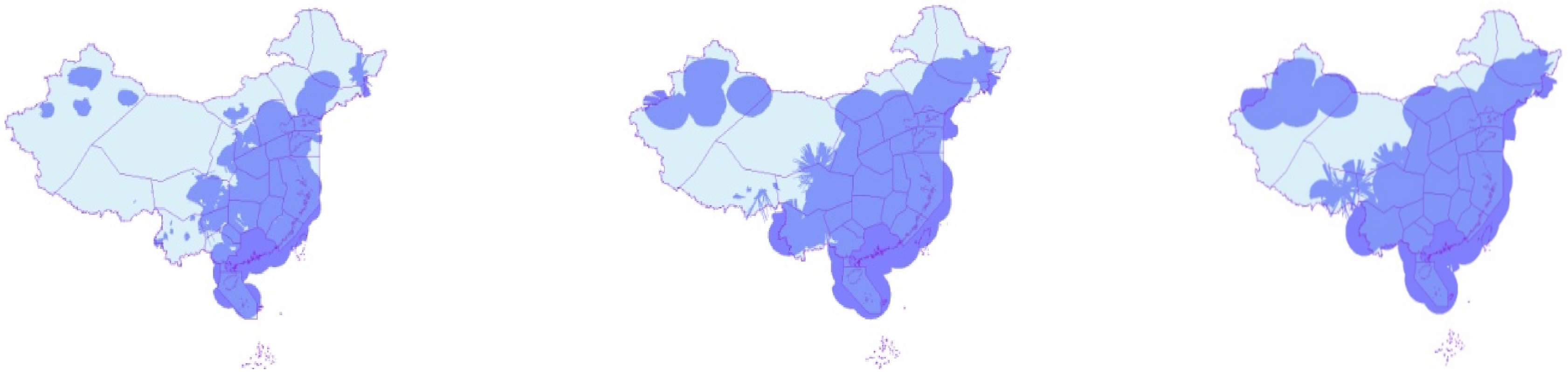
ACARS covering on 3300、6600、8400m

# Flight Trial with 2 A/C

## Ground-Air Datalink Network Scheme

### ■ VDL Mode 2 network

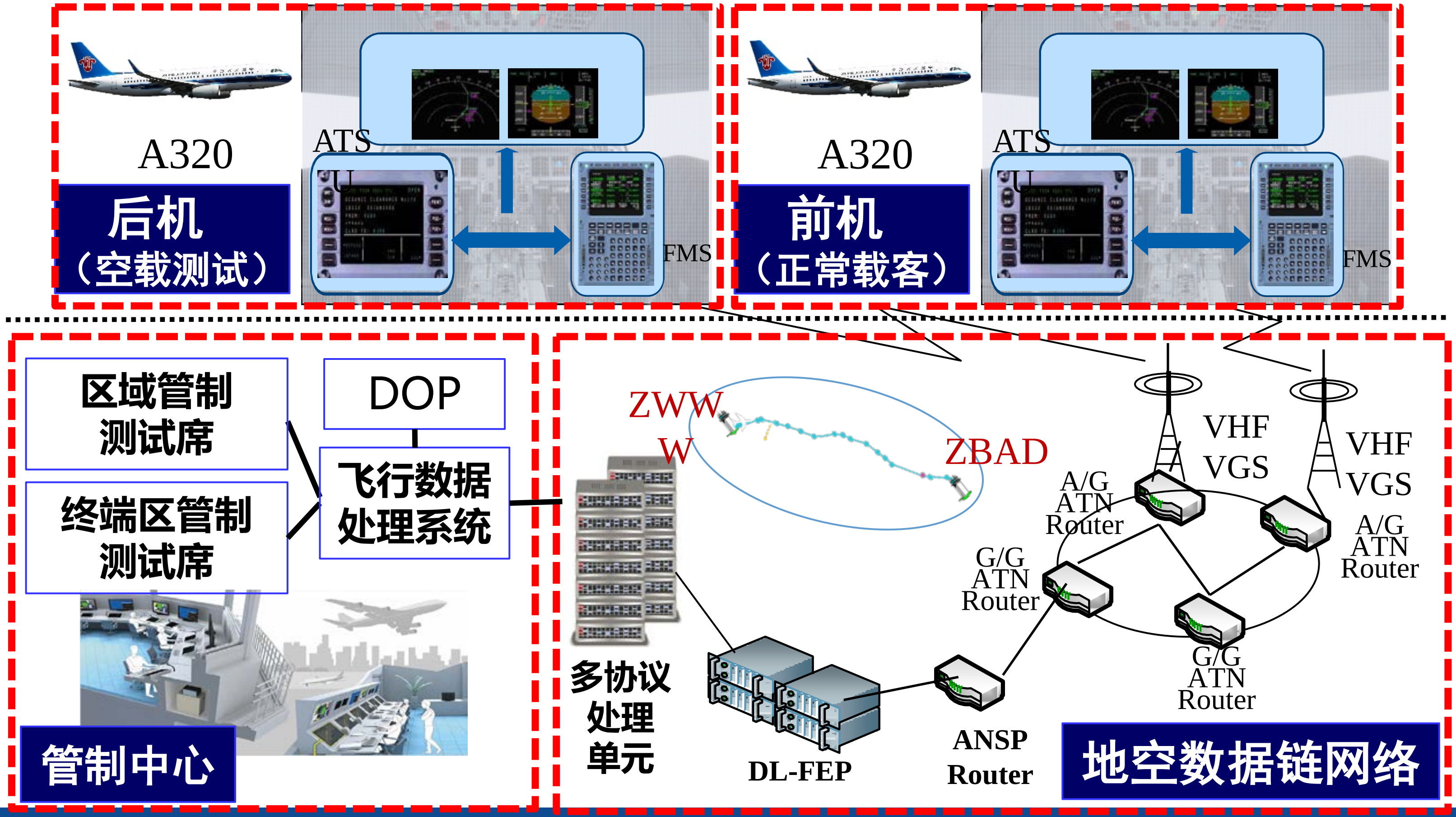
- 91 airports, 106 ground station capture the VDL Mode 2 communication function
- VDL Mode 2 achieve the communication covering of  mid-eastern China
- 46% of the domestic fleet  possess the capability of VDL Mode 2 communication, message delay is less than 2 seconds.



VDL Mode 2 covering on 3300、6600、8400米

# Flight Trial with 2 A/C

➤ **VDL Mode 2+ATN**



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# Next Step

# The Next Step

## TBO Implementation Strategy

| scene | | conflict management | Traffic synchronization | Capacitive current equalization | airspace management | Airport operation |
|---|---|---|---|---|---|---|
| **Flight Trial** | Single A/C | Digital ATC+ EPP | RTA | -- | -- | -- |
| | Multiple A/C | Digital ATC+ In-trial separation | RTA+ AMAN | FF-ICE/1+ EPP应用 | -- | AMAN |
| **Very Large Demons-tration** | Trial route | Digital ATC | RTA+ AMAN | FF-ICE /1&2 | CDO /CCO | AMAN |
| | All phases | Digital ATC | RTA+ AMAN | FF-ICE /1&2 | CDO /CCO | DMAN+ SMAN |
| **Operati-on** | Region | Digital ATC+ self-separation | RTA+ EMAN | FF-ICE /1&2 | CDO /CCO | -- |
| | All airspace | Digital ATC+ Self-separation | RTA+ EMAN | FF-ICE /1&2 | Autonomous Operation Route | DMAN+ SMAN |

# The Next Step

| | | |
|---|---|---|
| Application | FANS 1/A<br>AEEC 623<br>FANS 3/C | • Provide DCL/D-ATIS service based on AEEC623 in Tower. Provide CPDLC/ADS-C service based on FAN1/A on remote and oceanic areas.<br>• According to the outcome of experiment and validation, plan to provide ATC information service based on extended AEEC623 and provides ATC instructions and information service based on extended AEEC623 and CPDLC（FAN1/A）<br>• The long term objective is implementing TBO and providing CPDLC/ADS-C service based on ATN. |
| Network | ACARS<br>ATN/OSI<br>ATN/IP | • Closely follow and participate the progress of research and standard development of ICAO in ATN domain.<br>• Stay informed of the implementation and application of ATN/OSI in Europe.<br>• Carry out research on ATN OSI/IPS Gateway to support aircrafts equipped with either ATN/OSI or ATN/IPS in addition to existing ACARS. Both ATN/OSI and ATN/IPS will be supported during the transition period. |
| Physical link | VDLM2<br>SATCOM<br>Future COM | • Deploy more Datalink VHF ground stations with the ability of ACARS and VDL MODE2 in China to improve redundancy and signal coverage.<br>• INMASAT Beijing ground gateway station officially provides services, and gradually promotes the INMASAT broadband communication sb-s data link network services. Promote Chinese SATCOM for the application of ATC.<br>• Promote the ATC application of 5G AeroMACS independently researched by CAAC on the airport surface, and carry out the research and application of 5G LDACS on route. |

# The Next Step

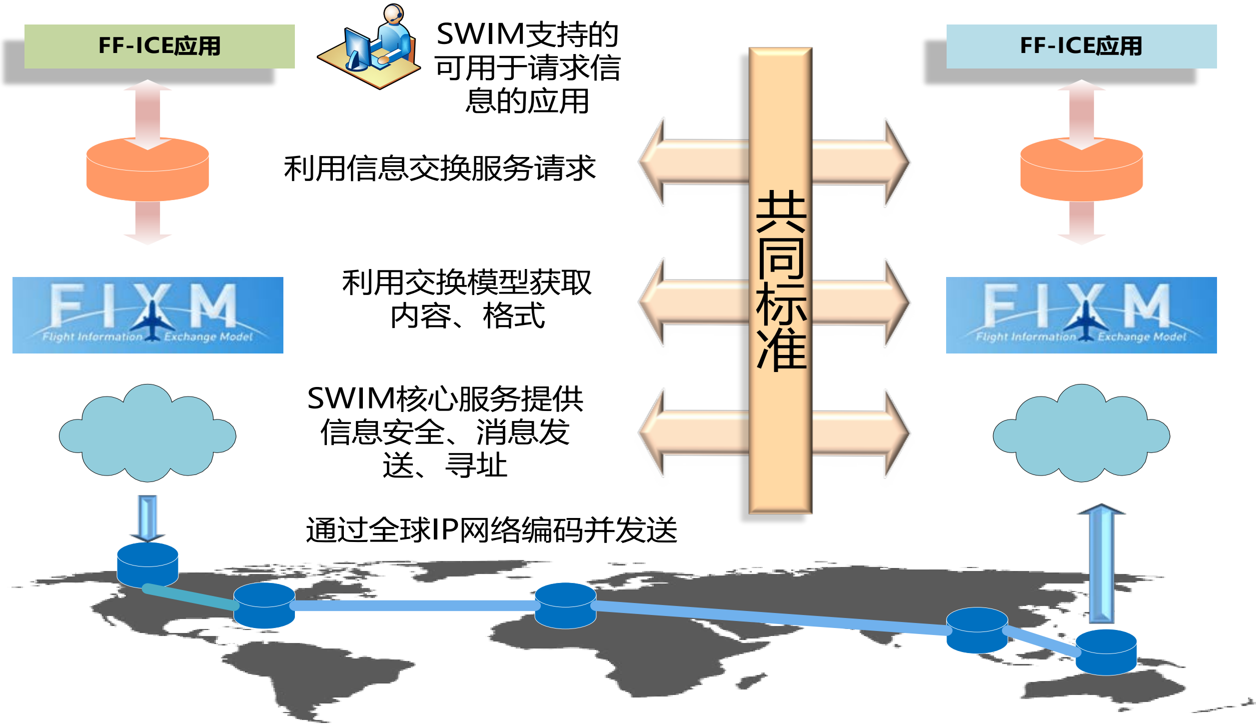
## To Develop TBO Implementation Strategy

- By Phase of Flight: Pre-departure, Departure, Climb, En-route, Approach, etc.
- By Task: CM， TS, DCB, AO, AM, etc.
- Mix Operation of TBO and Non-TBO
- Technology Evolution Strategy :
  - A-G ATN
  - Information Management Infrastructure
  - ATM Automations
  - Avionics Upgrade

# The Next Step

## FF-ICE R1

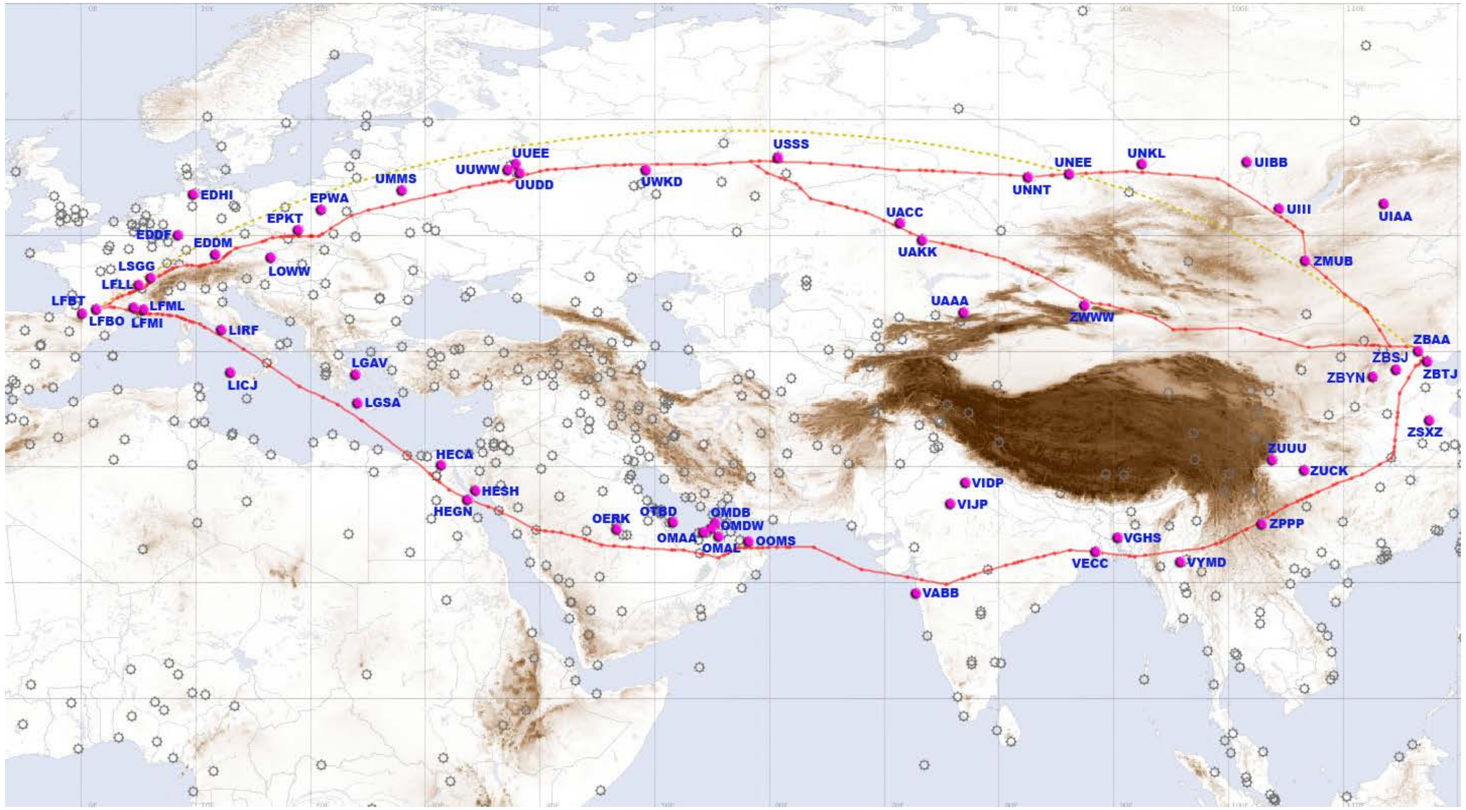
- **FF-ICE R1 Validations**

# The Next Step

## I4D Intercontinental Flight Trial

- Airbus Ferry Flight
- CPDLC/ADS-C via INMARSAT
- EPP application in ATFM/AMAN



# THANK YOU

CANSO OPERATIONS

SHAPING OUR FUTURE SKIES

canso.org

# The Frontier of ATFM & A-CDM

CANSO Asia-Pacific Operations Workgroup Meeting

8 – 9 November 2021

*In which we explore…*

# How will ATFM & A-CDM evolve?

*What new concepts are there?*
*What are the emerging technologies?*
*What possible applications will arise?*

Exploration Topic 1

# ATFM/A-CDM Integration

# CANSO's Guide – released in Oct 2020



1 Executive Summary
2 Acronyms
3 Background Basics
3.1 Basics of ATFM
3.2 Basics of A-CDM
3.3 ATFM/A-CDM Integration
4 Benefits of ATFM/A-CDM Integration
4.1 Purpose and Benefits of ATFM/A-CDM Integration
4.2 Integration Benefits: the European Network Example
5 ATFM/A-CDM Integration Concept
5.1 Conceptual Approach to the Integration
5.2 Key Information Exchanges for Successful Integration
5.3 Exchange of ATFM Measure Information
5.4 Exchange of Flight Update Information
5.5 Exchange of Flight Departure Information
6 Sample Use Cases for AFTM/A-CDM Integration
6.1 Use Case 1 – Exchange of ATFM Measure Information
6.2 Use Case 2 – Exchange of Flight Update Information
6.3 Use Case 3 – Exchange of Flight Departure Information
7 SWIM and ATFM/A-CDM Information Exchange
7.1 What Is SWIM and Why Is It Relevant?
7.2 SWIM and ATFM/A-CDM Information Exchange
8 Recommendations for ATFM/A-CDM Integration
8.1 Stakeholder Engagement
8.2 Establishment of Common Objectives
8.3 Integration Planning & Execution
8.4 Data Quality & Testing
8.5 Success Measure Development
9 Case Studies

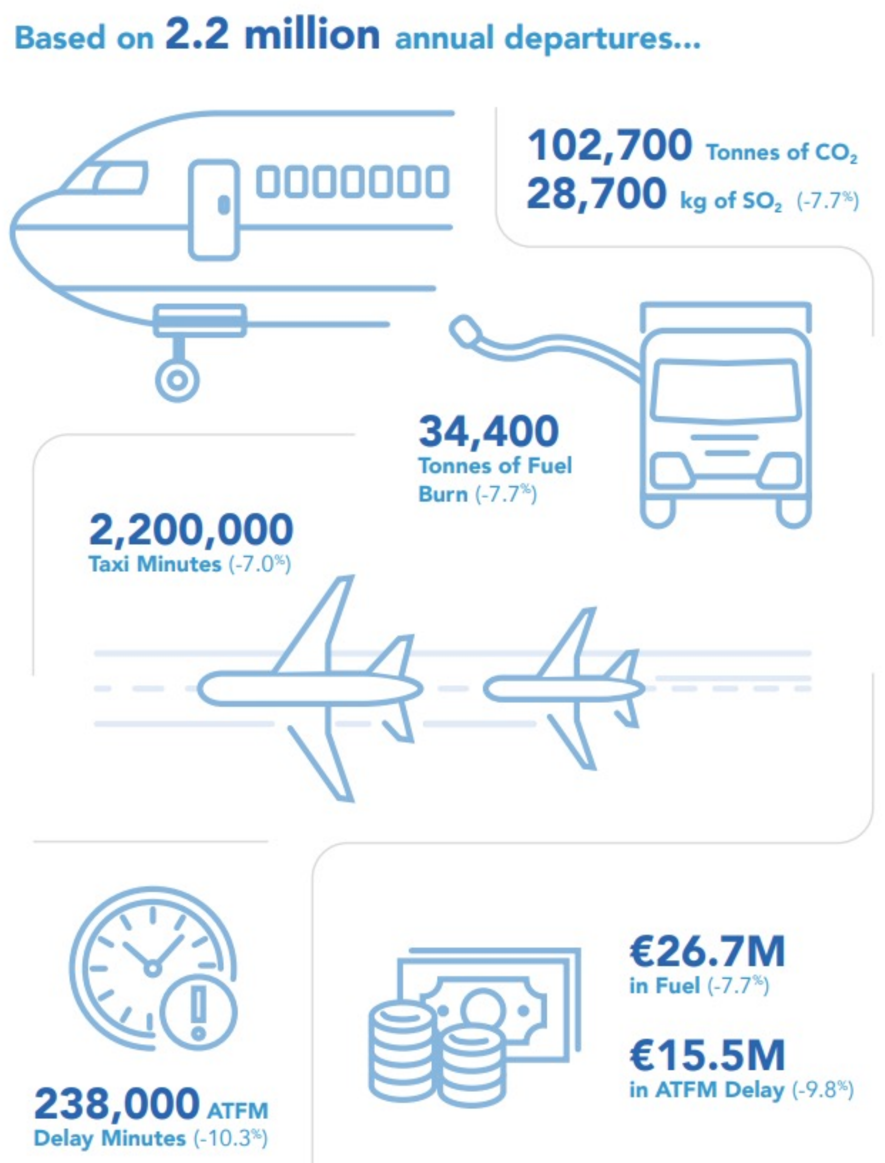

The "WHY"!

The "HOW"!

KEY PRINCIPLE has been SCALABILITY

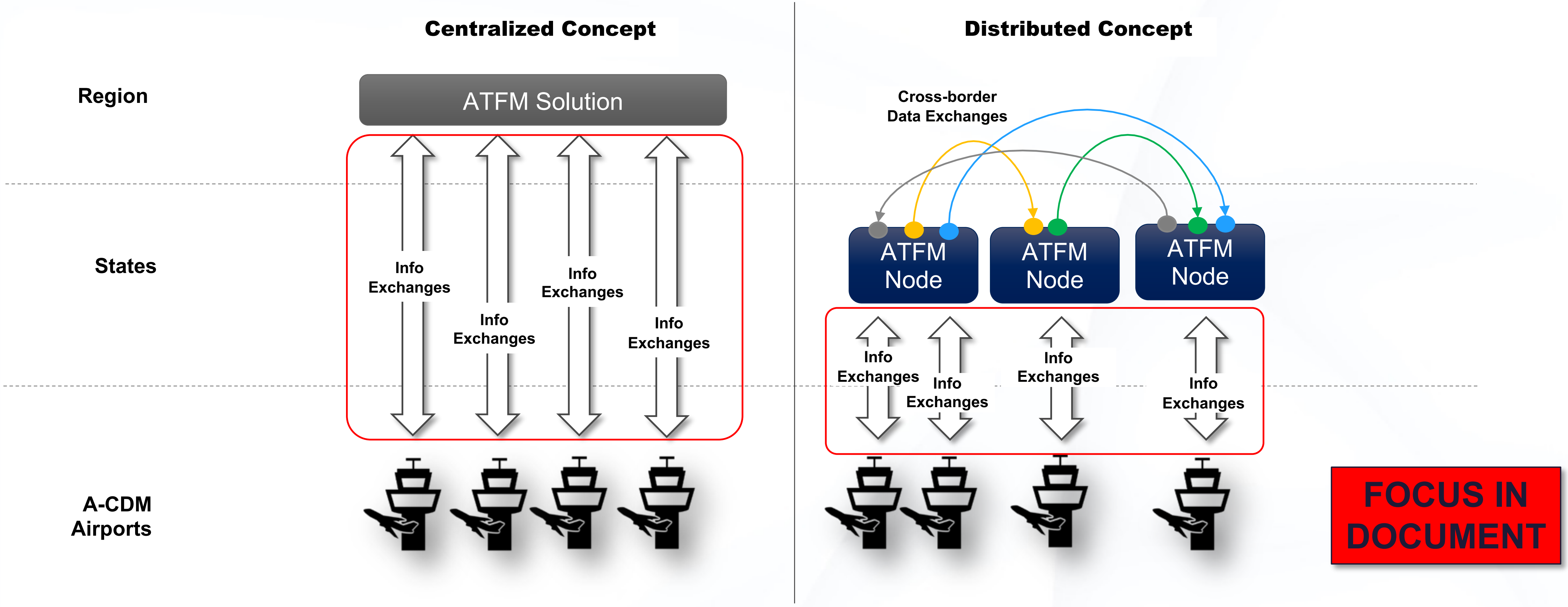
- ✓ Conceptually
- ✓ Specific with Use Cases
- ✓ SWIMs role
- ✓ Approach

# ATFM/A-CDM INTEGRATION BENEFITS


Source: EUROCONTROL's A-CDM Impact Assessment, Final Report, March 2016

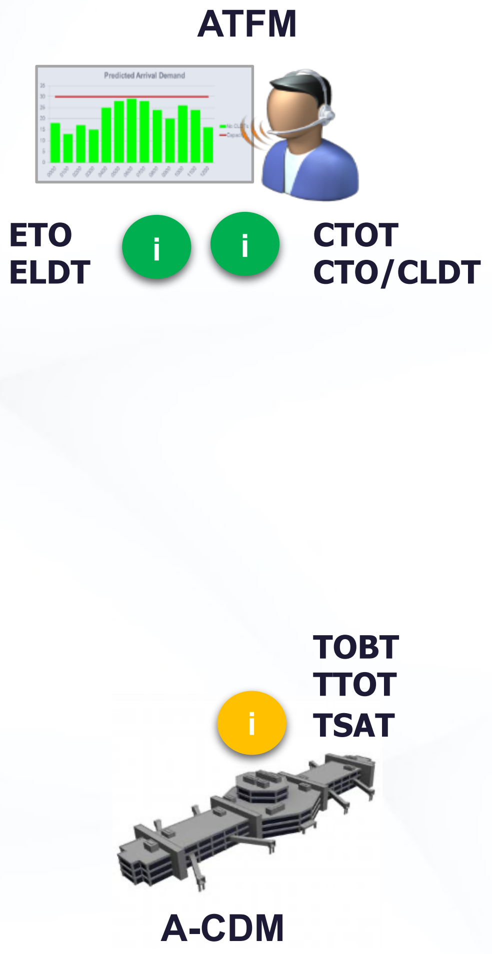
# Two different ATFM concepts



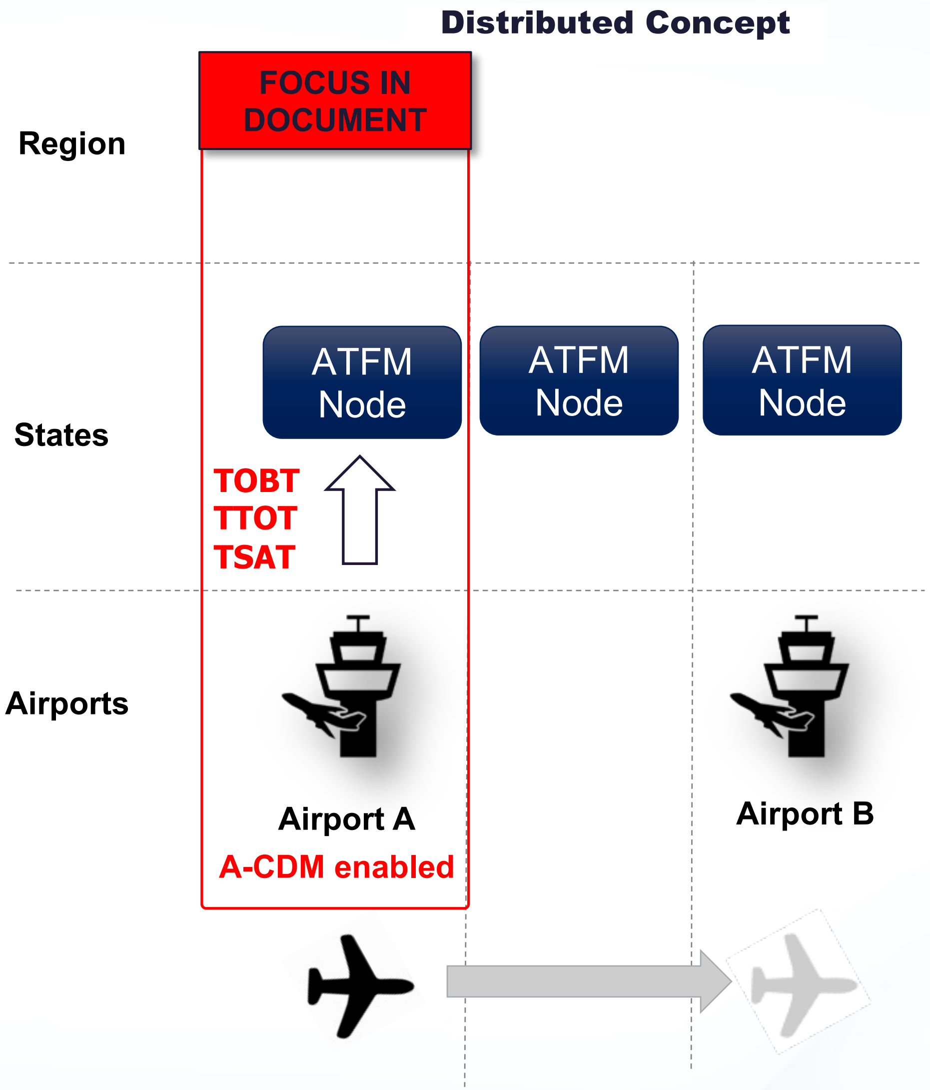
# ATFM / A-CDM Information Exchange

## Three Key Information Exchanges

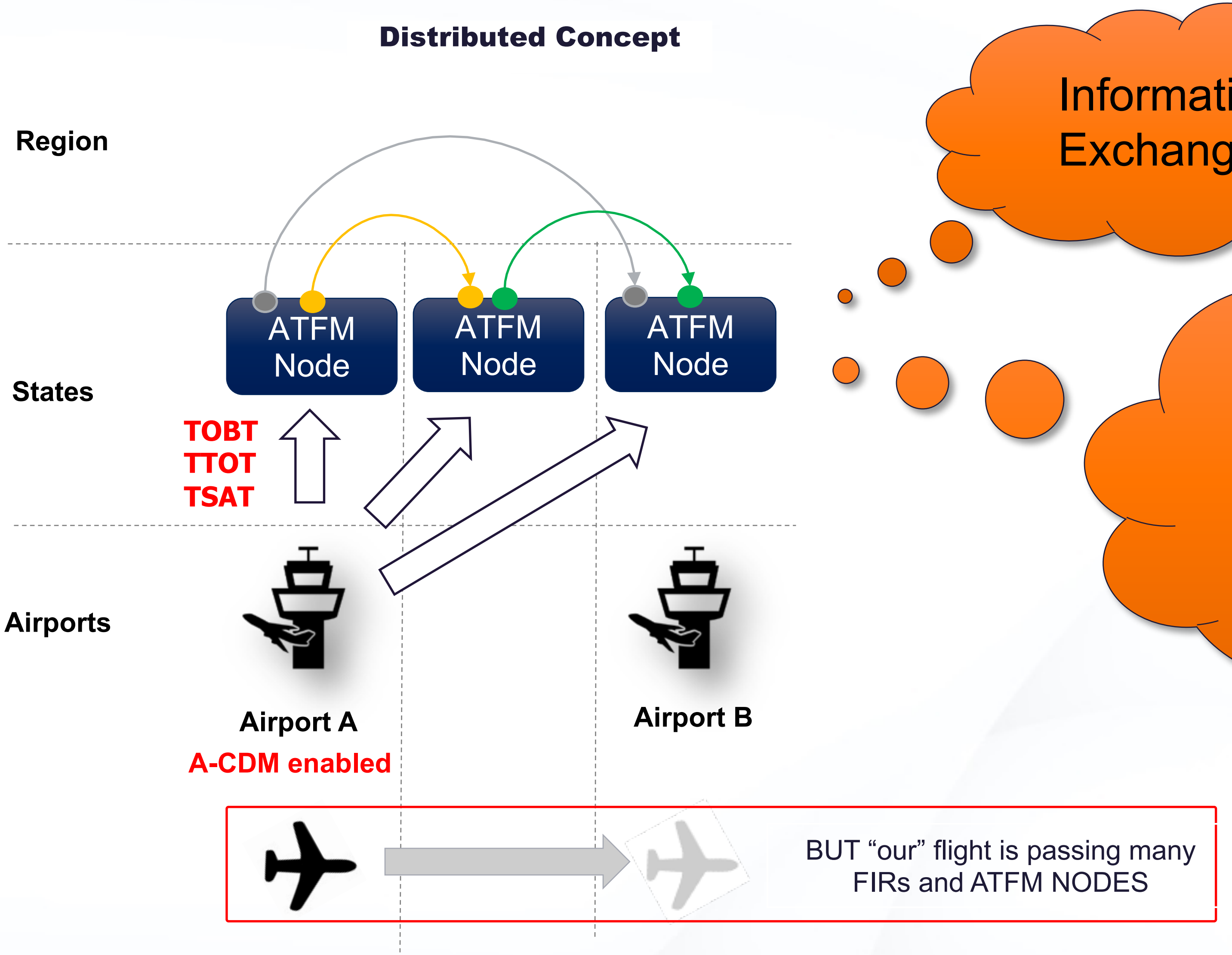
1. ATFM measures (e.g. ATFM slots) from ATFM to A-CDM
2. (Updated flight information from ATFM to A-CDM)
- Flight departure information from A-CDM to ATFM



# AFTM & A-CDM Integration



# AFTM & A-CDM Integration




Information Exchange?

Which ATFM Node should "act" on the info?

How is the DCB and automation be done?

# Exploration Topic 2

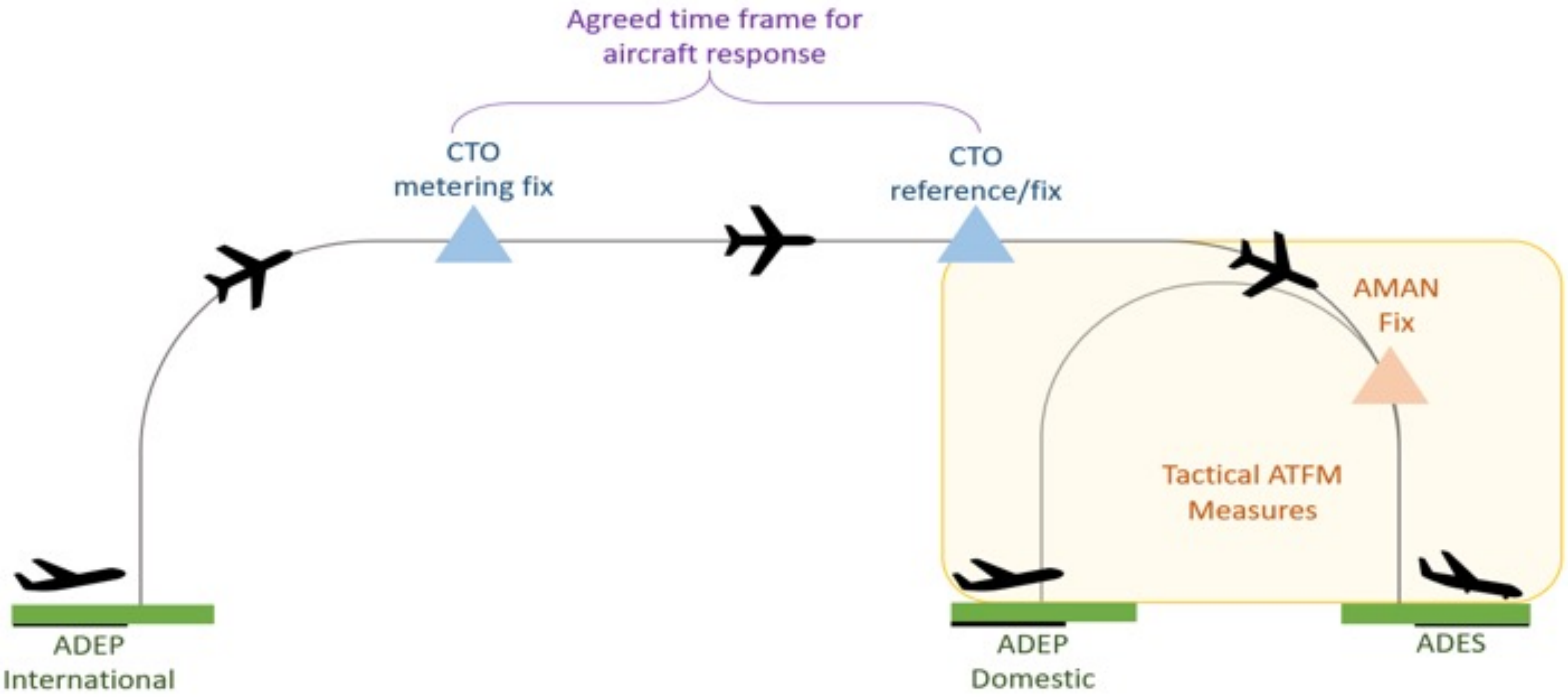
# Long-Range ATFM

# LONG-RANGE ATFM CONCEPT

CANSO

Proposed Definition:

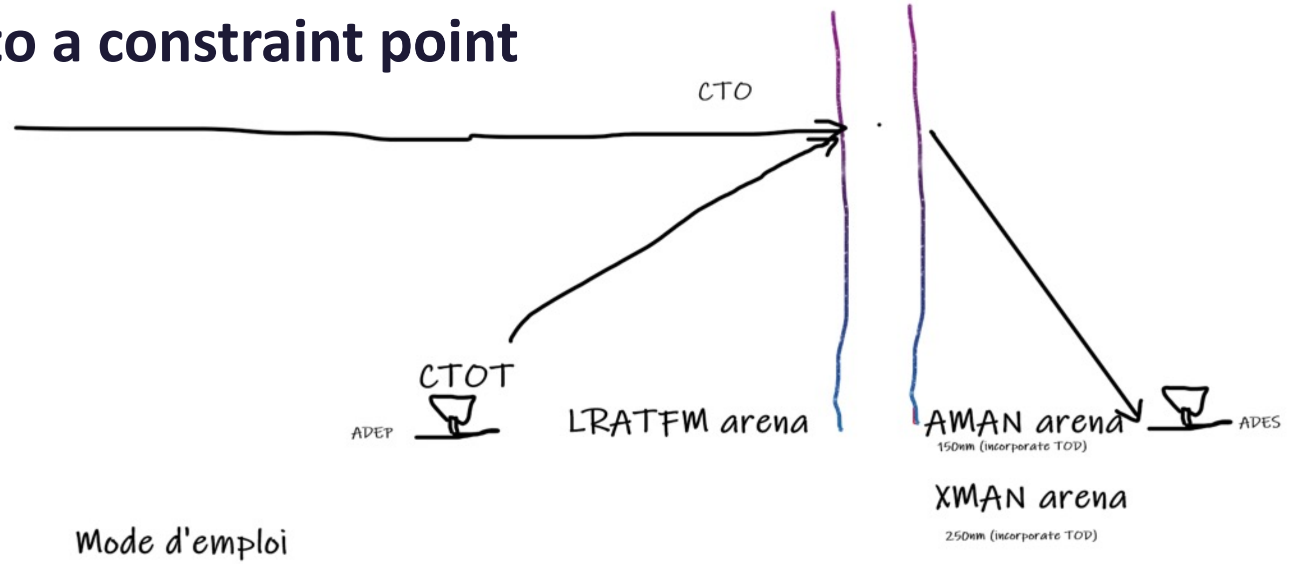
**The integration of pre-tactical and tactical ATFM methods to deliver a collaboratively metered flow of aircraft to a constraint point (airport or waypoint).**



# LONG-RANGE ATFM CONCEPT

Proposed Conceptual Ground:

**The integration of pre-tactical and tactical ATFM methods to deliver a collaboratively metered flow of aircraft to a constraint point (airport or waypoint).**




Mode d'emploi

-all aircraft are included in a GDP and CTO/CTOT and CLDT landing times determined.

-CLDT are then ignored

-ENR ATC assign CTO and TWR ATC assign CTOT

-Once the aircraft enters the AMAN Arena, the solution is seamless.

-GDP are given less priority by AMAN- ie, they enter the AMAN Arena as "Frozen"

-LR flights enter the AMAN Arena as "Un-stable"

# LONG-RANGE ATFM CONCEPT

Core Principles Under Exploration:

1. **LR-ATFM shall be considered as one of the ATFM Measures available to an ATFM Unit to holistically balance capacity and demand for a constrained resource, i.e., LR-ATFM should not be used in isolation when other ATFM Measures are applied (e.g., a Ground Delay Program for short-haul traffic).**

    - Application of ATFM Measures including LR-ATFM should consider equity in access to the constrained resource, i.e., delay should be fairly and appropriately shared between airspace users requiring access.

# LONG-RANGE ATFM CONCEPT

CANSO

Core Principles Under Exploration:

2. **LR-ATFM delay that is allocated to (airborne) aircraft shall consider factors which may render the allocated delay ineffective or unachievable.**

   - The extent of the LR-ATFM delay should be commensurate with what can be efficiently absorbed in the (remaining) cruise phase of flight, i.e., airborne aircraft have limited capacity to (efficiently) absorb delay.

   - The horizon at which LR-ATFM delay is allocated should consider the accuracy of demand prediction and operational capacity declaration at that point in time, i.e., effort should be made to prevent the allocation of LR-ATFM delay that proves to be unnecessary when the aircraft is approaching the point of constraint.

# LONG-RANGE ATFM CONCEPT

Core Principles Under Exploration:

3. **LR-ATFM delay should be issued as a Controlled Time Over at a specific point is space rather than a speed advisory.**

   - Issuing speed advisories for enroute aircraft for LR-ATFM purposes should be avoided as to allow the flight crew's discretion on how and whether the allocated delay can be safely achieved.
   - Flight crew shall advice ANSP of speed changes in accordance with ICAO PANS-ATM.
   - To avoid complicated ANSP jurisdiction matters across FIR boundaries, consideration should be given on providing LR-ATFM delay as an advice rather than an instruction (incentives could be provided to ensure flight crew act in accordance with advice provided).

# LONG-RANGE ATFM CONCEPT

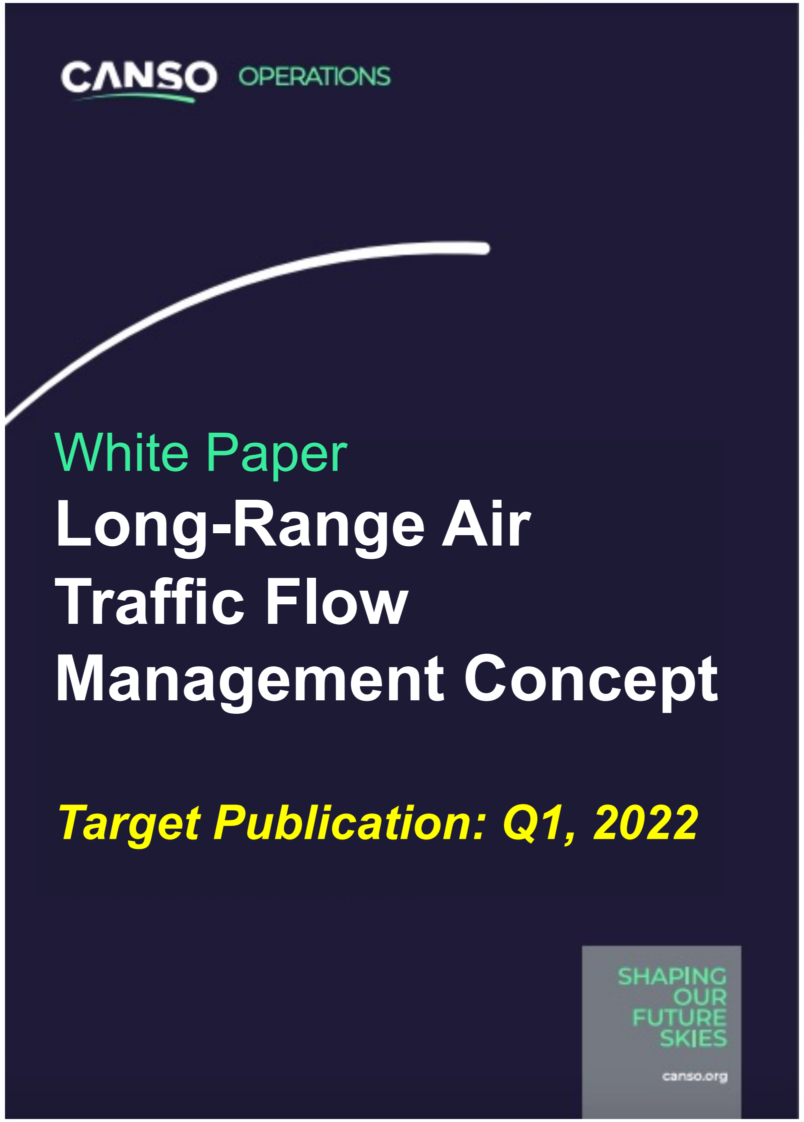
Core Principles Under Exploration:

4. **Final runway landing slot allocation as part of tactical Arrivals Management (AMAN) should be consistent with LR-ATFM to ensure a predictable transition and minimise double allocation of delay.**

   - The LR-ATFM delay which has been already absorbed outside the tactical AMAN arena should be accredited when determining the final landing slot.

# LONG-RANGE ATFM WHITE PAPER

CANSO


CANSO OPERATIONS

White Paper

**Long-Range Air Traffic Flow Management Concept**

***Target Publication: Q1, 2022***

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## A few cans of worms…

*How do we deal with conflicting ATFM measures, especially as LR-ATFM applies to trans-regional flights?*

*How do we consider (high) variations enroute for the long-range flights when implementing LR-ATFM measures?*

*What is the role of an ATC unit in facilitating a flight's LR-ATFM measure compliance for a constraint 2-3 FIRs away?*

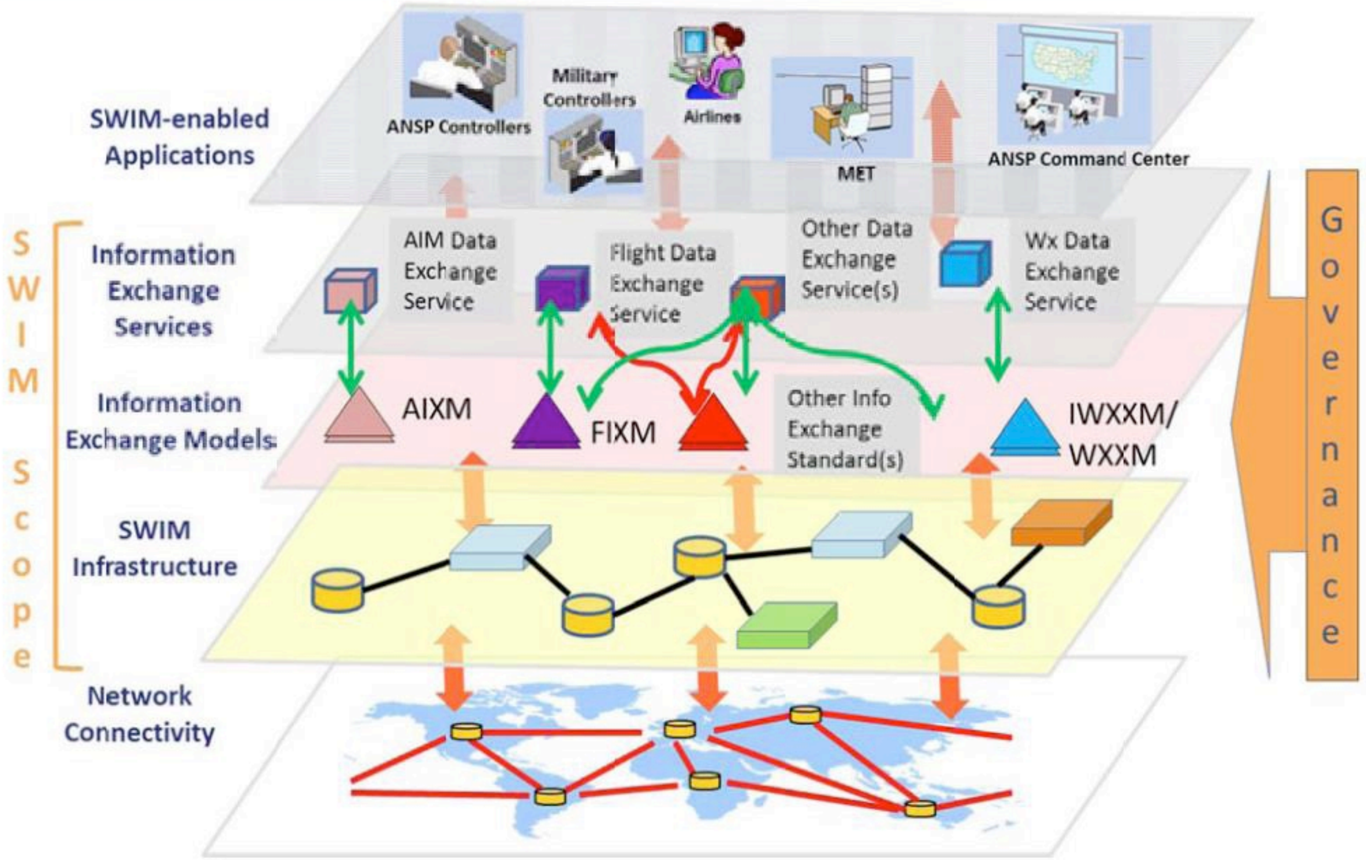
*What level of integration is required – if at all – between an ATFM system and AMAN/XMAN system?*

**…still to be addressed**

Exploration Topic 3

# ATFM/A-CDM on SWIM

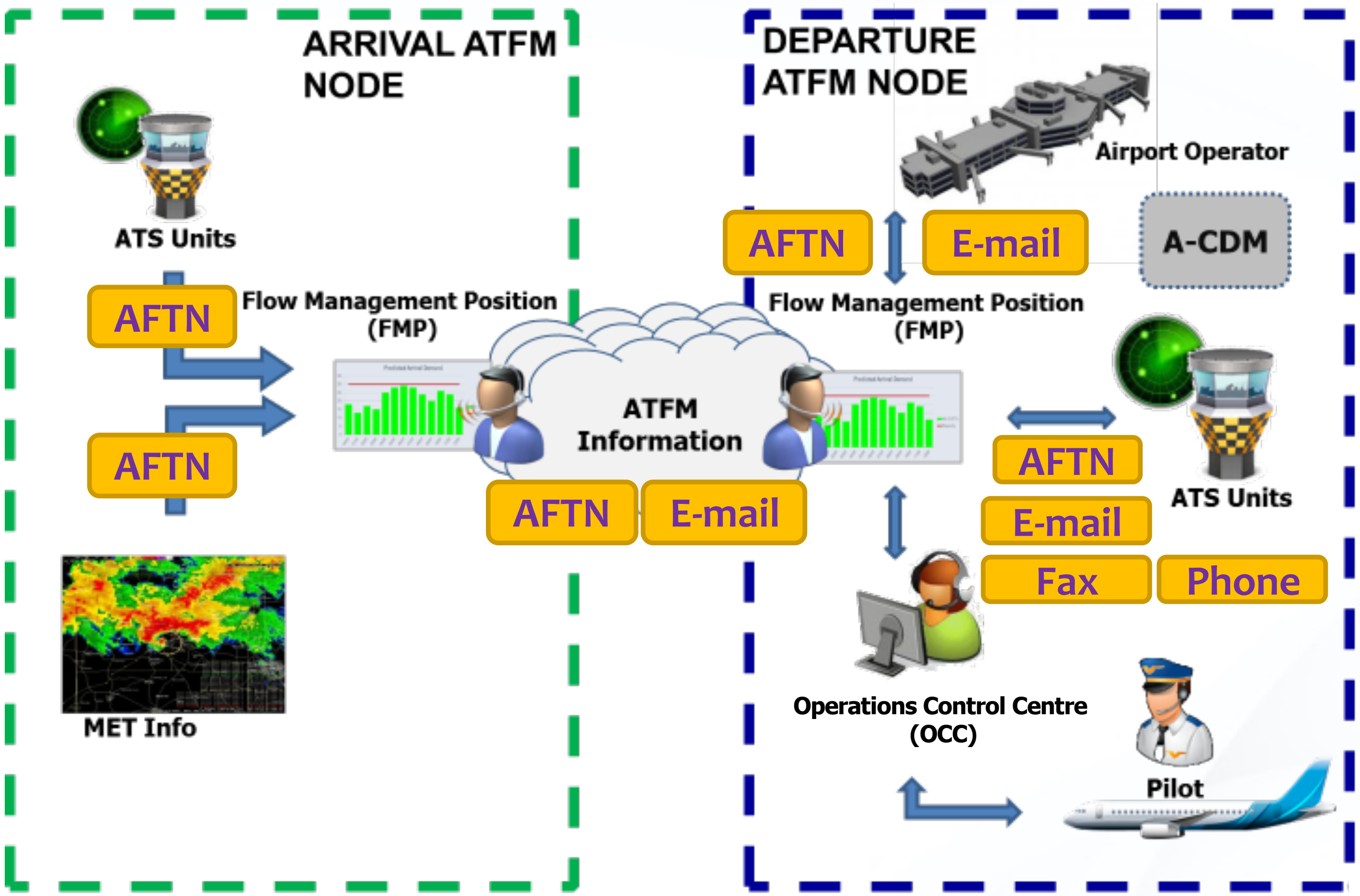
# REMINDER: WHAT IS SWIM?




- Consists of **standards, infrastructure**, and **governance**
- Enables the **management** of ATM-related information and its **exchange**
- Between **qualified parties** via **interoperable services**

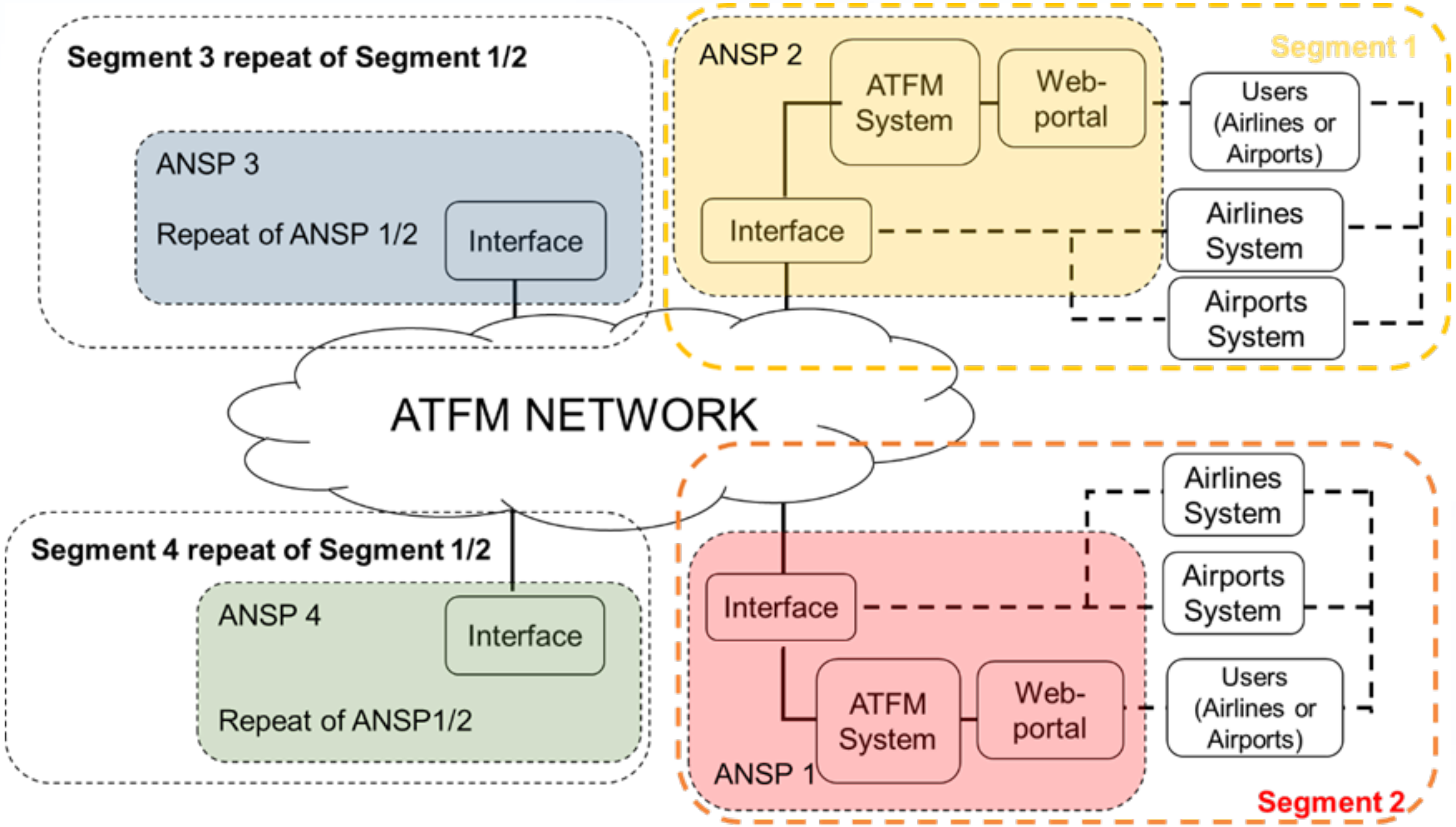
*ICAO Manual on SWIM (Doc 10039)*

# SWIM & ATFM: WHY?




- (Semi-) manual and unscalable
- Limited scope of available formats for information exchange
- Limited applications

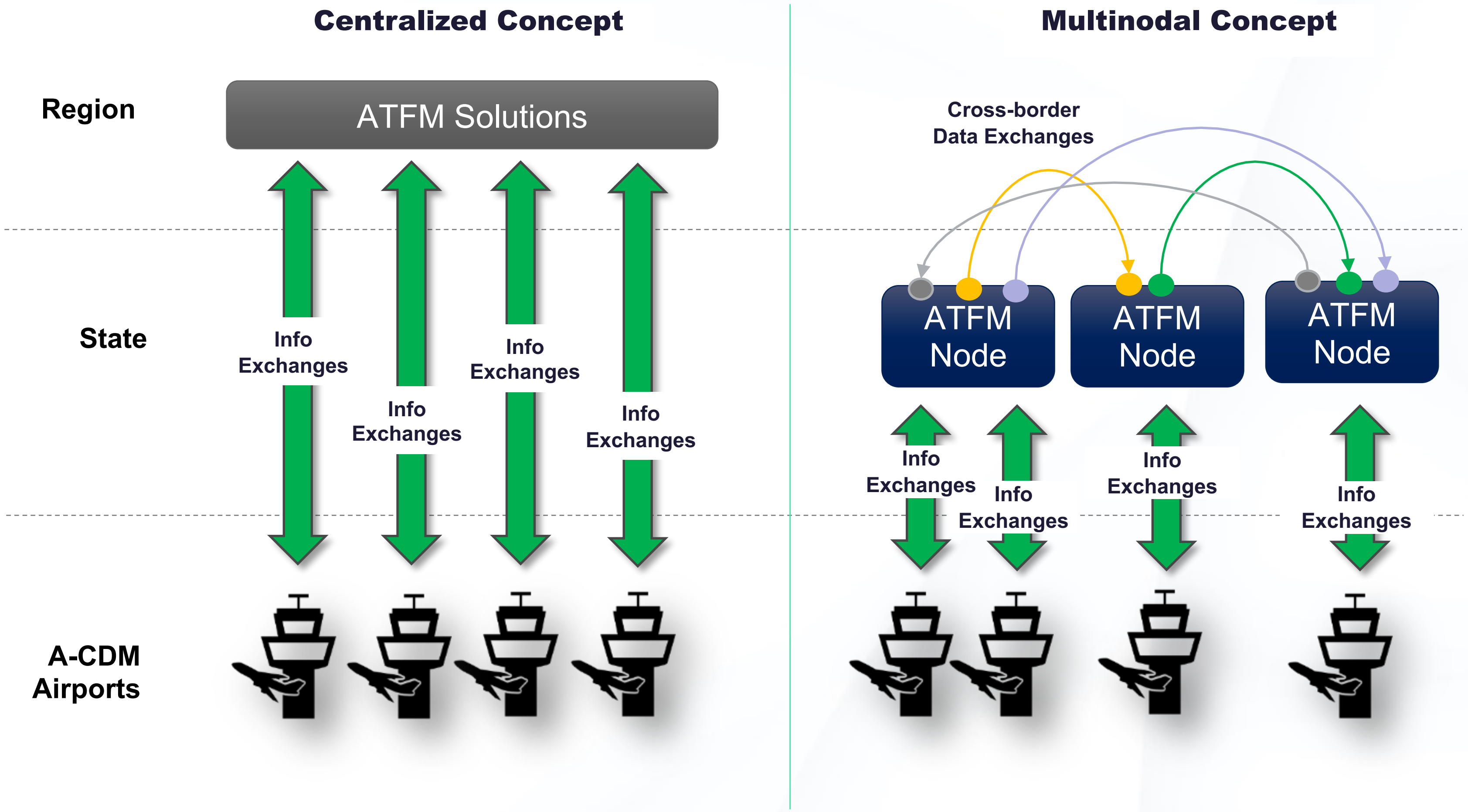
# SWIM & ATFM: WHY?




**Possibilities for…**

- Automated exchange and interactions
- Expanded scope and flexibility of information exchange
- Extensive new applications and services

# SWIM & A-CDM: WHY?



Exploration Topic 4

# ATFM & A-CDM as Managed Services

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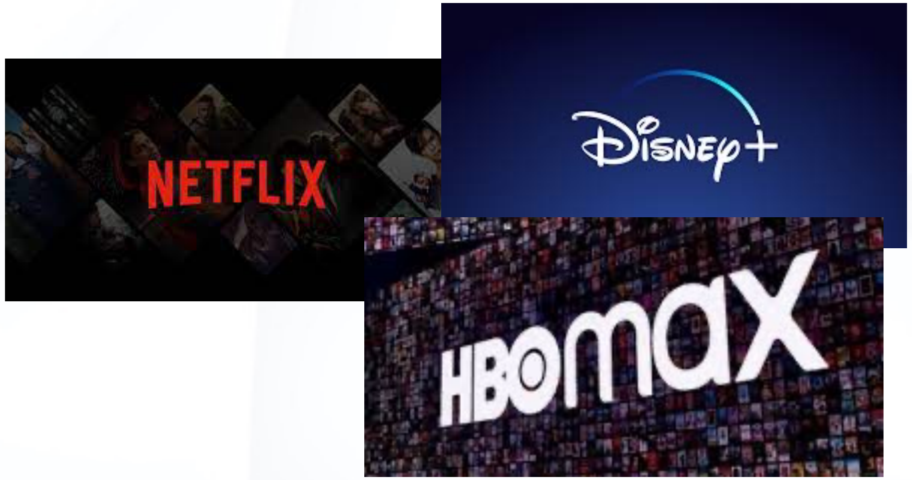
# Managed Services Transforming Industries

Music

Spotify

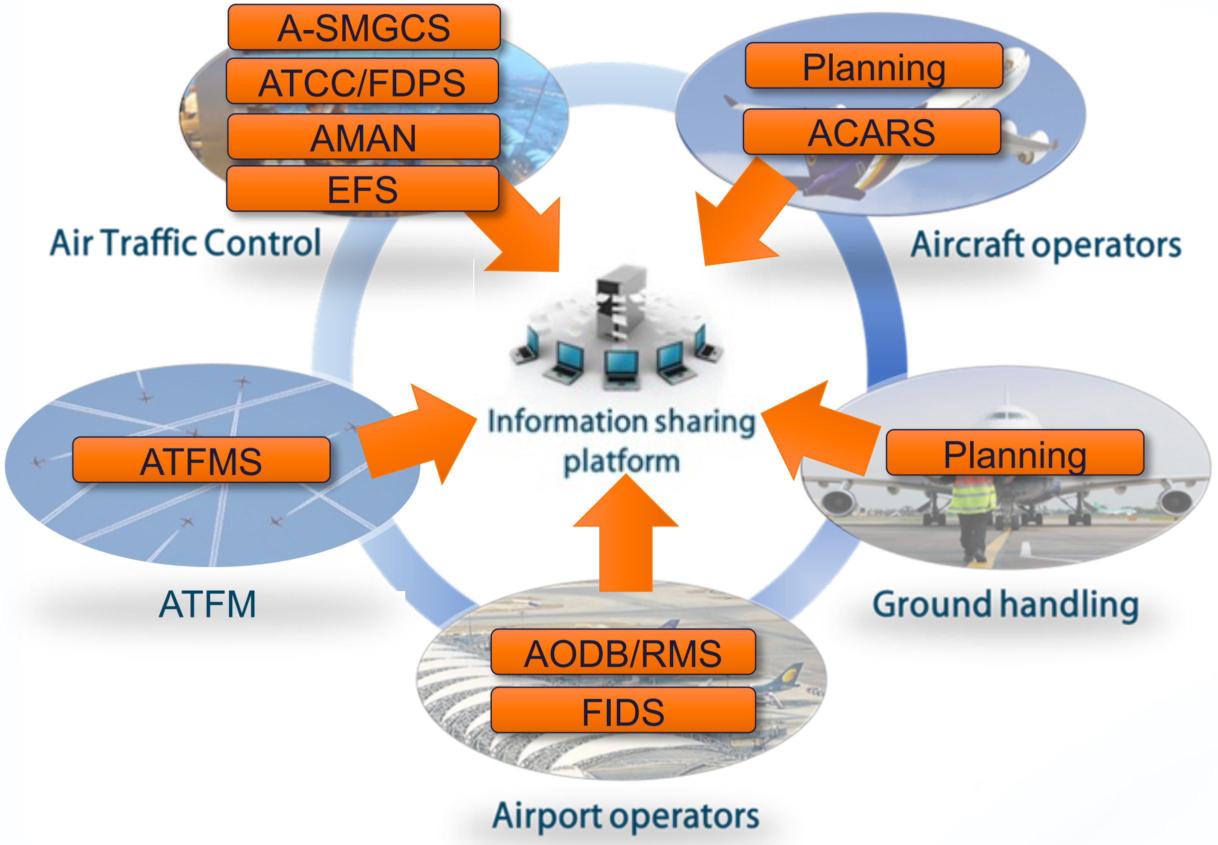
Google Play Music

# Closer to “home”…

# A-CDM as a Managed Service

**"Today" A-CDM is implemented by:**

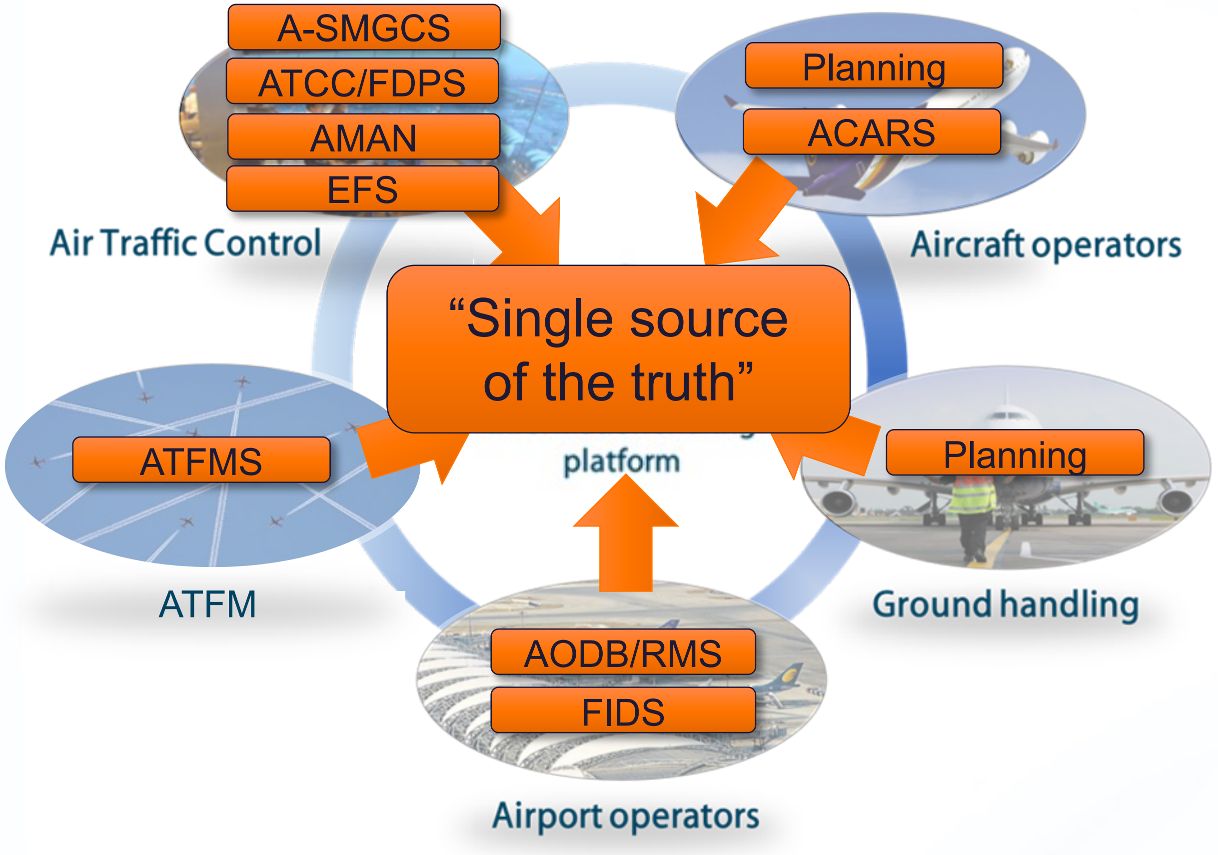



- Putting an A-CDM Platform in place with hardware and software managed by the implementer (Airport Operator or ANSP)

- Enabling information sharing from and to multiple systems like:
  - AODB/RMS
  - FIDS
  - A-SMGCS
  - ATC Automation System/FDPS
  - AMAN
  - EFS
  - Airline/GH Planning systems
  - ACARS
  - …and more

# A-CDM as a Managed Service

**"Today" A-CDM is implemented by:**

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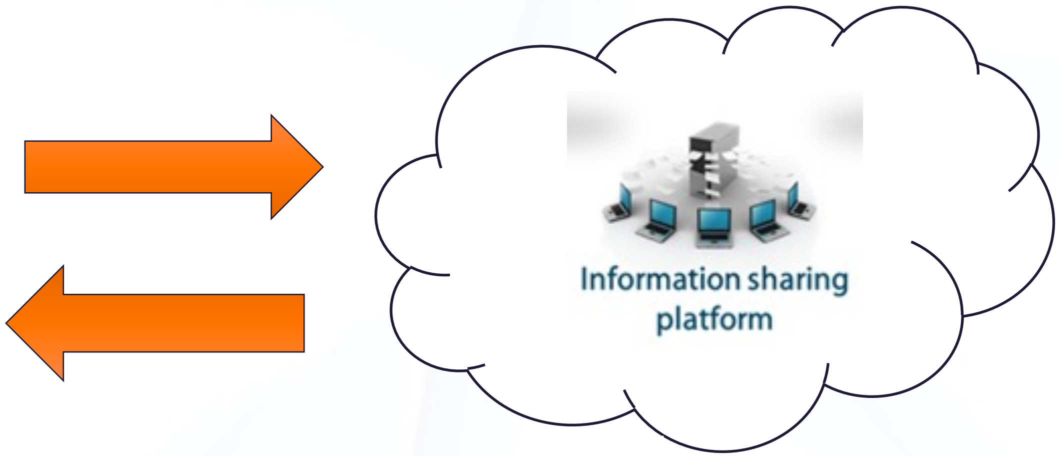
  - AODB/RMS
  - FIDS
  - A-SMGCS
  - ATC Automation System/FDPS
  - AMAN
  - EFS
  - Airline/GH Planning systems
  - ACARS
  - …and more

- The A-CDM platform processes and presents the information.

# A-CDM as a Managed Service

**What about “tomorrow”…**


- \+ No infrastructure to be owned or managed
- \+ Less need for CAPEX investments
- \+ Easier to scale and adapt to different implementations, multi-airport concepts
- \+ Any device concept enabled

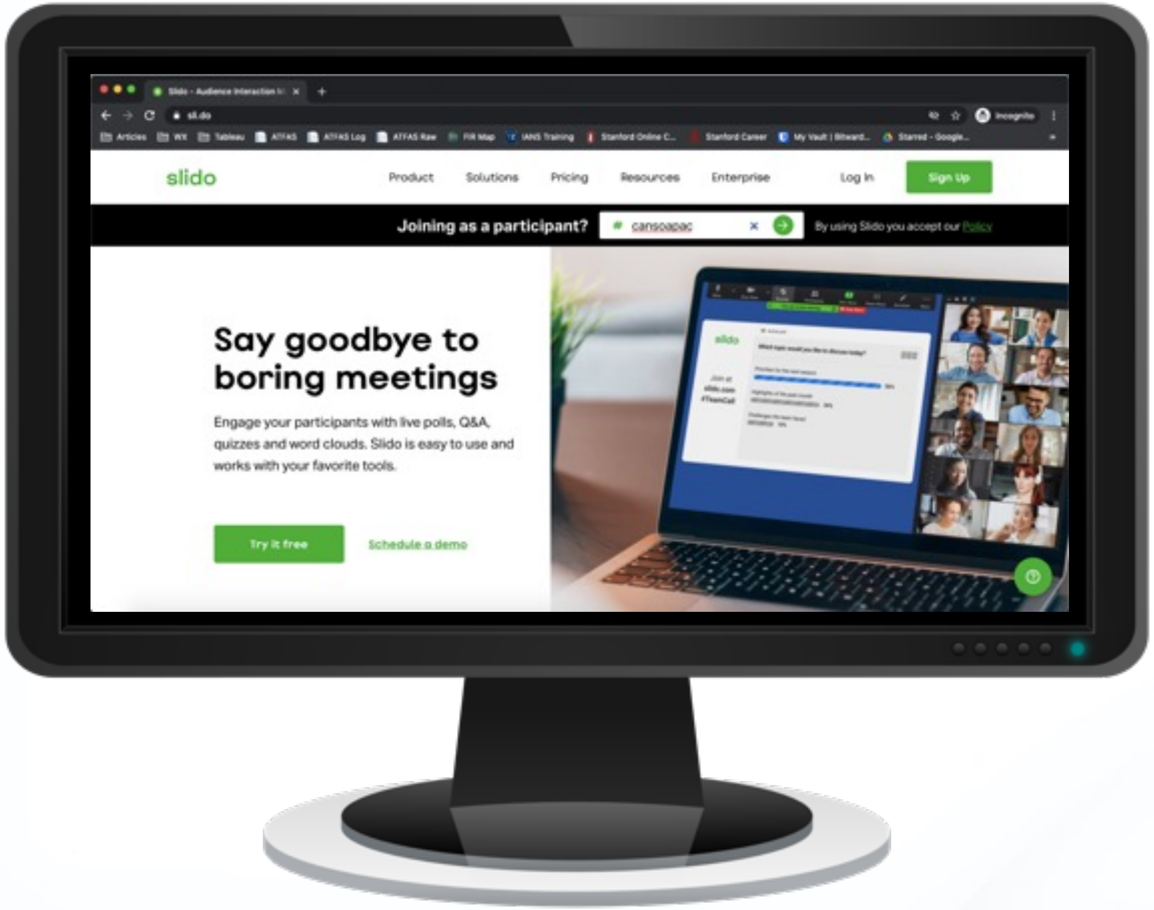
- \- Outsourcing strategies are “lacking” and the “trust”
- \- Non-standard interfaces, SWIM Services is a key factors

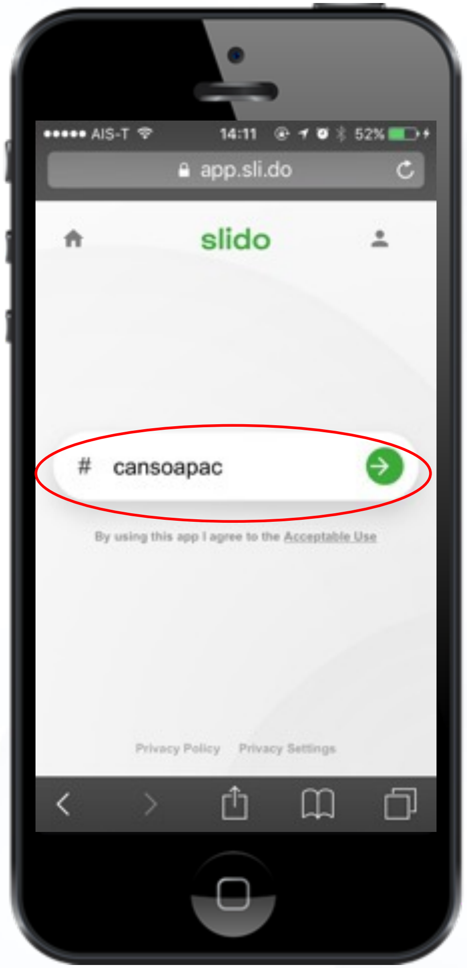
# ATFM as a Managed Service

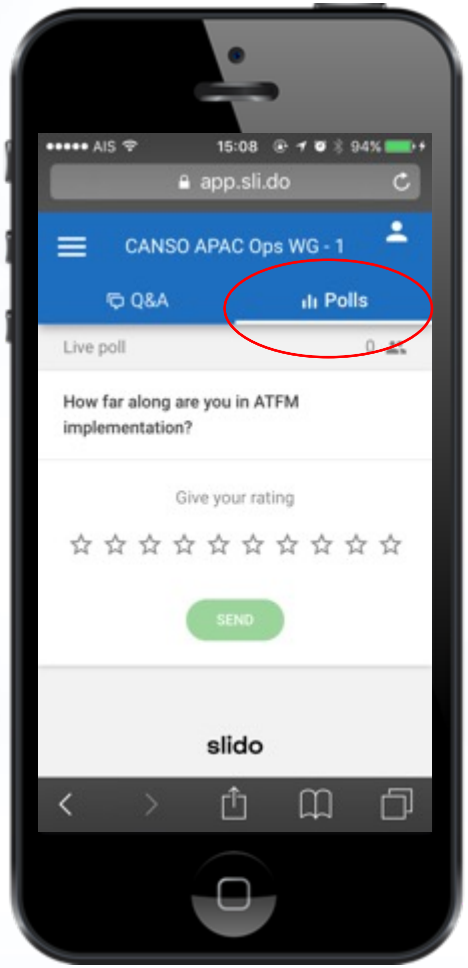
**You have seen the possibility with A-CDM, what about ATFM? Is it possible as a managed service as well?**

# ATFM as a Managed Service

Go to **http://sli.do** and enter the code **#mngsvc**



# ATFM as a Managed Service

## Benefits of ATFM as a Managed Service

- Smaller ANSPs don’t always require an ATFM service
- Reduced use of resources
- Minimal implementation costs
- Centralized ATFM is always more effective
- Accurate demand predictions
- Common situational awareness
- Better regional picture and ultimately global picture
- Could remove political constraints
- Could help with the implementation of FF-ICE

# ATFM as a Managed Service

## Constraints of ATFM as a Managed Service

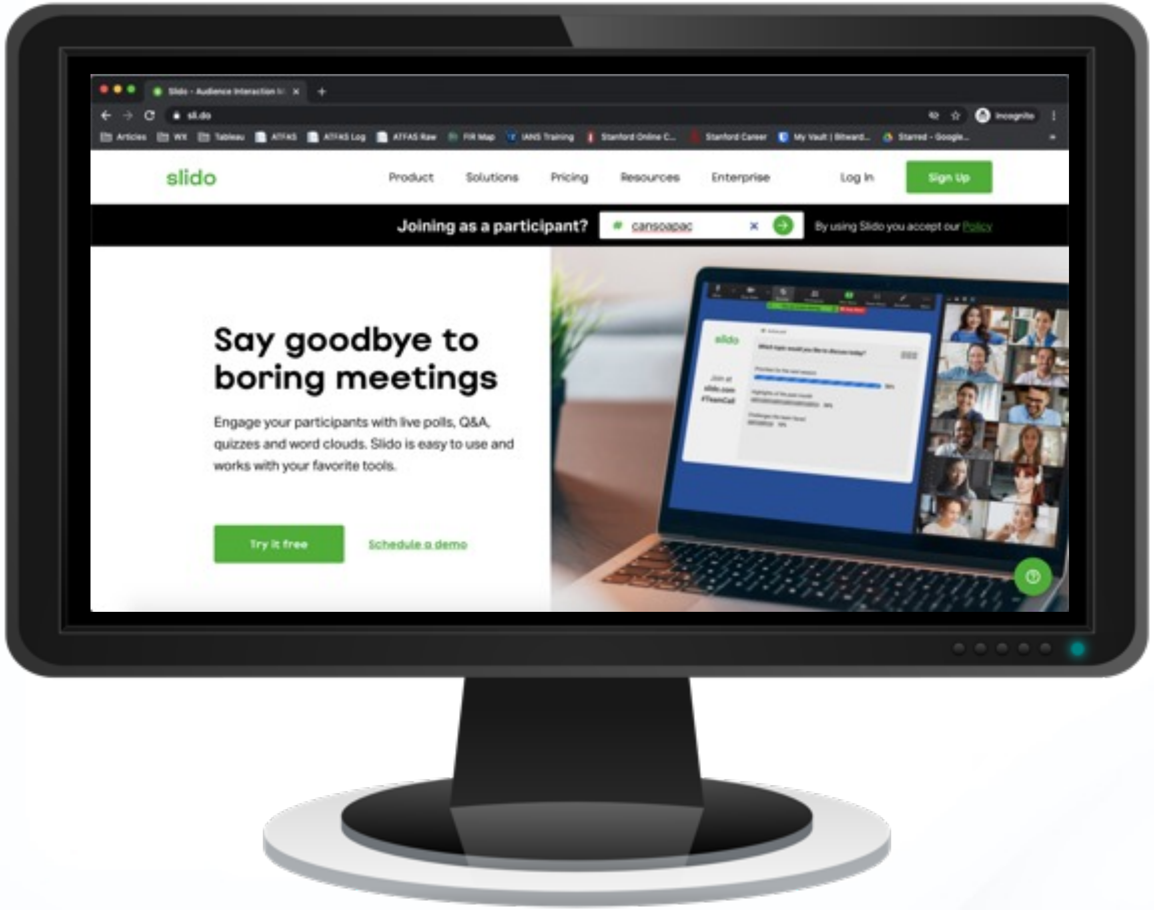
- Lack of willingness by ANSPs to share information
- Resistance to share information because of security reasons
- Completely new process, resistance to change
- Costing model could be complicated

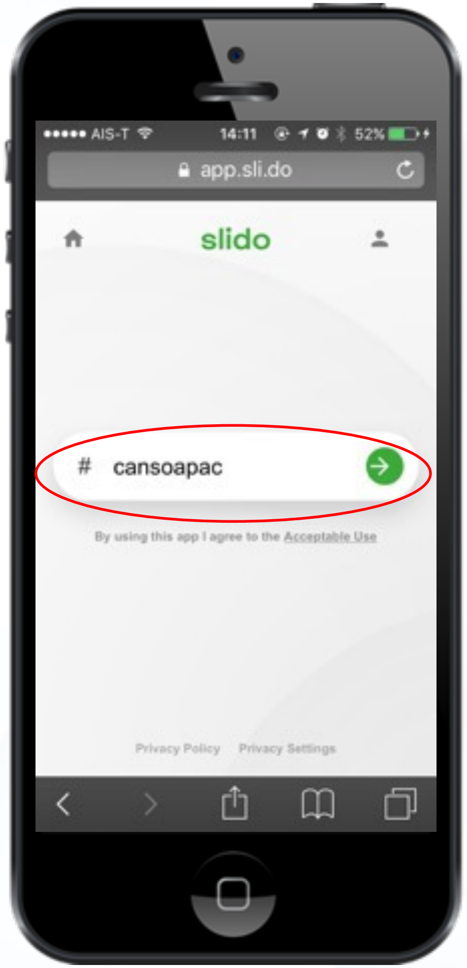
- *Technically not possible:*

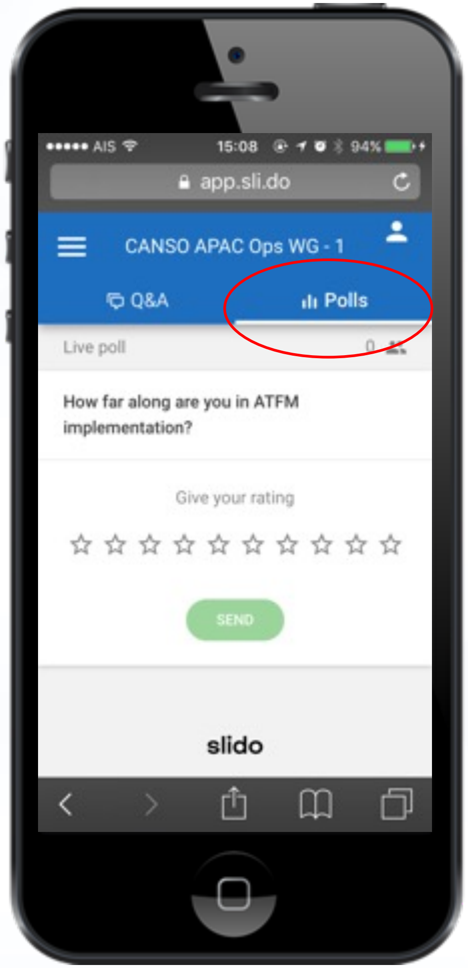
  *Technically ATFM as a managed service is now possible*

# ATFM as a Managed Service

Go to **http://sli.do** and enter the code #**mngsvc**



Brainstorming

# What More Can Be Explored in ATFM & A-CDM in Asia/Pacific?

# YOUR THOUGHTS

Go to **http://sli.do** and enter the code #**atfmfuture**

# OPEN DISCUSSION

# REMINDER: KEY PUBLICATIONS

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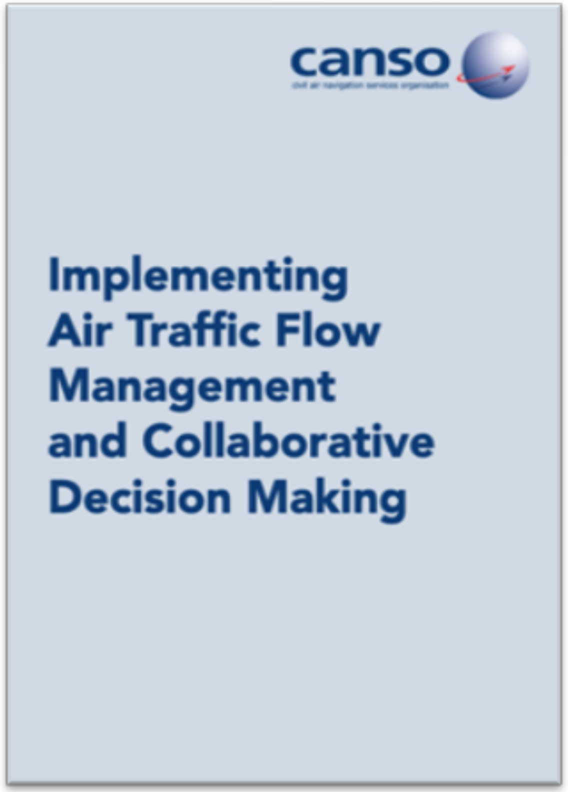
Airport Collaborative Decision-Making: Optimisation through Collaboration

An Introductory Guide for Air Navigation Service Providers

**Published Jun 2016**



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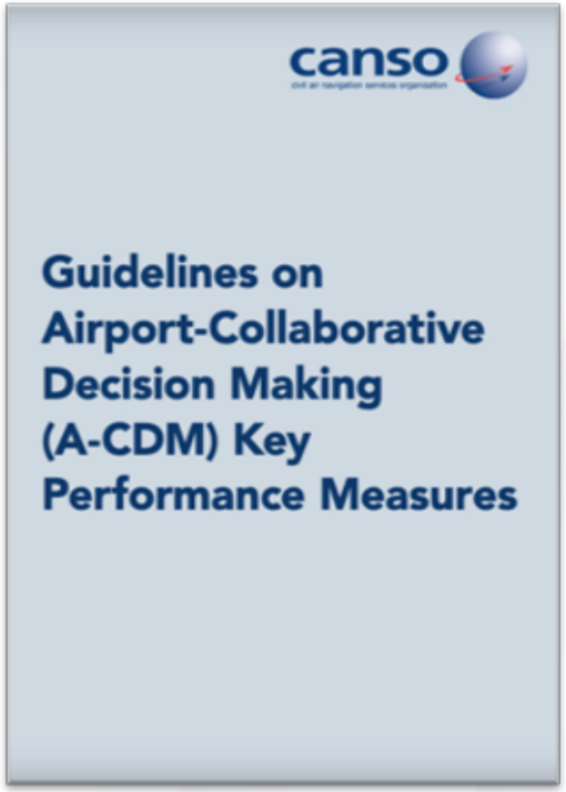
Implementing Air Traffic Flow Management and Collaborative Decision Making

**Published Apr 2019**



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Guidelines on Airport-Collaborative Decision Making (A-CDM) Key Performance Measures

**Published May 2019**

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CANSO Guide on ATFM/A-CDM Integration

**Published Oct 2020**

# THANK YOU

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# Hong Kong International Airport

# Implementation of Enhanced Wake Turbulence Separation (eWTS)

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Civil Aviation Department

# Content

1. Background
2. Hong Kong eWTS Project
3. Hong Kong eWTS Implementation Plan
4. Operational Experience
5. Runway Occupancy Time - Arrival

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## 1. Background

# ICAO Wake Turbulence Separation Minima

- **Procedures implemented over 40 years ago based on theoretical calculations primarily using the maximum take-off weight of aircraft.**
- **Since that time there have been significant changes in airframe design, aircraft structure and increases in aircraft weights**

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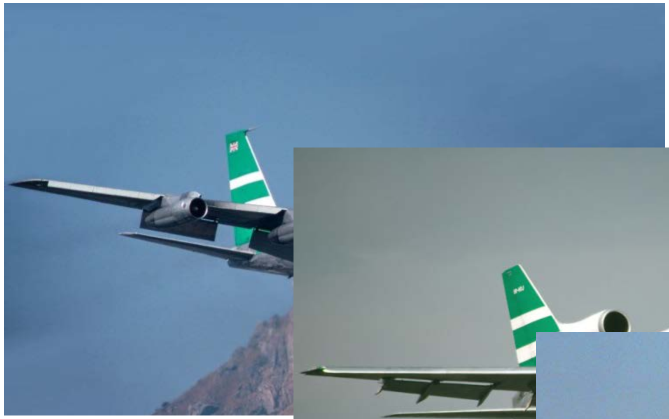
# 1. Background

## 40 Years of Aircraft Development



1970s


1980s

1990s


2000s

# ICAO Enhanced Wake Turbulence Separation (eWTS)

- **Based on qualitative and quantified data collected from comprehensive wake vortex studies conducted in Europe and the US.**

- **A series of test flights and simulator exercises provided data for accurate measurement and calculation of the generation of wake turbulence by different types of aircraft.**

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# ICAO Enhanced Wake Turbulence Separation (eWTS)

- **Utilises seven groups of aircraft, using a combination of criteria:**
  - **maximum take-off weight,**
  - **wingspan,**
  - **wake generation characteristics, and**
  - **resilience to wake encounters.**
- **The operational benefits of the procedure include:**
  - **consistent and efficient delivery of arrivals,**
  - **to optimise runway capacity,**
  - **improved runway delivery rate,**
  - **reduced flight time and improved schedule reliability,**
  - **accommodate schedule plans for post-pandemic recovery.**

# 2. Hong Kong eWTS Project

## Hong Kong Project Timeline

- **Jun 2017** **Hong Kong Incremental Capacity Study findings**
- **Jun 2018** **Hong Kong RECAT-EU Project commences**
- **Apr 2019** **ICAO State Letter introduces Proposal for Revised Wake Turbulence Separation Minima**
- **Jul 2019** **Hong Kong RECAT-EU Project renamed ICAO-RECAT Study**
- **Jun 2020** **ICAO State Letter announced eWTS to be implemented on 5 Nov 2020**
- **Nov 2020** **Hong Kong implements eWTS for arrivals**

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# Hong Kong eWTS Programme

- **Project Safety Plan**
- **Safety Analysis Plan using Eurocontrol Template**
- **Collection of LIDAR, Flight Data and ATC records**
- **Safety Assessment Process**
- **Local Safety Case Report**
- **Implementation and Training Plan**
- **Conduct Stakeholder Workshops**

# 2. Hong Kong eWTS Project

## Collect Data for 12 Months

**ATM Surveillance Data**

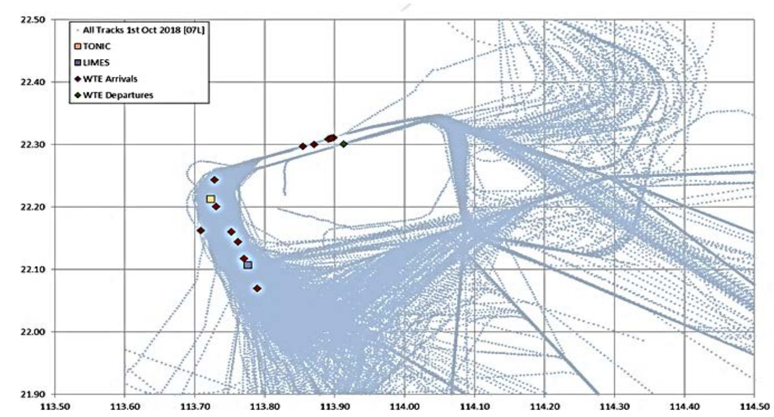
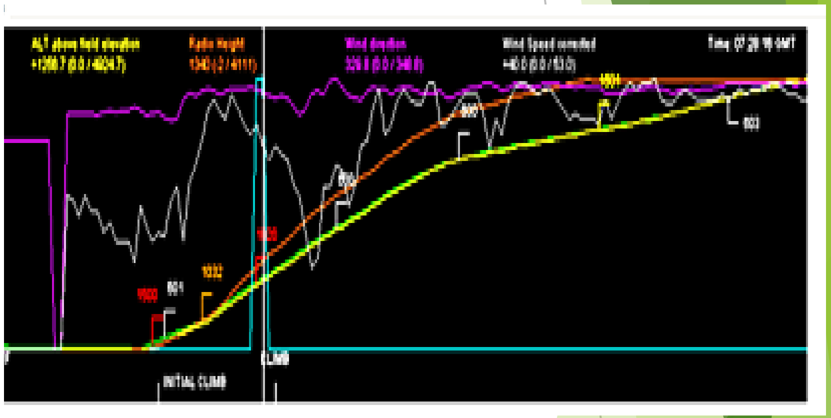



*Figure 13: Location of reported WTE Encounters during 07L operations, overlaid on typical 07L daily flight tracks.*

**Flight Recorder Data**



**Pilot reports of wake turbulence encounters were analysed with information from ATC surveillance data and aircraft flight recorders**

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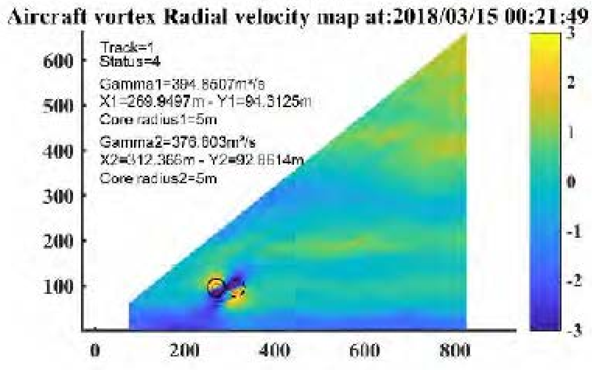
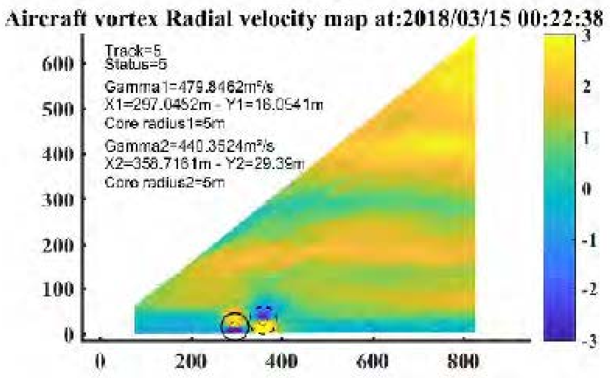
# Comprehensive Lidar Data Analysis

- ➢ **Records of vortex formation and dissipation**

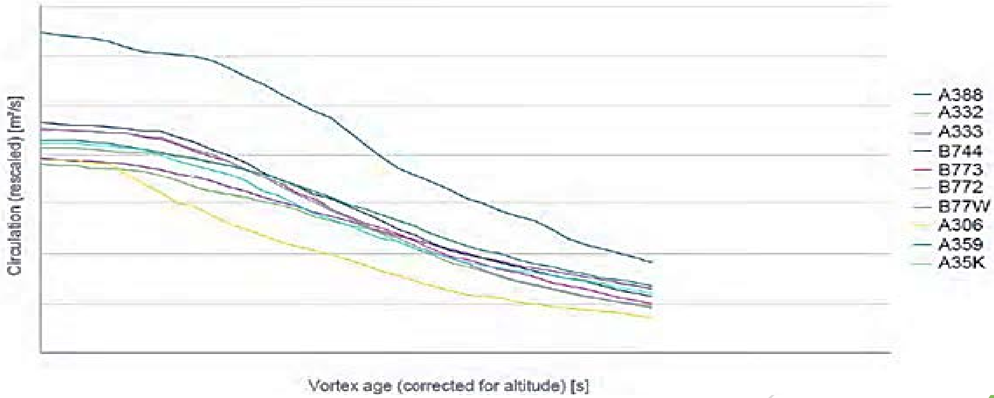
Scan 1




Scan 5




- ➢ **Compare vortex dissipation rates**

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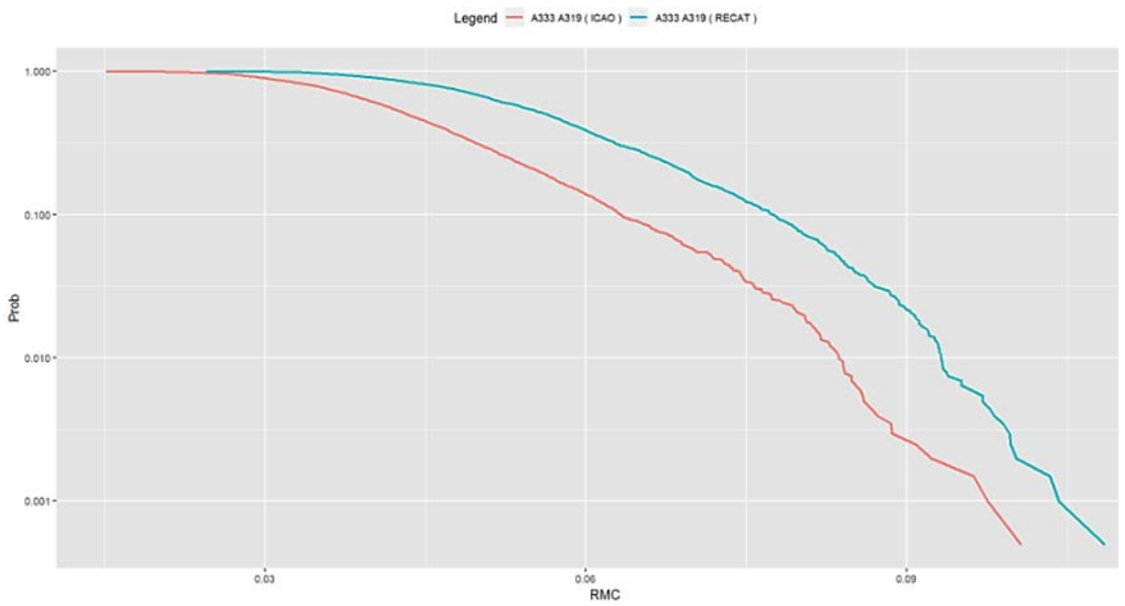
# Calculation of Risk Values




- **Comparison of wake encounter risk for each aircraft pair (e.g. A333 and A319) using ICAO and ICAO-RECAT minima**

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2. Hong Kong eWTS Project

# Reports and Documentation


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## 2. Hong Kong eWTS Project

# Safety Assurance Summary Report

**'Overall, the safety analysis concludes that the predicted impact to wake turbulence encounter reporting and severity is in line with expectations of the RECAT-EU Safety Case and the detailed analysis of local Hong Kong wake data supports the reductions in wake separation.'**

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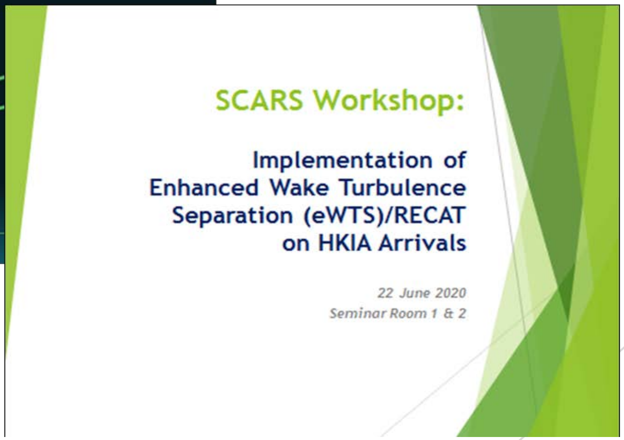
# 3. Hong Kong eWTS Implementation Plan

## Conduct Local Safety Case

- **Comparison of Hong Kong data analysis with Eurocontrol RECAT-EU Safety Case data**
- **Hazard Identification Workshops**
- **Risk Assessment and Mitigation Forums**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# 3. Hong Kong eWTS Implementation Plan

## Controller Training

- ➢ **Need for stricter speed control**
- ➢ **Awareness of rate of closure**
- ➢ **Timely issuance of landing clearance**
- ➢ **Recovery actions**

**Simulator training for Approach controllers**

**ICAO 7 Wake Turbulence Groups**

**Distance-based Enhanced Wake Turbulence Separation (eWTS) Minima**

| Follower / Leader | Group A | Group B | Group C | Group D | Group E | Group F | Group G |
|---|---|---|---|---|---|---|---|
| Group A | | 4 NM | 5 NM | 5 NM | 6 NM | 6 NM | 8 NM |
| Group B | | 3 NM | 4 NM | 4 NM | 5 NM | 5 NM | 7 NM |
| Group C | | | | 3 NM | 3.5 NM | 3.5 NM | 6 NM |
| Group D | | | | | | | 4 NM |
| Group E | | | | | | | 4 NM |

**Comprehensive briefings for Aerodrome controllers**

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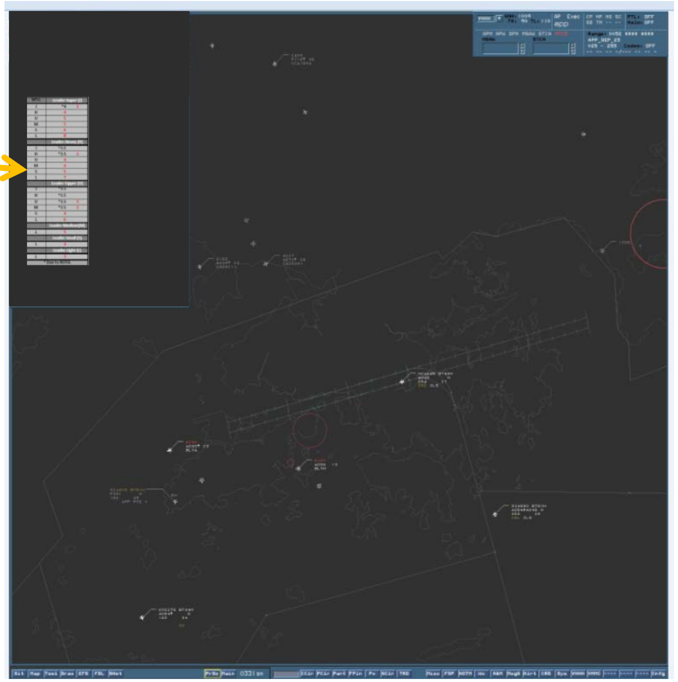
# 3. Hong Kong eWTS Implementation Plan

## ATM System Adaption

**Approach and Tower controller situation display**

**Cue card**

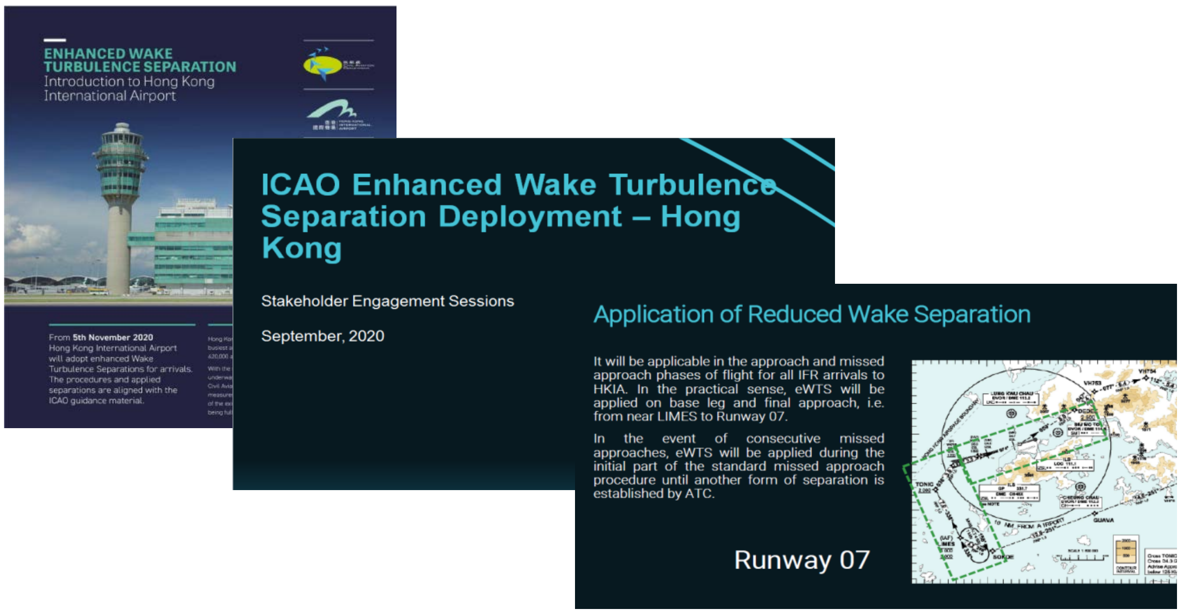


**Cue card with eWTS separation minima shown on screen for easy reference**

# 3. Hong Kong eWTS Implementation Plan

## Stakeholder Engagement

- Pilot Workshops and Briefings
- AIP and AIC Documentation.




**More than 70 aircrew and airline personnel participated in Briefing Sessions on the implementation of eWTS at HKIA.**

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## 4. Operational Experience

# Since Introduction of eWTS for Arrivals on 5 November 2020

- **More consistent and accurate spacing on final approach**
- **No increase in pilot reports of wake turbulence encounters on final approach**
- **No increase in occurrences of go-arounds due to a catch-up situations between aircraft on final approach**

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# 4. Operational Experience

## ICAO Wake Turbulence Minima and Benefits of ICAO eWTS Minima

**A350 (Heavy)**

**A350 (Group B)**

**ICAO 4 NM**

⟺

**eWTS 3 NM**

**B777 (Heavy)**

**B777 (Group B)**

**A330 (Heavy)**

**A330 (Group B)**

**ICAO 5 NM**

⟺

**eWTS 4 NM**

**A320 (Medium)**

**A320 (Group D)**

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# 5. Runway Occupancy Time – Arrival (ROTA)

## Aircrew Active Participation

**The benefits of eWTS can easily be negated if pilots:**

- **do not comply with ATC speed restrictions on final approach**
- **do not adhere to minimum runway occupancy times for arrivals (ROTA)**
- **do not vacate at the first available rapid exit taxiway**

# Enhanced Wake Turbulence Separation implemented by Civil Aviation Department, Hong Kong with the assistance and cooperation of

Airport Authority Hong Kong

Hong Kong Observatory

Cathay Pacific Airlines

NATS

Eurocontrol