
ICAO
INTERNATIONAL CIVIL AVIATION ORGANIZATION
A UN SPECIALIZED AGENCY

CONNECTED AIRCRAFT

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BACKGROUND

Global Air Traffic Management Operational Concept

- “The future ATM system … will rely on explicit and unambiguous information and on wide information exchange within the system. Key information relates to the future position of aircraft, and to the meaning and status of that information. “

- “Information on planned future aircraft behavior can be obtained from the aircraft systems (avionics). It is associated with the commanded trajectory and will enhance airborne functions. The aircraft intent data correspond either to aircraft trajectory data that directly relate to the future aircraft trajectory as programmed inside the avionics, or the aircraft control parameters as managed by the automatic flight control system. These aircraft control parameters could either be entered by the flight crew or automatically derived by the flight management system.”

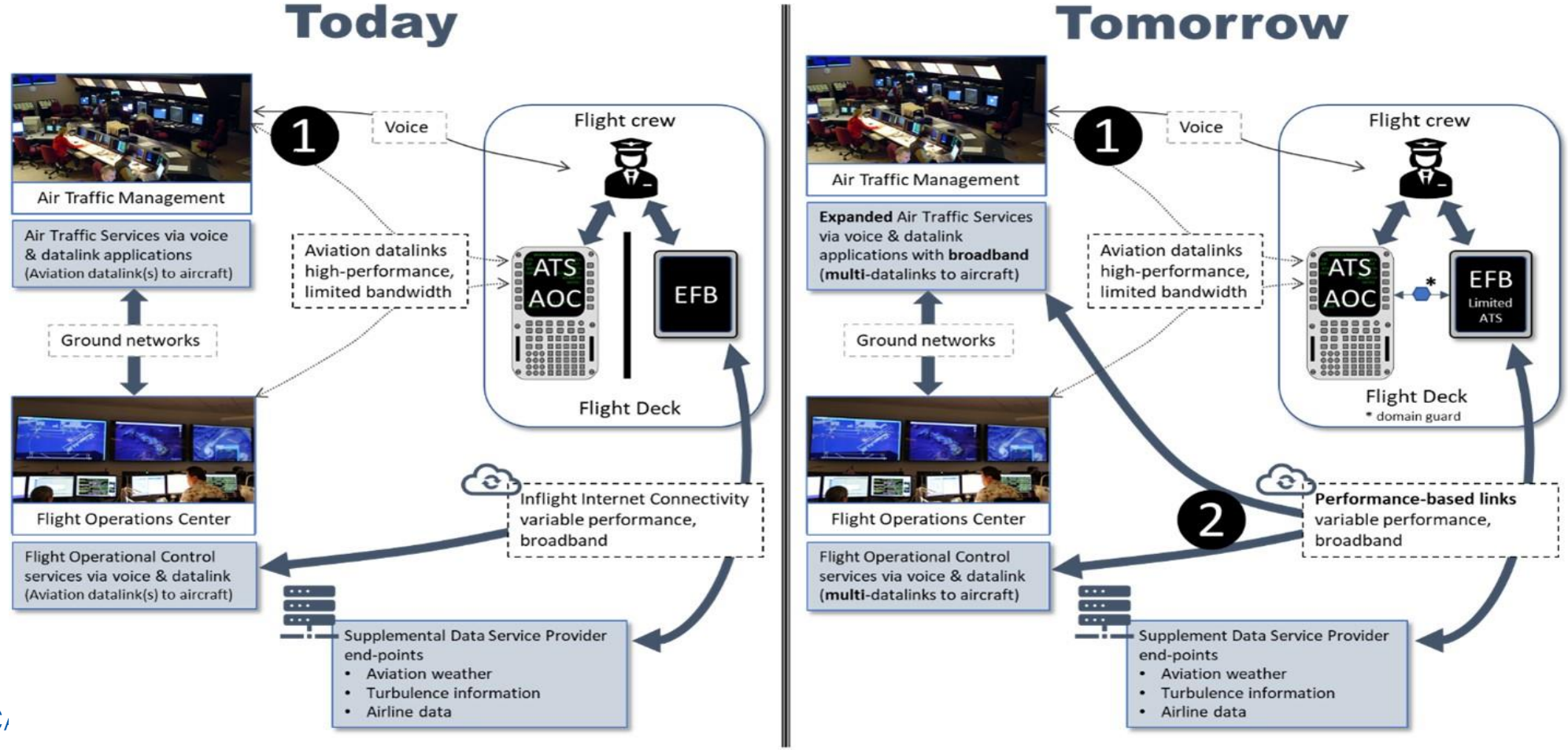
CONCEPT

Connected Aircraft

- Establishing performance requirements is done in alignment with operational needs and existing regulatory constraints/expectations.
- Required performance and failure conditions need to be identified and requirements allocated to the communication systems.
- Technical considerations:
  - Data exchange transaction time (one-way or round-trip)
  - System availability and continuity
  - Data integrity and identity authentication
  - Spectrum usage
  - System monitoring and alerting

CONCEPT

Connected Aircraft (cont'd)



CONCEPT

Connected Aircraft (cont'd)

- The CA concept envisions that messages can be loaded into the FMS, similar to what CPDLC does today, while respecting necessary requirements for data integrity and segregation, thereby reducing crew workload and eliminating transcription errors.

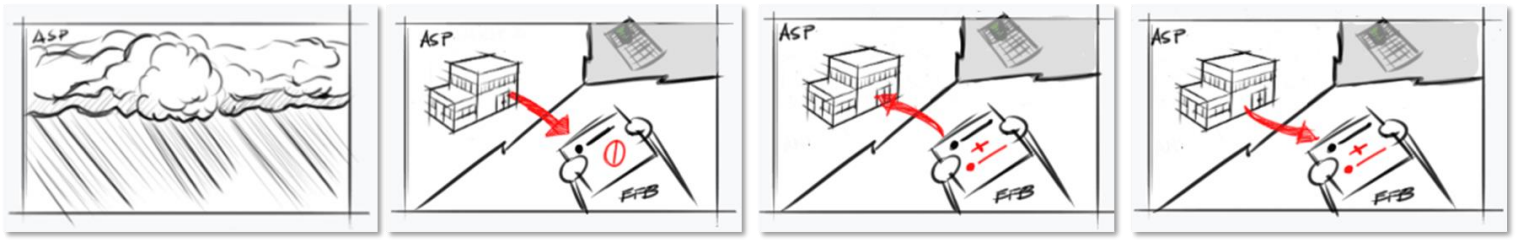
- The addition of commercial pathways provides a supplemental solution to support real-time capabilities and updates to the ATCO. Information regarding the current state—such as aircraft position, future intent, guidance modes and settings, and performance limits—will be able to be sent to both ATM and the FOC.

- An aircraft with communications capabilities (both aviation and non-aviation specific subnetworks) will have implications on both airborne and ground-based systems, namely, the establishment and maintenance of multiple active links. This will require new management techniques to ensure safe and effective operations.

USE CASES

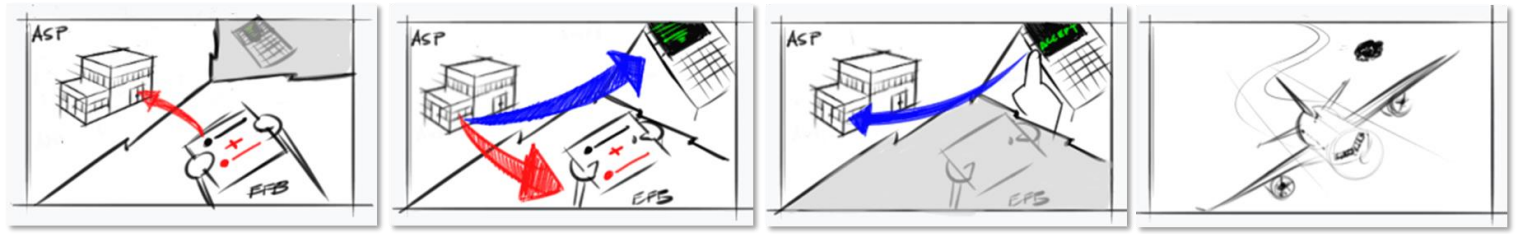
Connected Aircraft Application

- Trajectory negotiations avoid a weather constraint
- Commercial link (red) used in conjunction with aviation link (blue)



1. Developing weather along route of flight
2. ASP identifies a constraint and sends to flight crew's EFB
3. Flight crew analyzes constraint, solves for efficient routing around constraint with EFB and submits a trial request to ASP for a new trajectory
4. ASP approves the trial request

Continued →

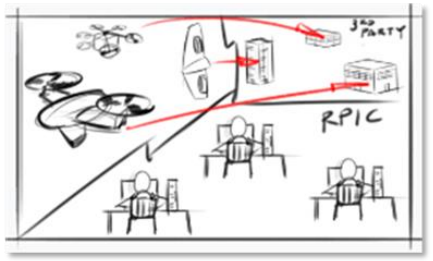


5. Flight crew submits revision request
6. ASP responds with a revised clearance using primary means of communication to allow the flight to proceed with the approved request
7. Flight crew acknowledges the clearance using primary means of communication
8. Revised trajectory performed

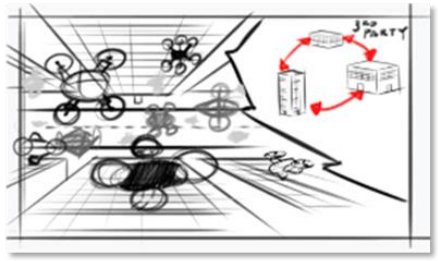
USE CASES

New Entrant Application

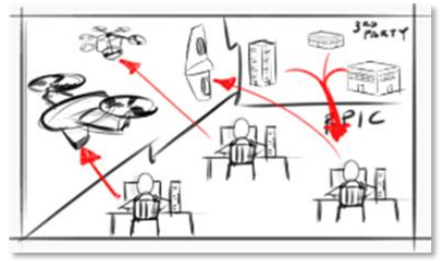
- UAS location sharing
- Information on vehicle state (speed, location, direction of flight) sent to the ground
- Information consolidated and a traffic picture is sent back to RPICs for improved real-time situational awareness



1. UAS sends data to third-party UAS Service Suppliers (USS)



2. Third-party USS aggregate urban UAS flight patterns



3. Remote Pilot in Command (RPIC) receives data to conduct operations

ADDITIONAL THINGS TO CONSIDER

Connected Aircraft (CA)

- EFBs play a notable role in the CA concept, providing a potential interface for the AU to take advantage of additional efficiency, flexibility, and cost effectiveness in the delivery and display of certain kinds of information, supplementing and enhancing the information provided by the FMS.

- Aircraft domain guard function - Protection mechanism(s) between the Aircraft Control Domain (ACD) and Airline Information Services Domain (AISD) and Aircraft data gateway enables the exchange of aircraft avionics data in other protocols and services consistent with COTS technologies

ADDITIONAL THINGS TO CONSIDER

Connected Aircraft (CA)

- Technical Considerations also include communication infrastructure and required performance are covered in the CA conops.
- System Safety such as example of functional hazard assessment included in the CA conops
- Cyber Security and Data Integrity must be addressed.

STANDARDIZATION

Connected Aircraft (CA)

- Interoperability is critical to achieving widespread adoption of these capabilities.

- One means of achieving interoperability is to standardize CA services without reference to the underlying data link technology. Such standards would include service functional descriptions, end-to-end performances, and operational safety assessments without any reference to the communication path, enabling stakeholders or CSPs to select the best data link technology for the service.

REGULATORY CONSIDERATION

Connected Aircraft (CA)

- To fully realize the benefits of the CA concept, global, cross-border operations are envisioned. To support the States in this environment, they should be supported by global standards and regulatory guidance across all necessary areas.

- Communication Network – Ground-Air and Ground-Ground

- EFB and Applications - Operational approvals consist of a combination of design considerations for fault mitigation, testing, operational trials, and operational mitigations. This concept and methodology should be embraced in future applications.

Thank You!

ICAO

BACKUP

CONCEPT

Connected Aircraft

- TBO example
  - the TBO concept is enabled through the exchange of data and trajectories via a data communications system connecting the flight crew, ATM, and FOC. This data communications capability allows for the exchange of information and provides a means of negotiation between the ATM and the flight deck. Through the EFB, the flight crew receives weather or constraint information and initiates trajectory negotiations with ATM. Similarly, the flight deck communicates with the FOC, receiving optimized flight plans and environmental information, resulting in an operational benefit.

- CA uses a performance-based approach for defining requirements for data communications.
- These requirements suggested here describe a level of end-to-end performance needed to support the end-application, but not necessarily the means of compliance.