Topics

❖ Data link in Boeing ATM concepts

❖ Boeing communications strategy (a/g focus)
  – The context: ATS data link for Boeing
  – Current situation and some of the immediate steps
    ❖ Basic business case premise, and the next driver
    ❖ Key gaps
    ❖ FANS and ATN
  – The next step

❖ Concluding messages
Data link Enables Boeing ATM Vision

Hybrid Ground and Space Based Communication, Navigation, and Surveillance

Trajectory Based Airspace Management

System Wide Information Management

- “Layered” security approach
- Open system principles—growth for the future
- Phased transition plan—builds on existing plans

Simplified airspace design
But it is "integrated data link"

Integrated data link is essential to ATM's vision:
- Enables 4-D Trajectory negotiation and separation
- Enables large-scale data sharing and integration
- Enables airspace redesign
- Enables seamless interoperability thru flight domains

Integrated data link includes a full CNS solution (CNS, not 'C'):
- Data link applications
  - CPDLC: direct controller to pilot communications
  - ADS-A: Automatic Dependant Surveillance
  - Others, e.g: AOC, GPS augmentation, GLS approach path, etc.
- For aircraft, the capability to interface with FMC and other avionics
- For ANSPs, the capability to share and use trajectory data
  - Primary examples: flight plan consistency, flight plan conformance, route clearance, trajectory negotiation
A nice example

The FMC can accept routes, altitudes and speeds in order to build an arrival trajectory that the aircraft will follow.

To meet a fix entry time

RNAV Routes
Speeds
Altitude Constraints
Required Time of Arrival
Current Situation: business cases and IP

- A high percentage (95%+) of data link traffic is non-ATS.
  - Airline Operational Control (AOC), Aeronautical Administrative Communication (AAC), etc.
  - AOC data link traffic “pays the bill” for airplane equipage and sustaining ground networks.
  - ATS data link concepts that ignore this find life difficult

- Current AOC protocol is obsolete
  - AOC will migrate to broadband IP (from ACARS)
  - IP is being deployed on aircraft (e.g. Connexion, Swift broadband)
  - Ground infrastructure is already built on IP

- IP within ATS
  - Some ground/ground ATS services are already migrating to IP
  - There is limited consideration of IP within the a/g ATS community

  ➢ Resulting in a lack of related IP system / protocol requirements
  ➢ Resulting in a lack of aviation service history to analyze potential a/g certification and security issues
AOC service experience with IP is critical to demonstrating adequacy for ATS

- AOC is going directly to broadband IP, bypassing ATN
  - ATS implementation needs to recognize this for migration planning
- For ATS, do not delay deployment of either FANS or ATN waiting on IP
  - There are ATS issues for IP
  - Investments in FANS and ATN will be supported on the migration path
- We don't see intermediate steps between ATN and IP
Current situation: key gaps

- VHF frequency congestion is a significant issue
  - VDL-2 is welcome intermediate step
    - Multiple, fully funded VDL-2 operational deployment programs
    - A welcome intermediate step, but it does not solve the overall VHF congestion problem
      - Avoid movement of new applications and systems into the VHF band
      - Pursue other sub-networks and spectrums (broadband)
  - RCP (Required Communications Performance)
    - Should form the basis of future steps
    - Current material is immature
- Security requirements
  - Should be a core part of future steps
  - Current material is immature and not progressing quickly enough
- And then there is the current equipage situation …
Current Situation:
ATS data link deployment (May '04)
Current Situation:
Aircraft datalink deployment

- FANS 1/A aircraft
- ATN aircraft (European operators)

Significant increases with no indication to subside (based on funded programs)
Specifics on aircraft Equipage

**FANS-1/A**
- All current production Boeing models offer FANS
- B777 and Airbus A330 / A340 come with FANS basic
- Airbus A320 will offer FANS as an option
- Boeing & Airbus future models (B7E7 & A380) will offer FANS
- US DoD is equipping 1500 aircraft with FANS

**ATN**
- B737-NG aircraft offer non-integrated ATN
- Some airlines type-certing B737, B757, B767 and A320 aircraft with non-integrated ATN
- Airbus is adding ATN to its 5 Belugas
- Airbus is adding ATN to some A320s
- To date, these solutions are only 'C' of CNS (no support for advanced ATM)
- Future aircraft (e.g. B7E7) are being designed to redress this
  - But retrofit is problematic, and fleet intrusion will be many years coming
  - Airborne dual-stack cannot address all FANS / ATN issues
And about those dual-stack aircraft

✅ Is there such thing as a dual-stack aircraft?

✅ In techno-speak, "yes".
  – AAL B767s now carry both FANS-1 and ATN.
  – B737-NGs will soon do the same.

✅ In operational-speak, "absolutely not"
  – These a/c are configured to use only one system
  – An airline cannot even reconfigure between flights

✅ In real terms, there is no dual-stack a/c
  – Because of costly architectural issues, and because of certification and approval issues
  – This is a "now" statement
  – Future aircraft allow reduced risk

✅ Multiple organizations recognize this:
  – Boeing, Airbus, LINK2000+, FAA Flight standards
So what does all that mean?

- Worldwide oceanic data link services are FANS-1/A, with no ATN accommodation planned today
  - NAT is analyzing the feasibility of ATN accommodation
  - THANKS
- Domestic Europe is devoted to ATN
  - But is pursuing a standardized FANS-1/A accommodation solution for some for its domestic data link services
  - THANKS
- Domestic US is planning for ATN
  - But is still creating discrete ATN and discrete FANS airspaces.
- Aircraft manufacturers cannot solve this problem without the ANSPs
- The next step is coming at us via our business cases
  - Broadband IP
  - It helps ATS data link to understand and try to use this fact
- Basically, it means we need an ATS migration strategy
Migration strategy: guiding principles

建立健全的指导原则

- 不要延迟装备等待下一步
  - 这包括宽带IP
  - 下一步尚未定义
- 支持FANS项目（简单现实）
- 支持ATN项目（简单现实）
- 支持地面双栈在所有空域
  - 需要地面以解决所有问题
  - 地面是推动收敛的关键
- 支持使用集成数据链解决方案
- 支持宽带IP工作
  - 研究宽带IP标准
  - 进行试验，尤其是AOC，以建立服务历史，为航空适用性判断提供依据
- 保持向后兼容性
Key Messages Today

- Businesswise, decoupling ATS data link from AOC (and other) on-board data link is not a good idea
- Exclusive FANS & exclusive ATN airspace is not a good thing (for anybody)
- Full CNS data link is a key component of future data link applications (whatever the technology)
- Security requirements are a key gap
- Global RCP concepts are a key gap
- We are in dire need of a migration strategy that
  - Embraces both FANS and ATN
  - Investigates a transition to broadband IP
  - Maintains backward compatibility
More information?

Questions, comments, follow-up?

- rob.mead@boeing.com
- dung.q.nguyen@boeing.com

Please contact us if you have ideas on programs that could support, such as

- IP trials
- integrated data link trials