Evolution Towards Digital Voice

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Context and scope

• In the context of ATM communications, “digital voice” can mean number of different things, with each interpretation having very different technical and operational implications.

• Purpose of this presentation is to help narrow down the discussion on the future of the digital voice within SESAR and broader industry forums.
Motivation

• Why digital voice for continental operations?
  • Running out of VHF spectrum. (Not enough frequencies for opening new sectors.)
  • Some potentially useful features not available with analogue VHF voice.

• ...but there are some myths associated to digital voice
  • It’s spectrally more efficient. (Yes, but only in some specific cases.)
  • It’s needed for virtual centre. (Yes, but only ground-ground.)
  • It’s needed for flight centric. (Not really – can be done with VHF.)
Operational view

• From operational perspective *digital voice* can be used in several ways
  • **Point-to-point telephone calls:**
    • Existing SATVOICE services in procedural airspace.
    • Moving from voice via radio operator to direct controller-pilot communication (DCPC)
    • Not matching the currently foreseen operational concepts for continental airspace
  • **Teleconferencing:**
    • Aircraft join teleconferencing rooms as required.
    • Depending on ATM concept utilizing the service, this could be e.g. one room per sector, one room per ATCO, one room per ...
    • Could include VHF-like solution (e.g. for transition period)
    • Could include seamless voice handovers from one ATCO to another (driven from ground)
Technical implications for air-ground link

• Each has different technical implications for the air-ground link
  
  • **Telephone calls:**
    • Existing technology (SATVOICE) would be reproduced by other FCI links (L-DACS)
    • Call setup time is critical
  
  • **Teleconferencing:**
    • Always-on or long-duration teleconferencing would need a lot of bandwidth or highly optimized protocols and waveforms to support efficient over-the-air multicast.
      • Such technical concept doesn’t exist in today’s candidate solutions for aviation (LDACS, SATCOM) and it is very challenging to design and implement.
      • Multicast/broadcast solutions exist for 4F and are being designed for 5G. But they seem to focus on “uplink” only (point to multipoint, i.e. ATCO-aircraft).
    • For dynamic teleconference join/leave, the call setup time would be critical
Point-to-point telephone calls

Aircraft 1
- Headsets
- Audio Management Unit (AMU)
  - SATCOM
  - LDACS
  - AeroMACS
  - VHF
- Analog 4-wire
- System-specific point-to-point digital voice calls (VoIP, 3G...?)

Aircraft 2
- Headsets
- Audio Management Unit (AMU)
  - SATCOM
  - LDACS
  - AeroMACS
  - VHF
- Analog 4-wire

Comm. Service Provider (SITA, ARINC...)
- Call routing, authentication, billing, monitoring...
- G2G VoIP gateway
  - SATCOM
  - LDACS
  - AeroMACS
  - G2G VoIP gateway
- G2G VoIP
- VoIP PBX
  - ATC1
  - ATC2
- VoIP or other G2G point-to-point connection
  - ATC3
- Shared analog VHF channel
Teleconferencing with optimized a/g links

Aircraft 1

- Headsets
- Audio Management Unit (AMU)
- SATCOM
- LDACS
- AeroMACS
- VHF

Aircraft 2

- Headsets
- Audio Management Unit (AMU)
- SATCOM
- LDACS
- AeroMACS
- VHF

System-specific multicast digital voice

G2G VoIP gateway

Comm. Service Provider (SITA, ARINC...)
- Call routing, authentication, billing, teleconferencing...

VoIP or other G2G point-to-point connection

ATC1
ATC2
ATC3

VoIP PBX
VoIP PBX
VoIP PBX

Shared analog VHF channel

AeroMACS
LDACS
SATCOM
G2G VoIP gateway
G2G VoIP gateway
G2G VoIP gateway
Technical implications – ground infrastructure

• Ground-ground is using digital voice (VoIP) already today
  • Between VHF ground station and ATC
  • Between “aeronautical station” and ATC for HF voice or SATVOICE via radio operator.
  • Between ATC and Satellite Service Provider for DCPC SATVOICE.

• For “Teleconferencing” concept a new service infrastructure would be needed
  • Likely operated by CSPs
  • Similar to ZOOM, Webex, Teams services
  • Technology exists. The main hurdle is to certify it for safety critical use while considering the business case.
Research and Development needs

• Operational (top-down requirements flow):
  • Which digital voice operational concept is the most useful?
    • Telephone calls, teleconferencing, what flavor of teleconferencing...
    • How will digital voice combine / complement with VHF voice and Datalink Services?
    • What (if any) voice/data independency is needed?
  • What parameters are critical?
    • E.g. call setup time, voice latency, “always on” capability, number of users...?
  • Which (if any) digital voice extra-features are desirable?
    • Selective muting, caller ID, raise hand, call or participants prioritization...
  • How much are we willing to pay for the different features / parameters?
    • For VHF-like or long-running multi-user teleconferencing high CAPEX or OPEX is needed.
    • Short / infrequent telephone calls way more affordable
Research and Development needs

• Technical (bottom-up inputs)
  • Define, evaluate and down-select candidate high-level technical solutions.
    • See technical backup slides for preliminary outline of the different options.
  • Develop, validate and deploy the winning tech. solutions
Questions?