Future Communication Study

A joint Eurocontrol/FAA activity

ICNS Conference

1-3 May 2007

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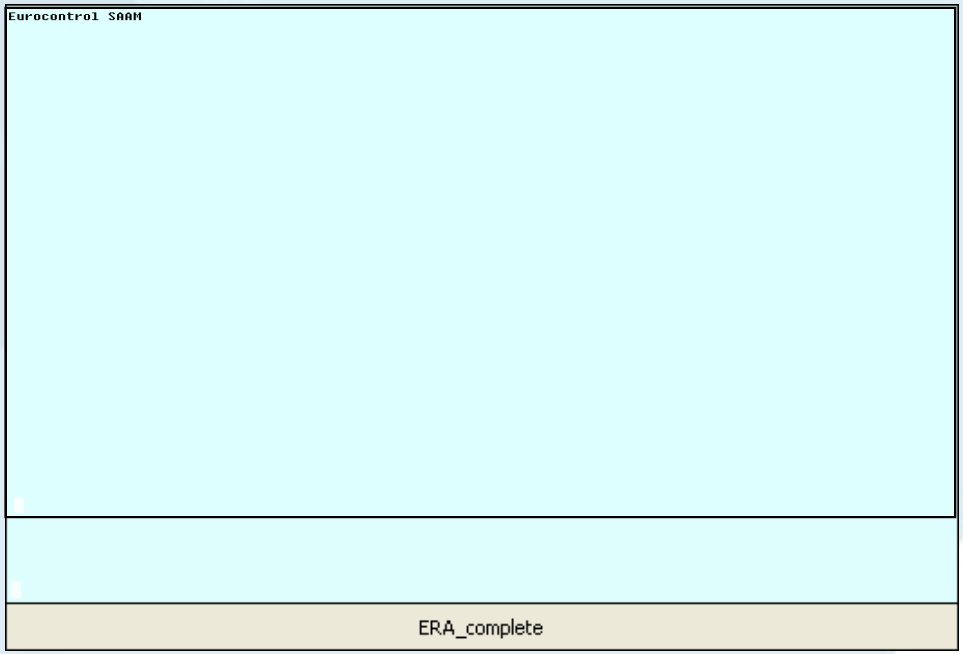
Future Communication Studies (FCS): Define the Future Communication Infrastructure (FCI)

- Background : Why we are doing that study ?
- Study content
- Technology assessments
  - Constraints
- Roadmap
- Planning
- Initial recommendations



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FCS Background

- Aeronautical air-to-ground voice and data communications capacity for Air Traffic Management (ATM) is reaching saturation
  - Most severe in Europe and parts of the United States
    - 8.33 kHz channel spacing in Europe
    - 25 kHz channel spacing in the US
- Various proposals to address this problem have been offered and approved independently; none has achieved global endorsement
- ICAO is seeking a common, global solution through the Aeronautical Communications Panel (ACP)
- The FAA and Eurocontrol have started a bi-lateral study of the problem with the support of NASA; study to provide major input to ICAO ACP

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FAA/Eurocontrol Joint Study

CCOM
FAA/EUROCONTROL
Coordination Committee

- FAA/Eurocontrol 3 year joint study
- Objectives:
  - Identification of requirements and operating concepts
  - Investigation into new mobile communication technologies
    - Technology Pre-Screening
    - Technology Alternatives Assessment
  - Development of a Future Communications Roadmap
  - Improvements to maximise utilisation of current spectrum
  - Creation of industry buy-in

User Input & Recommendations

U.S. ATMAC

- Sustain voice communications in VHF band as long as possible
  - Minimize channel use, current spectrum
  - 8.33 kHz channel spacing is the preferred first alternative only when current 25- kHz spectrum no longer meets operational needs
  - New voice solutions should be considered only after all non-equipment solutions have been exhausted
    - Spectrum allocation
    - Policies and procedures
  - Aeronautical Data Link System (ADLS) is important
    - Use existing VHF capabilities / equipment (VDM2, 1090 MHz, UAT) to provide ADLS until Future Communications Study recommendations and milestones are set
  - Commit to a data link technology, schedule, and funding by 2007.
  - ADS-B implementation plans from ATC communication

European States

- Sustain voice communications in the VHF band as long as possible
- Sustain future operation of voice communications in the VHF band
  - by expanding 8.33 services (vertical expansion and potentially into the upper VOR band)
- Foresee a change in paradigm in the 2020 timeframe where additional capacity is provided by making data the primary mode of communications
- Given this short timescale to develop and implement new technologies, a decision has to be made soon.
- Looking for a solution, but one that focuses on the requirements of the high-density core areas
- Demonstrate a solid business case for the introduction of future systems
- In the case of Satellite communications, consider options of having a dedicated ATM system vs. sharing the infrastructure with other services.
- Facilitate the migration to a new system by considering the introduction of a digital voice service. This is a desirable step but not critical.

- Use VHF band and existing technologies and equipment as long as possible
- Prepare for digital communications to support anticipated shift in operational paradigm
- Ensure timely technology decisions
- Ensure solid business case for new technologies
- Ensure solutions resolve local issues, and are globally applicable

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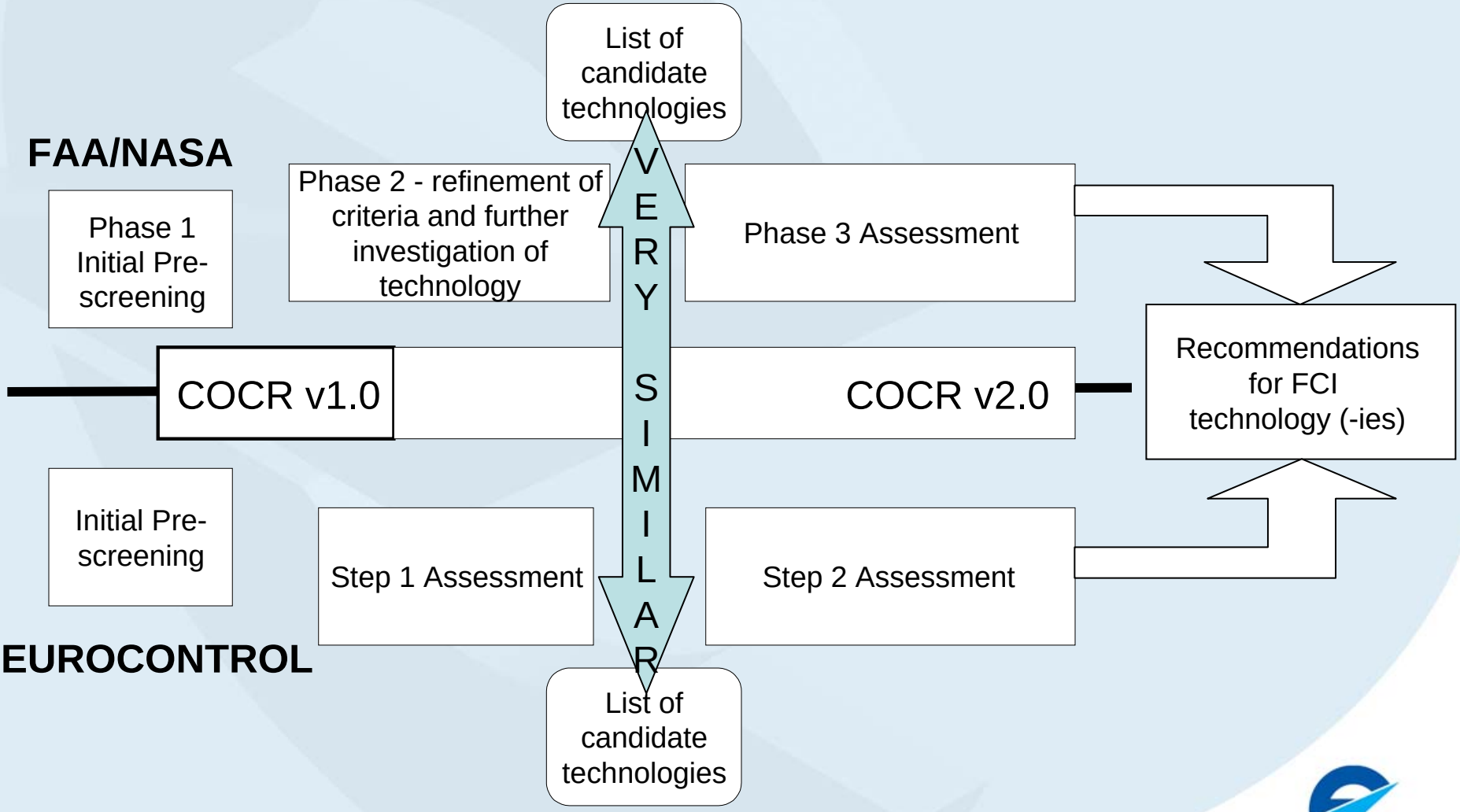
FCI activities: Technology assessments



Results of Technology Evaluation

NASA – ITT	Common Recommendations		Eurocontrol
Continental	• P-34 • Broadband-VHF • Wideband CDMA • Enhanced TDMA • L-band Datalink [(x)DL3]	• P-34 • Broadband-VHF • Wideband CDMA • Enhanced TDMA • L-band Datalink [(x)DL3]	**Continental** • [(x)DL4]
Oceanic	• INMARSAT Swift Broadband • Custom Satellite	• INMARSAT Swift Broadband •Custom Satellite	**Oceanic**
Airport	• IEEE 802.16	• IEEE 802.16	**Airport**

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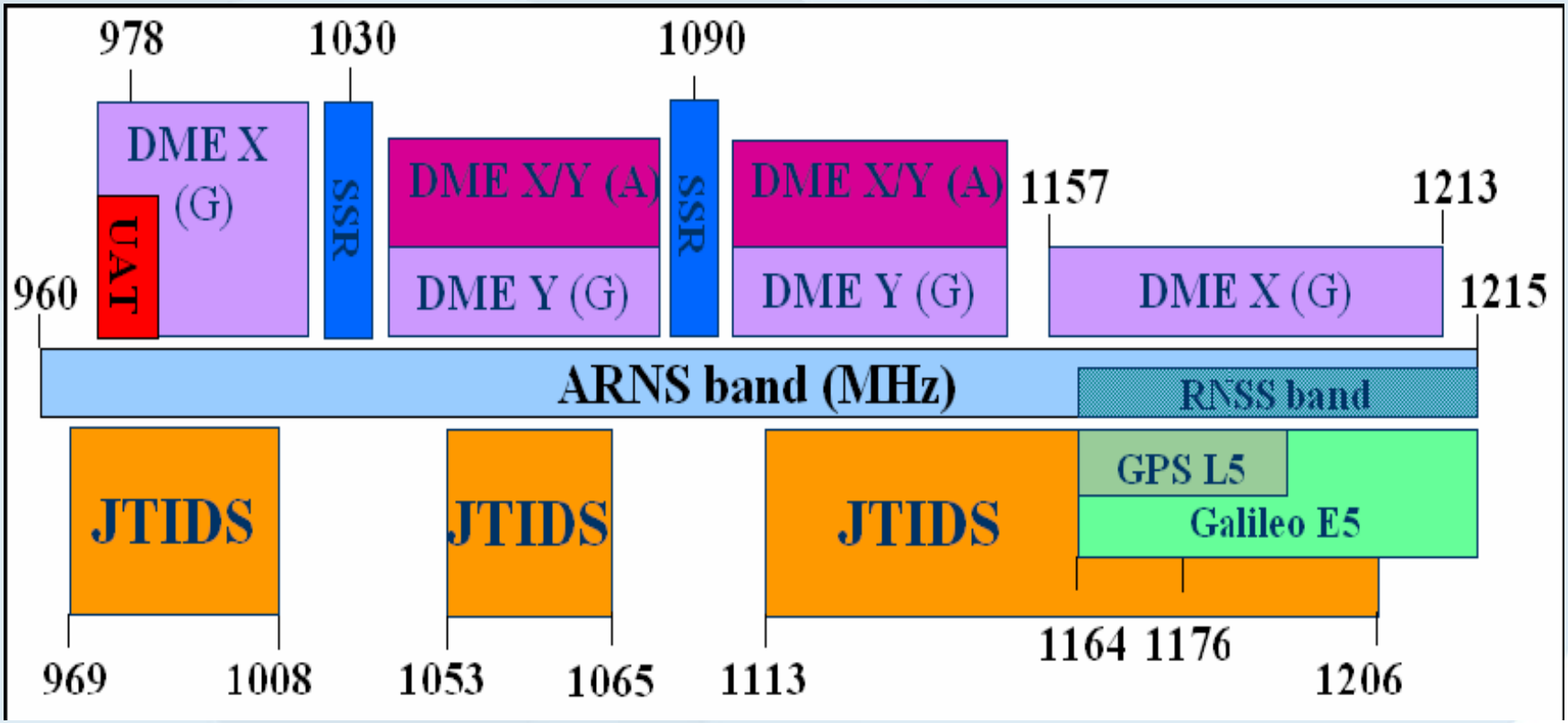
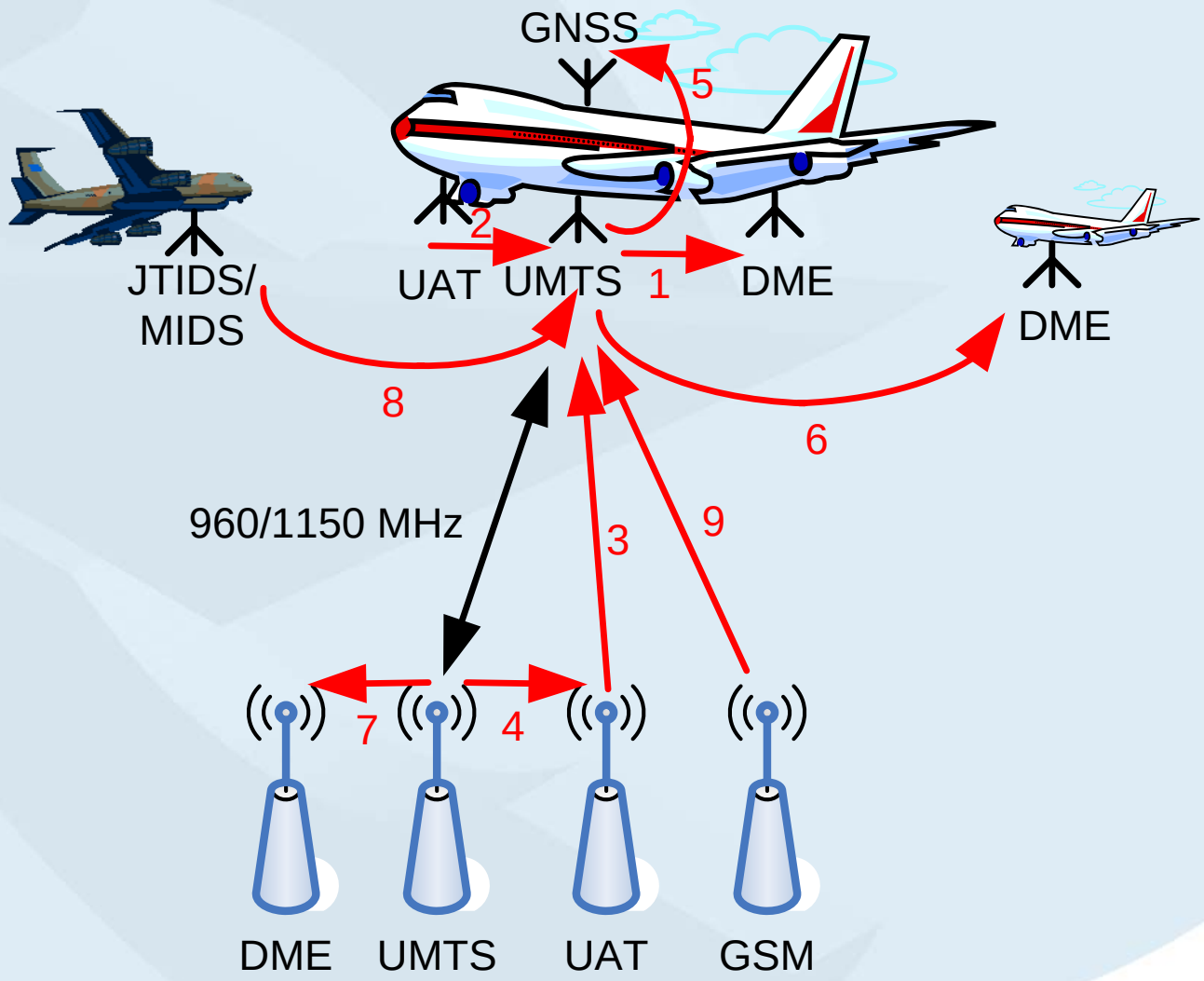
L-band Services Spectrum Allocation



Common L-band Interference Sources



ITT Detailed Technology Assessment Tasking (Phase III)

- Three major task areas have been identified
  - Screened Technology Analyses (with focus on technologies not yet investigated)
    - Candidate technologies for additional detailed investigations include W-CDMA, B-VHF and L-Band E-TDMA
    - Common Model/Tool Development
  - DME and Mode S Interference Measurements
  - Final Technology Evaluation and Recommendations

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EUROCONTROL Technology Assessment - Step 2 Investigations

- Work is closely coordinated with the interested European partners
- Initial results made available to SESAR
  - Alignment of technology plan and concept of operations
  - Provides input to development of Master Plan
- Key task areas:
  - Detail Common Evaluation Scenarios
  - Focus on Spectrum Compatibility Investigations
  - Refine Evaluation Methodology
  - Final Technology Evaluation and Recommendations

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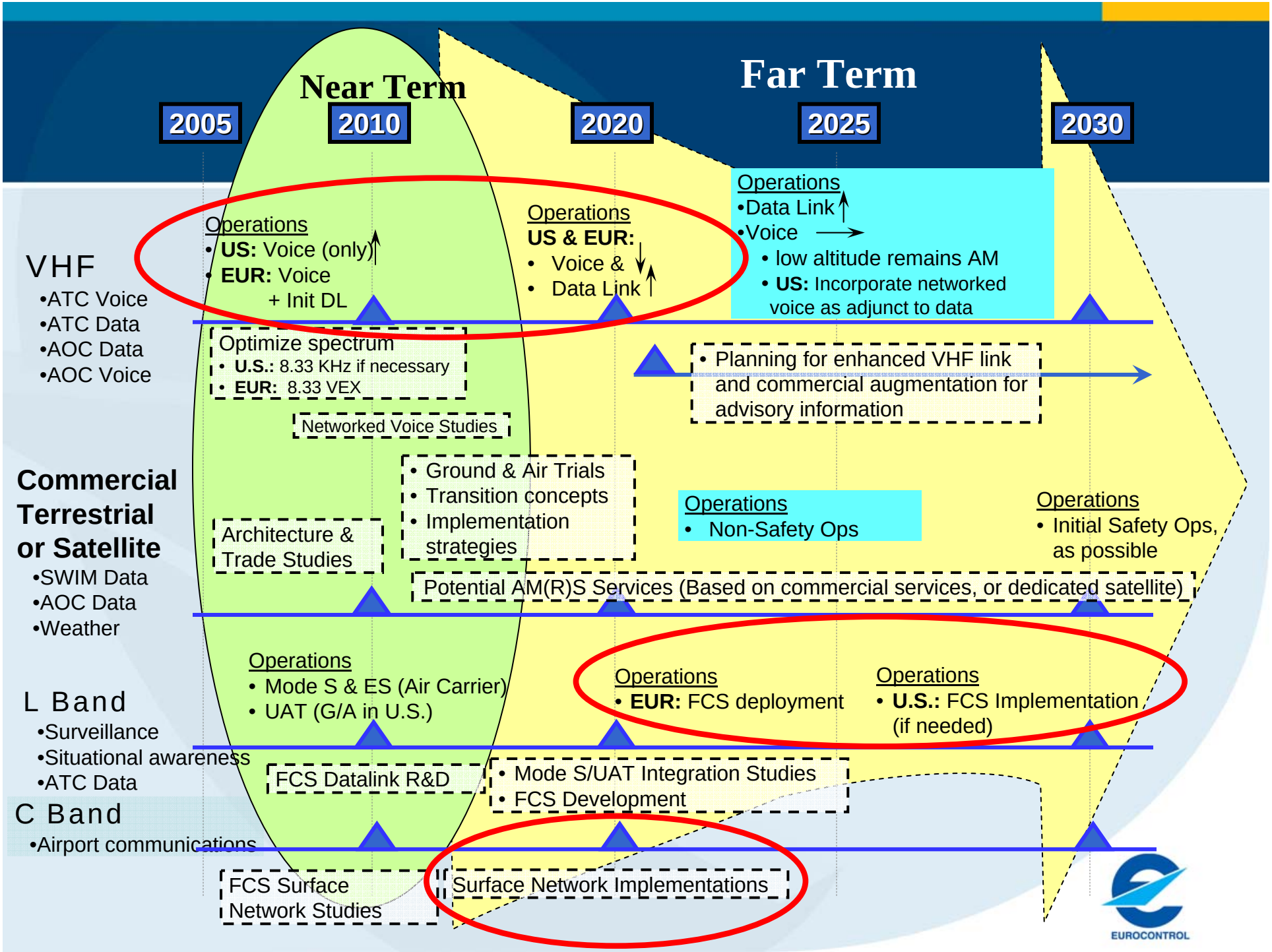
Near Term
Far Term
2005
2010
2020
2025
2030
VHF
•ATC Voice
•ATC Data
•AOC Data
•AOC Voice
Operations
• US: Voice (only)
• EUR: Voice
+ Init DL
Optimize spectrum
• U.S.: 8.33 KHz if necessary
• EUR: 8.33 VEX
Networked Voice Studies
Operations
US & EUR:
• Voice &
• Data Link
Operations
•Data Link
•Voice
• low altitude remains AM
• US: Incorporate networked voice as adjunct to data
• Planning for enhanced VHF link and commercial augmentation for advisory information
Commercial Terrestrial or Satellite
•SWIM Data
•AOC Data
•Weather
Architecture & Trade Studies
• Ground & Air Trials
• Transition concepts
• Implementation strategies
Operations
• Non-Safety Ops
Operations
• Initial Safety Ops, as possible
Potential AM(R)S Services (Based on commercial services, or dedicated satellite)
L Band
•Surveillance
•Situational awareness
•ATC Data
Operations
• Mode S & ES (Air Carrier)
• UAT (G/A in U.S.)
Operations
• EUR: FCS deployment
Operations
• U.S.: FCS Implementation (if needed)
FCS Datalink R&D
• Mode S/UAT Integration Studies
• FCS Development
C Band
•Airport communications
FCS Surface Network Studies
Surface Network Implementations
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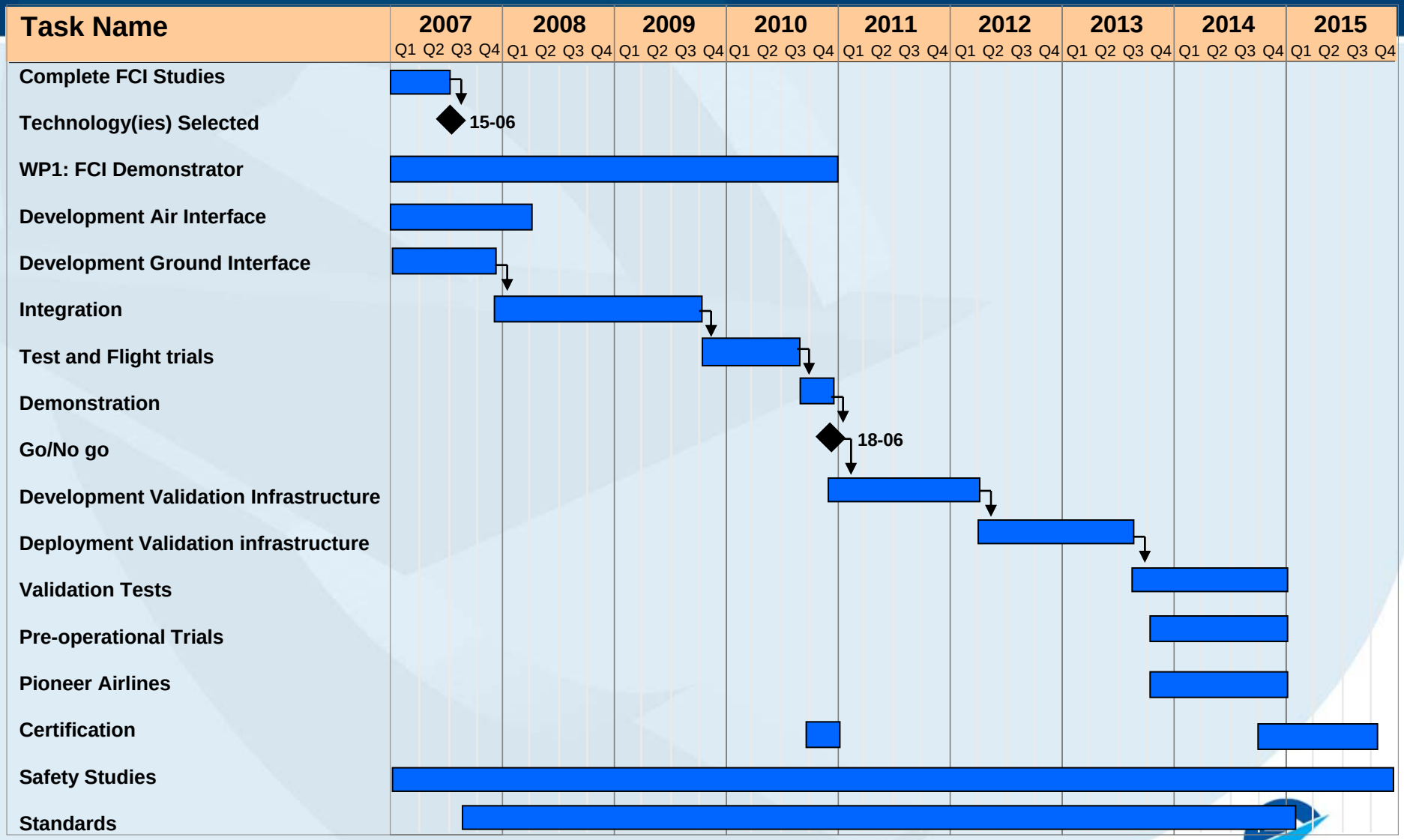
Draft Target Plan for FCI Development and Deployment



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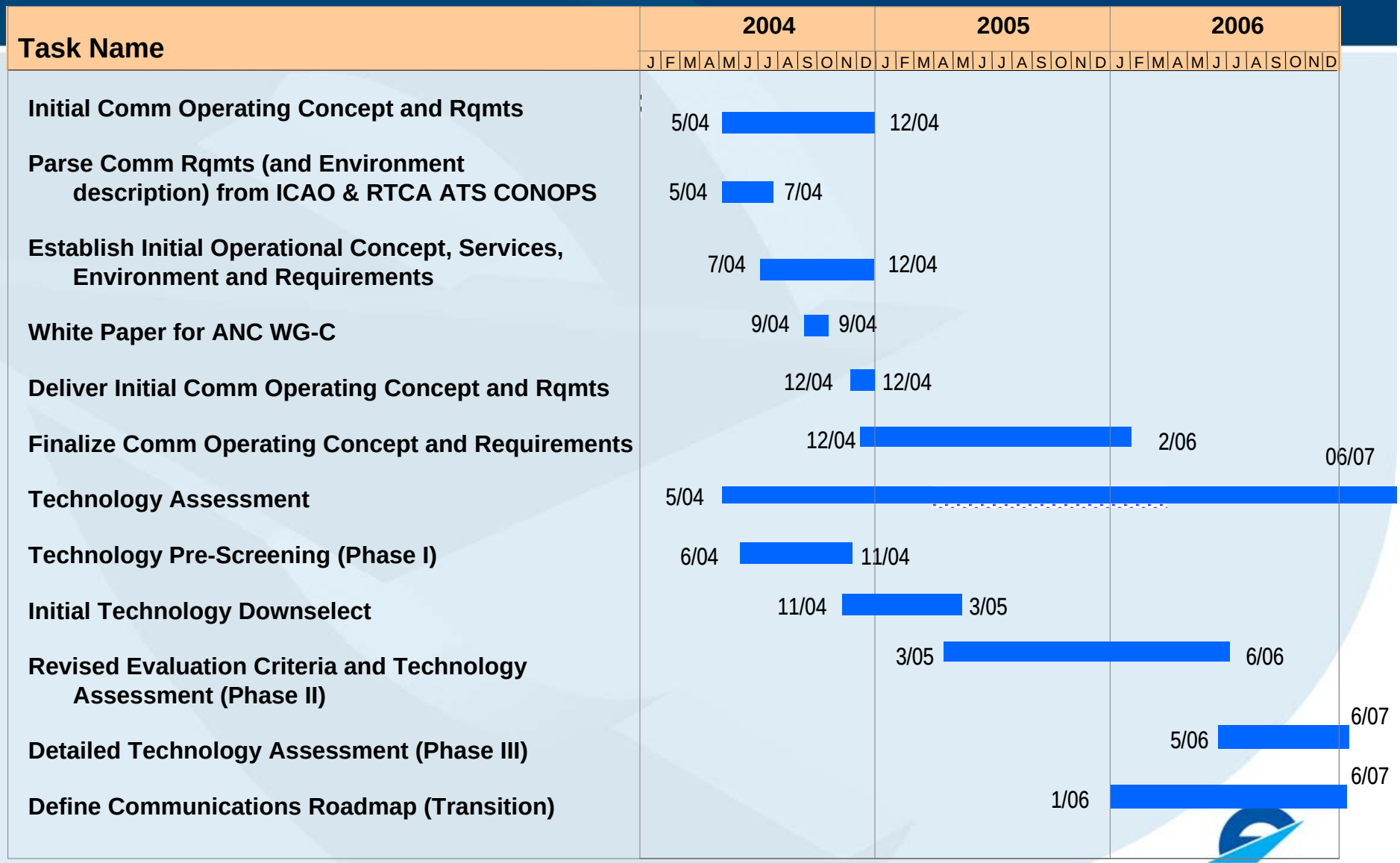
Study Schedule



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SESAR D3, Draft Initial recommendations (Extract)

- VHF 8.33 is universally applied.
- VHF 25KHz and UHF retained for military interoperability.
- SATCOM voice for oceanic area.
- New integrated FCI communications system. Includes the following components
  - terrestrial A-G datalink component (VDL2 , complemented by new technology)
  - a new satellite A-G datalink .
  - Airport surface data coms – IEEE 802.16aero supports ATS and AOC coms.
  - Ground-ground data transport network Shared for voice and data technologies – cost efficiencies.
  - Software radios (and flexible architecture) become available to aid avionics integration and global interoperability.
- As part of new FCI, improvement of existing ATN or specific IP transport layer to support end to end QoS management for continental ATS use. Oceanic requirements to be integrated.
  - Integrated avionic supporting integrated continental/oceanic services.
- Evaluate digital voice for Air Ground communications.

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Likely assessment outcome (in progress)

- Fully COTS solution does not appear possible for aviation
  - Therefore Consider COTS components
- No single technology is expected to meet requirements in all service volumes
  - FCI shall be a system of systems that need to address both ATS & AOC and include current technologies and integrate new one(s) in a smooth way (all airspace, all aircraft) when required by operational needs.
  - Components are likely to be different technologies
    - Current operational technologies in continental airspace(25/8.33 KHz, ATN/VDL-2, 1090 ES…)
    - New terrestrial technology (L-Band) for near airport, TMA and en route
    - oceanic and remote can only be covered by 'beyond horizon' such as satellites (commercial and/or dedicated system)
      - Commercial satellites services on their own may not have sufficient continuity/availability to meet ATS requirements
      - what about dedicated satellite system ? What about HF?
    - 802.16e (C-Band) for airport surface where there are high data exchange requirements and can 'off load' en route communications into another band
  - Strategy to operate also in VHF band (Long term)

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Likely assessment outcome (in progress)

- New terrestrial technology (L-Band and in future VHF)
  - Requirements
    - Step-1: Data communication (A/G, A/A)
    - Step-2: Digital voice desired (networked voice)
  - Modulation scheme.
    - P34, B-AMC (B-VHF in L Band): OFDM based technologies.
      - May require free spectrum in L-band, co-site interferences with current technologies remains a challenge
    - Designed by spectrum constraints (AMACS/LDL, i.e. E-TDMA like)
    - Is tailored technology needed?
- Other considerations
  - What about QoS?
  - What about upper layer
    - ATN, IP
  - What about application development?
    - Define new application services. Missing in current ICAO ACP?

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Input to ICAO process

- At ACP-1
  - Explain the activities to date
    - Final COCR version 2.0 and results
    - Status report of the technology assessment - not results but process
- At WG-C in September
  - Propose ‘desirable characteristics’ of future technologies
    - Identify those technologies that have some (or all?) of these features
    - Illustrate how the technologies could be deployed in the different airspace types
      - What are the good features of each technology?
      - TBC - no one technology can meet all the requirements in all airspace
      - TBC - solution will be a mixture of a few technologies

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