ato
AIR TRAFFIC ORGANIZATION

FAA/EUROCONTROL Future Communications Study Overview and Status

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ATO Operations Planning
Systems Engineering Directorate

Background

- Air Traffic Management voice and data communications capacity 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
- New Air Traffic Management concepts are being introduced requiring enhanced data link performance
- Various proposals have been offered and approved independently
  - None has achieved global endorsement
- ICAO ANC 11 Recommendation 7/4 requested a new, global A/G Communications System be investigated
- FAA/EUROCONTROL/IATA agreed to collaborate to ensure that a new system was identified within the appropriate time frame

Joint Study Definition

FAA/EUROCONTROL, Cooperative Research and Development Action Plan 17: Future Communications Study

- Objectives:
  - Provide communications capacity to support Air Traffic Management through 2030
  - Allow a realistic transition for service providers and airspace users
  - Support Air Traffic Services and Airline Operational Control Communications for safety and regularity of flight
  - Address spectrum depletion in both regions
  - Investigate multi-mode avionics for implementation

International Coordination through ICAO Aeronautical Communications Panel (ACP) Working Group-C

Study Framework

- Extend service life of existing systems
  - Investigate methods to improve current spectrum efficiency for 25 kHz and 8.33 kHz DSB-AM systems
- Develop future Communications Operating Concept and derived Performance Requirements
  - Determine key safety and performance issues
- Investigate new technologies for mobile communications
  - Technology Pre-Screening
  - Technology Alternatives Assessment
  - Technology Simulation
- Develop Communications Roadmap
  - Identify evolutionary path to next system

FAA/EUROCONTROL FCS Organizational Structure

Future Communications Study Steering Group
(Co-Chair- James Eck/FAA)
(Co-Chair – Mel Reese/Eurocontrol)

Study Direction
Management Coordination

Study Team Leads
(Brent Phillips/FAA)
(Jacky Pouzet/ Eurocontrol)

Resource Planning
Team Tasking & coordination
International Coordination

Technology Assessment
NASA Glenn Research Center
(Jim Budinger/NASA)
(Jacky Pouzet/Eurocontrol)

Candidate Technologies
Technology Feasibility/Maturity
System Modeling/Simulation
Prototype/Test

ITT/QQ Support

Operational Environment Description & Transition Analysis
(Rhonda Thomas/FAA)
(Nikos Fistas/Eurocontrol)

System Architecture
Safety/Certification
Security
Spectrum
Airborne Co-site
Ground System Integration
Cost/Benefits Considerations

Operational Concepts & Requirements
(G. Anderson/FAA)
(Danny Van Roosbroek/Eurocontrol)

Data/Voice Ops Concepts
Functional Analysis
Voice Usage Projection
Data Throughput analysis
Human Factors

Technology Identification

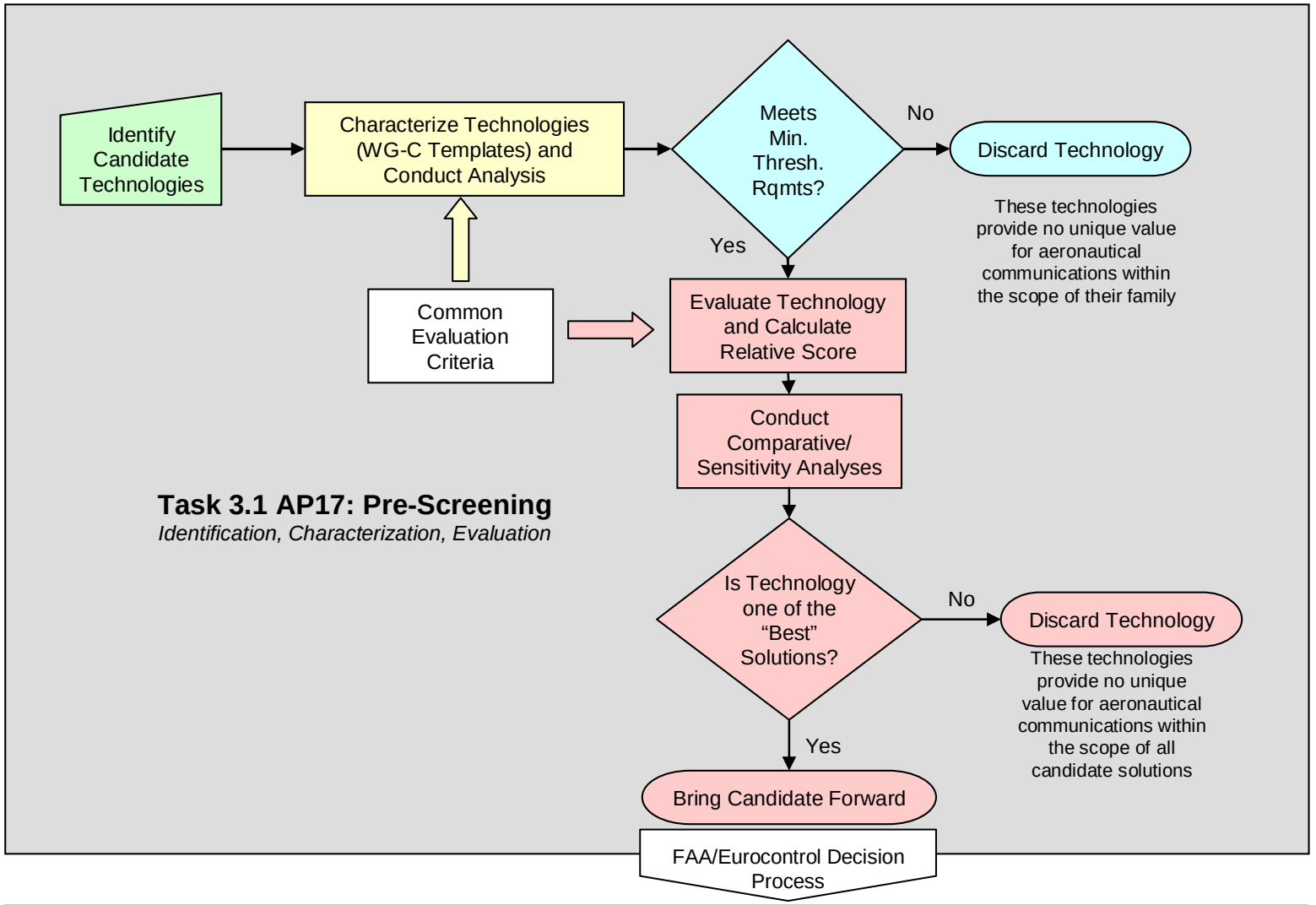
- In order to identify all technologies that may be applicable to aeronautical communications, a three pronged approach was used for technology identification:
  1. A survey of widely used and successful commercial and military technologies was conducted to identify technologies that offered potential value to A/G communications
  2. NASA released two Requests for Information soliciting technology candidate inputs from industry
  3. Technology candidates previously identified by the ICAO ACP WG-C were included in this study

- In all, over 50 technology candidates were identified in this process

Technologies Considered

Technology Family	Candidates
Cellular Telephony Derivatives	TDMA (IS-136), CDMA (IS-95A), CDMAone (IS-95B), CDMA2000 1xRTT, W-CDMA, TD-CDMA, CDMA2000 3x, CDMA2000 1xEV, GSM/GPRS/EDGE, TD-SCDMA, DECT
IEEE 802 Wireless Derivatives	IEEE 802.11, IEEE 802.15, IEEE 802.16, IEEE 802.20, ETSI HIPERPAN, ETSI HIPERLAN, ETSI HIPERMAN
Public Safety and Specialized Mobile Radio	APCO P25 Phase 1, APCO P25 Phase 2, TETRA Release 1, TETRAPOL, IDRA, IDEN, EDACS, APCO P34, TETRA Release 2 (TAPS), TETRA Release 2 (TEDS), Project MESA
Satellite and Other Over Horizon Communication	SDLS, Connexion by Boeing, Swift Broadband (Aero B-GAN), Iridium, GlobalStar, Thuraya, Integrated Global Surveillance and Guidance System (IGSAGS), HF Data Link
Custom Narrowband VHF Solutions	VDL Mode 2, VDL Mode 3, VDL Mode 3 w/SAIC, VDL Mode E, VDL Mode 4, E-TDMA
Custom Broadband	ADL, Flash-OFDM, UAT, Mode-S, B-VHF (MC-CDMA)
Military	Link 16, SINCGARS, EPLRS, HAVEQUICK, JTRS
Other	APC Phone (Airphone, AirCell, SkyWay)

Pre-Screening Process



Task 3.2 AP 17: Technology Investigation

Detailed Technology Analysis and Selections

Evaluation Criteria Overview

Category	Evaluation Category Description	Criteria
Communications Capabilities	Communication capabilities needed to support current and emerging ICAO ATM concepts	Meets Voice Needs
		Meets Basic Datalink Needs
		Meets Expanded Datalink Needs
Maturity for Aeronautical Environment	Technical maturity as well as the recognition for the safety assurance required for aeronautical standardization and certification	Technology Readiness Level
		Standardization
		Certification
Cost	Cost of infrastructure used by the service provider as well as the cost of avionics equipage by aircraft	A/G Communications Infrastructure
		Avionics
Other	Availability of suitable AM(R)S spectrum, support for security, and practical accommodation of transition	Spectrum Protection
		Security
		Transition

Study Status

- Requirements
  - Agreement on functions and required bandwidth
    - Performance requirements still pending
  - Evaluation of benefits incomplete
    - Potential timing differences in each region
  - ICOCR Version 4.0 Available for comment
    - http://www.nas-architecture.faa.gov/cats
- Environment/Constraints
  - 2015 initial implementation date agreed
  - Spectrum issues are different in each region
  - Regulatory perspectives/incentives may be different
  - L-Band and VHF VOR Band are potential venues for any new system
- Technology
  - Basic technology evaluations are similar

COCR Services and Scenarios

- 25 ATS (includes 6 FIS & 7 ADS-B), 21 AOC Services defined
- Depiction of a typical scenario to demonstrate how voice and data services are used in each domain to support the operational concepts in 2015 and the changes in 2030
- For each service domain:
  - List of services provided by ATS and by AOC
  - Estimates of the percentage of aircraft equipped for data link, and the relative percentage of voice and data link communications
    - 2015 values are based upon MITRE-CAASD U. S. equipage projections
    - 2030 values based on other supporting data and studies
  - Peak instantaneous Aircraft Counts (PIAC) for high density and low density for each airspace type
    - Based on EUROCONTROL SAAM model predictions
  - Scenarios include micro-jets, UAVs and Remotely Operated Vehicles (ROVs)

COCR Summary

- Concepts & Services agreed except for timing.
- Airspace in 2030 primarily consists of two classes:
  - Managed Airspace: 4-D Trajectory Management is the norm. Shared separation responsibility for specific operations.
  - Unmanaged Airspace: Separation responsibility transferred for all operations.
- 2015 – Voice still primary, aircraft equipage heavily mixed. Bulk of data services support evolution away from voice.
- 2030 – Data is primary, new services are supported by automation tools & cannot be done via voice.
- Traffic is 2.5 to 3 times today's traffic, but forecasts indicate spread over less dense periods (versus adding to current peaks).
- Coordination of document through ICAO to assess global applicability.

Requirements Summary

- **ATC Voice**
  - Steady, slowing or flattening channel growth; high safety performance
- **ATC Data**
  - Low, predictable bandwidth; high safety performance
- **AOC Safety Data**
  - Low predictable bandwidth; medium safety performance
- **Air-to-Air Data**
  - Low bandwidth; full requirement not well understood at this time
- **FIS-Broadcast**
  - Low to medium bandwidth; low safety performance
- **AOC Advisory Data**
  - Medium to high bandwidth; unpredictable, market-priced growth; low safety performance
- **System Wide Information Management Data**
  - Potentially high bandwidth; full requirement not well understood at this time
- **ADS-Broadcast**
  - Medium to high predictable bandwidth based on a/c equipage; high safety performance

Additional Guidance

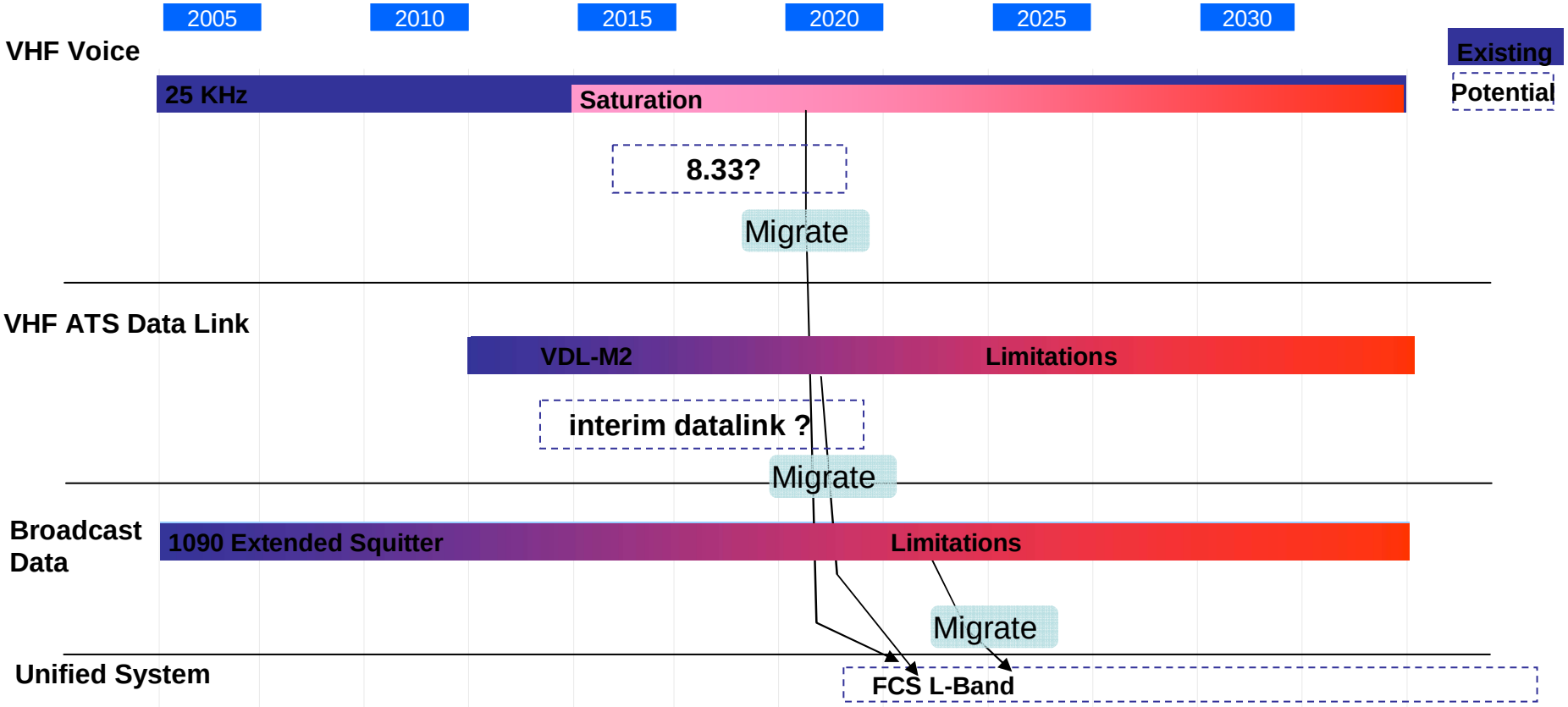
- Following a Meeting of the Senior Executive Management (SEM) Team, the FCS was directed to:
  - Make use of existing infrastructure (particularly in the aircraft) longer and more cleverly
  - Consider alternatives which make use of the VHF band including the possible use of the current VOR band
  - Look at separating the voice and data functions.

Alternative Options

- **Near Term Options**:
  - Extend the life time of VHF analogue voice through 8.33 kHz and possible use of adjacent frequency bands (e.g. VOR)
  - Extend the life of VHF analogue voice through relocation of data services to other frequency bands (960-1024 MHz)
  - Extend the life of VHF analogue voice by relocation of non-ATS voice and data services to another band.

- **Long Term Options:**
  - Use of the VHF band (118-137 MHz) for analogue voice and data/L Band (960-1024 MHz) for ADS-B
  - Use of the VHF band (118-137 MHz) for analogue voice /Other bands for data and ADS-B
  - Use of the VHF band (118-137 MHz) for analogue voice/Other bands for all digital voice and data.

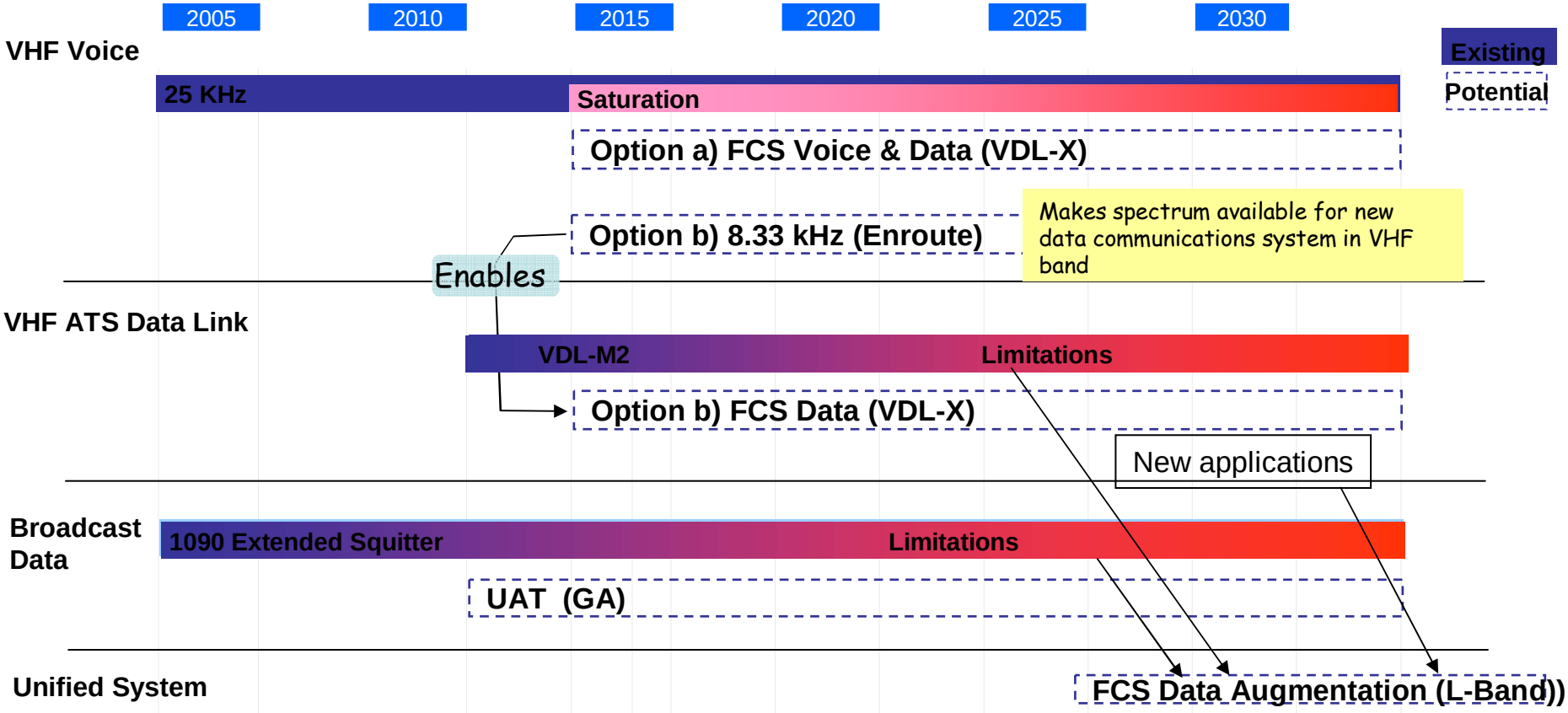
US Evolution Path #1
ATC Voice and Data Migrates to L-Band



Opportunities:

Challenges:

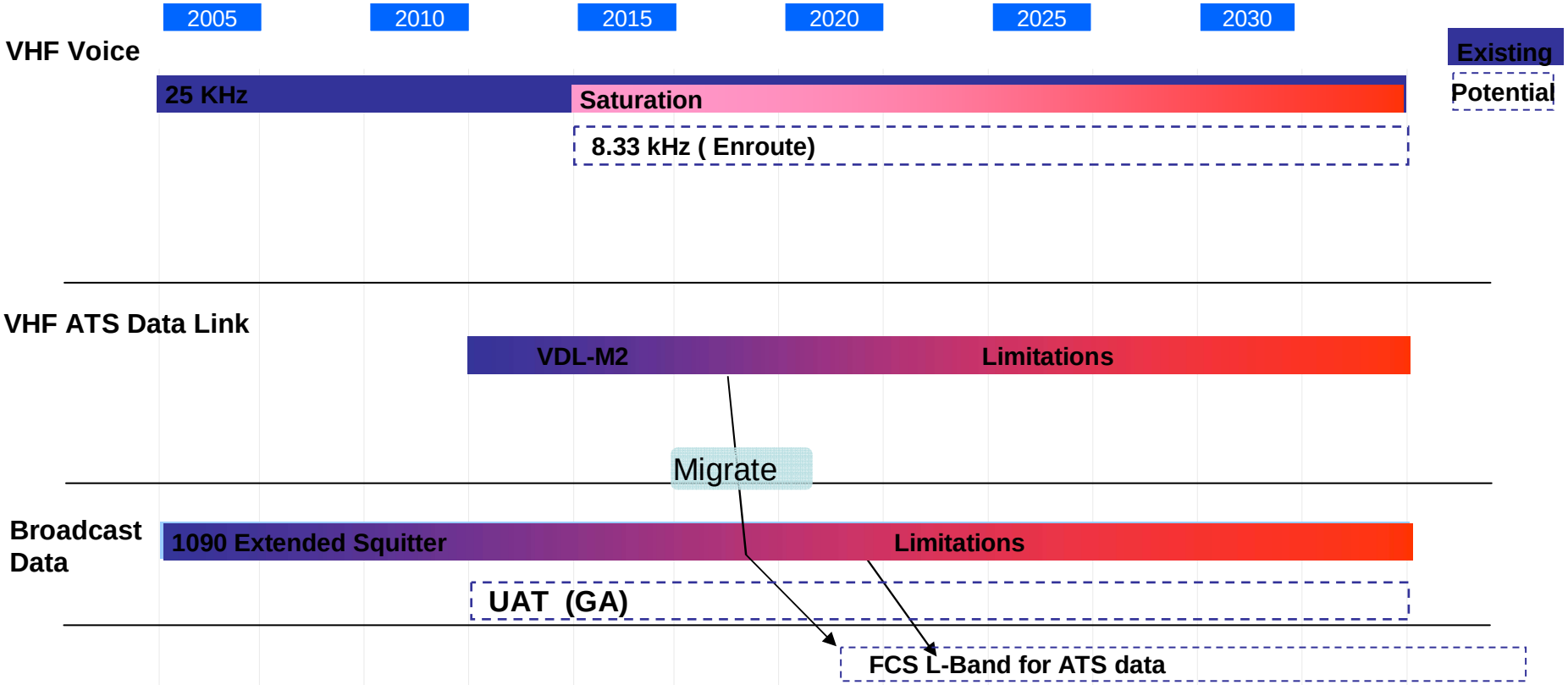
US Evolution Path #2
VHF Voice and Data/L-Band Data



Opportunities:

Challenges:

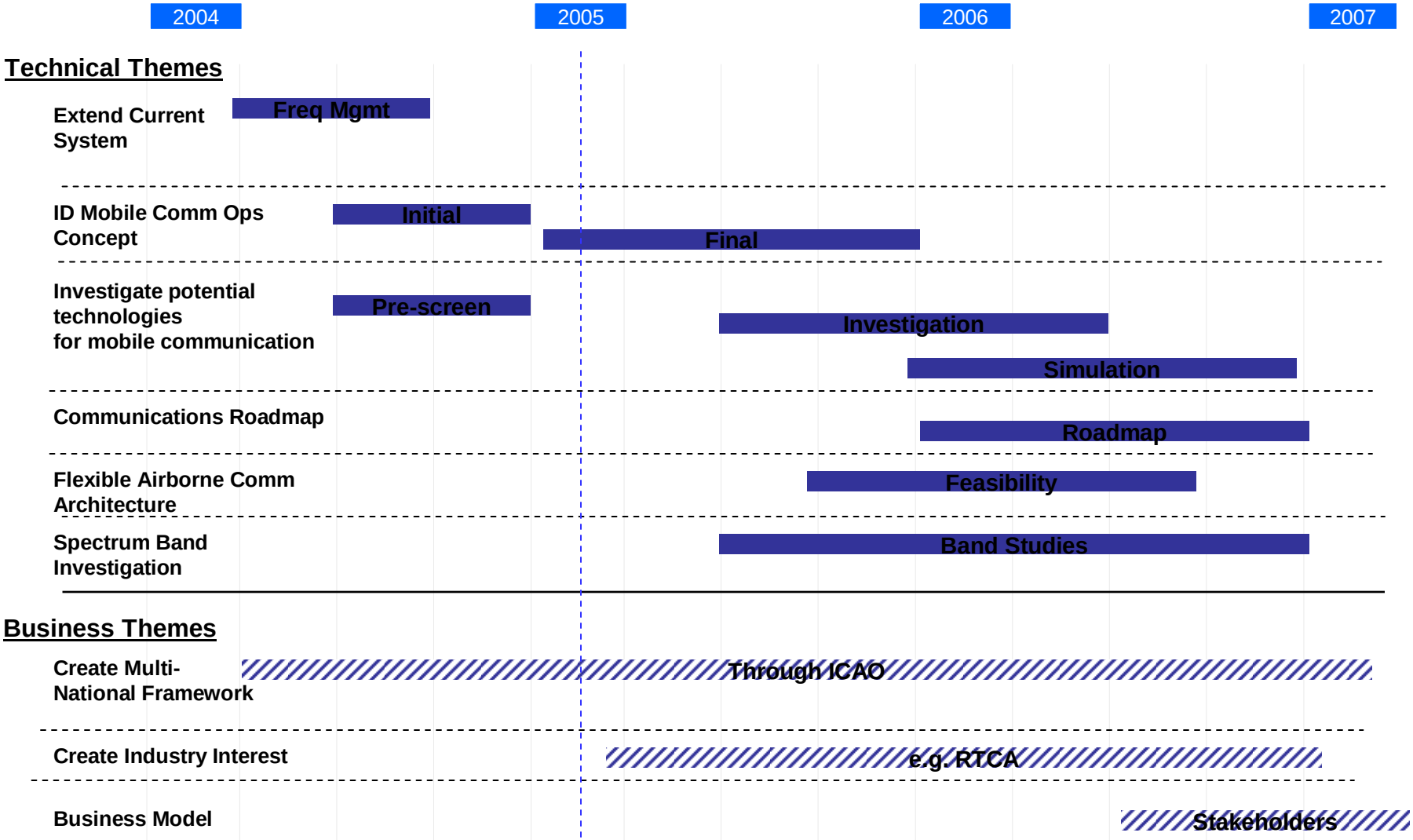
US Evolution Path #3
ATC Voice in VHF, and Data in L-Band



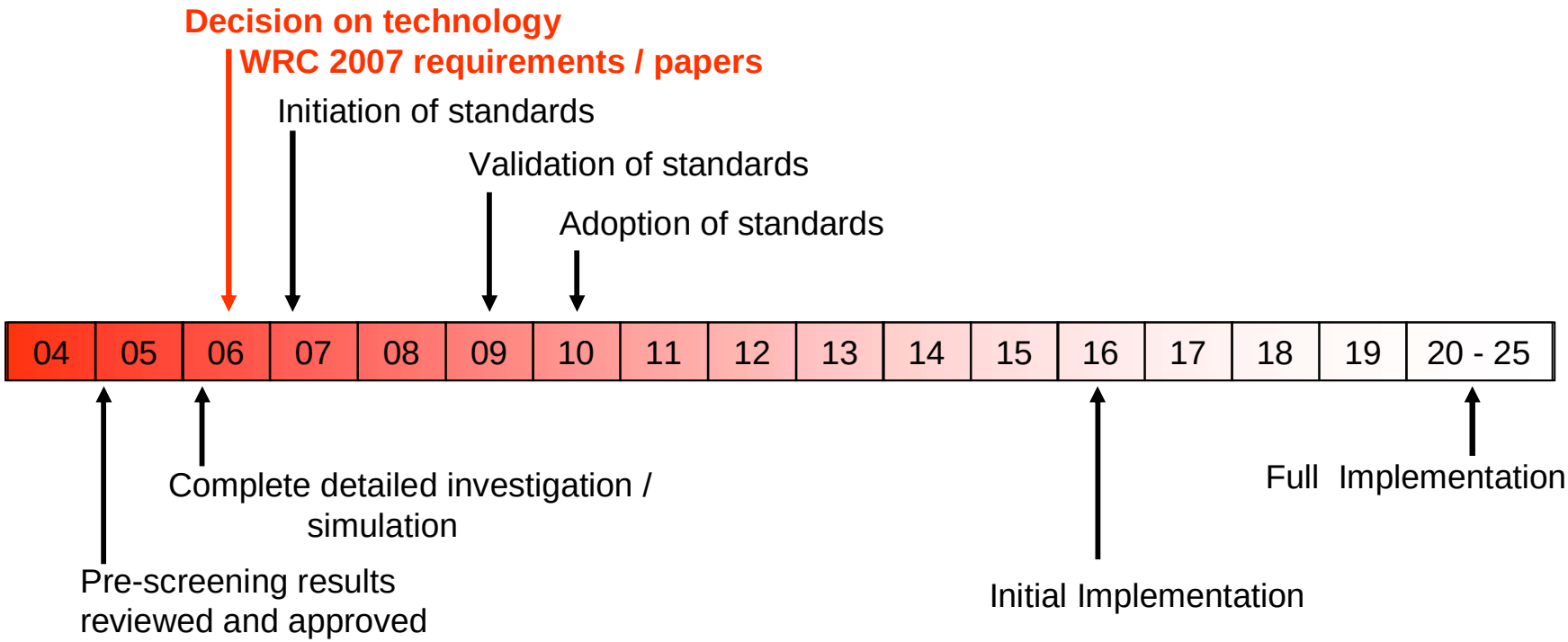
Opportunities:

Challenges:

Action Plan 17: Future Comm Study Work Plan



Timeline Towards Global Air-Ground Communications System 2020



** * Adopted from ACP WGC7/WP23, Kors van den Boogaaard (IATA)*

FCS Next Steps

- Complete three month review of study assumptions, constraints, requirements and alternatives
  - Examine additional VHF spectrum potential in Europe & US
  - Provide input to Single European Sky ATM Master Plan Definition Phase
- Two user reviews by Air Traffic Management Advisory Committee of study team products/proposals
  - Early April 2005
  - Early May 2005
- Report back to the SEM on study findings