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Advanced Engineering & Sciences
Communication, Information, & Intelligence Systems

FCS Technology Assessment Status

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August 15, 2005





Briefing Overview



- **Background and Objectives**
- **Technology Assessment Process and Pre-screening Results**
- **Deliberation Support and Results**
- **Planned Technology Evaluation Activities**
- **Questions**





Technology Assessment Background and Objective



- **Technology assessment is a defined element of the Eurocontrol/FAA joint action plan that established the Future Communications Study (AP17)**
- **Technology Assessment Objective**
 - **Progress investigation of potential communication technologies**
 - Operating inside the VHF band and outside the VHF band
 - To support the long-term mobile communication operating concept
 - Considering terrestrial and satellite based infrastructure





Technology Assessment Scope



- **FCS scope includes ATS and AOC communications**
 - It does not include AAC and APC communications
- **Voice and Data services were both in the original scope of the study**
 - Current guidance is to focus on data services only
- **ADS-B was added as a late element of the scope**
 - ADS-B and direct pilot to pilot data transfer were categorized as “enhanced” data services
 - Addressed and broadcast A/G data services were categorized as “basic” data services





Technology Assessment Elements

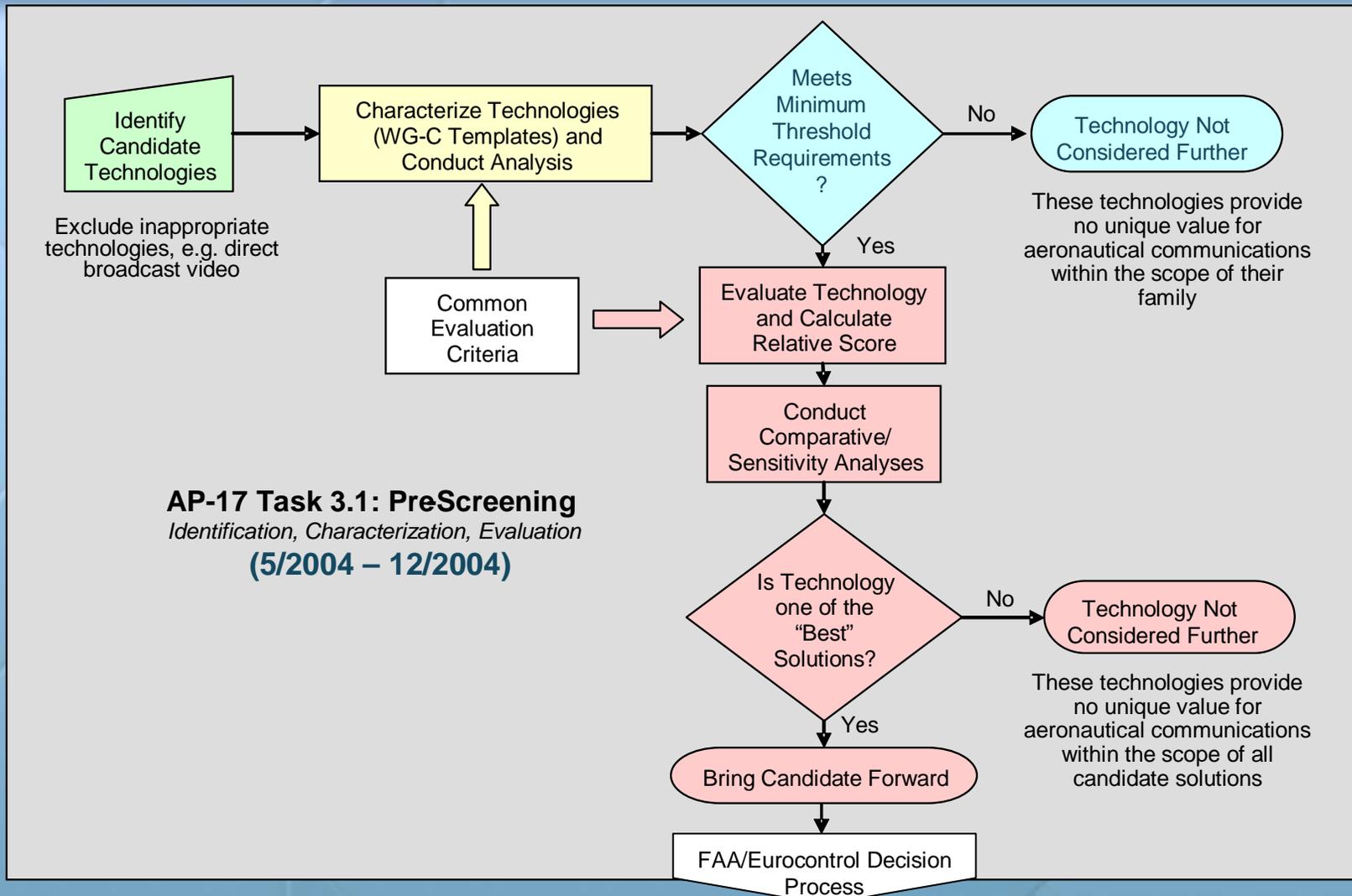


- **The AP 17 work plan defines three sequentially scheduled technology assessment tasks**
 - **Task 1 - Technology Pre-Screening (May – Dec 04)**
 - Evaluate potential candidates that are under development in industry
 - Provide the high level capabilities, projected maturity and potential applicability
 - **Task 2 - Technology Investigation (April 05 – June 06)**
 - Identify those technologies that can meet the requirements that have been defined by the COCR team
 - **Task 3 - Technology Simulation (TBD)**
 - Simulate the critical technology elements to verify ability to meet requirements





Future Communications Study Technology Assessment Process



AP-17 Task 3.2: Technology Investigation
Detailed Technology Analysis and Selections

(5/2005 – 9/2006)

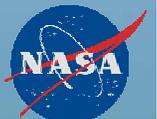
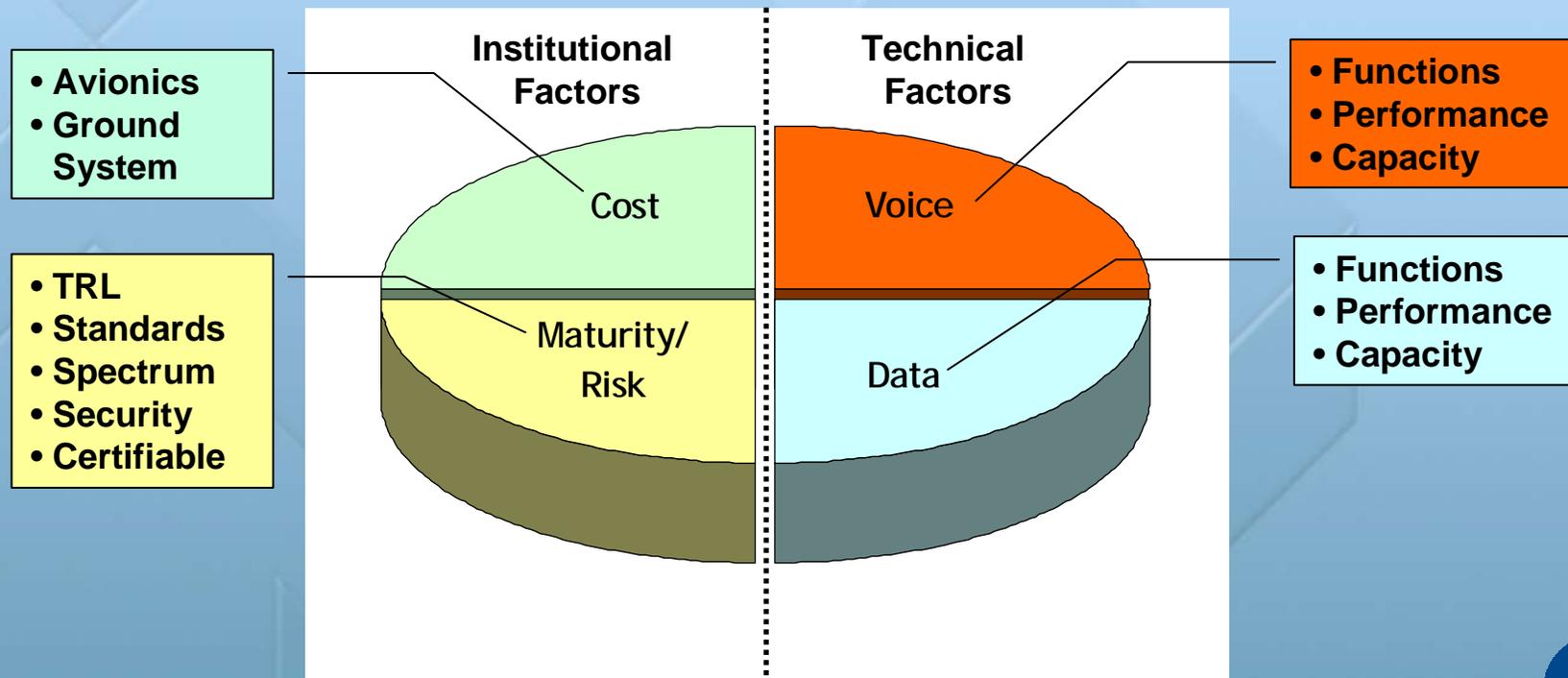




Technology Pre-Screening - Criteria



- Rated technologies against 26 specific criteria
 - Including both technical and institutional factors
 - Over all operational domains

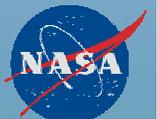




Technology Pre-Screening - Technologies Considered



Technology Family	Candidates
Cellular Telephony Derivatives	TDMA (IS-136), CDMA (IS-95A), CDMAone (IS-95B), CDMA2000 1xRTT, W-CDMA (US)/UMTS FDD (Europe), TD-CDMA (US)/UMTS TDD (Europe), 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 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, Inmarsat IV (Aero B-GAN), Iridium, GlobalStar, Thuraya, Integrated Global Surveillance and Guidance System, HF Data Link
Custom Narrowband VHF Solutions	VDL Mode 2, VDL Mode 3, VDL Mode 3 with SAIC, VDL Mode E, VDL Mode 4, E-TDMA
Custom Broadband	ADL, Flash-OFDM, UAT, Mode-S, B-VHF
Military	Link 16, SINGARS, EPLRS, HAVEQUICK, JTRS
Other	APC Phone (Airphone, AirCell, SkyWay)



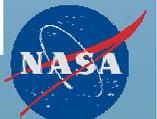


Pre-Screening Results – Technologies That Scored Well



Technology Candidates	All Evaluation Criteria	Voice	Basic Data	Expanded Data	Surface	Oceanic/ Polar	Applicable Spectrum
WCDMA			●				DME
802.16					●		MLS
P34	●		●	●	●		DME
P25	●	●					VHF
Aero-BGAN			●			●	SAT
Iridium						●	SAT
SDLS						●	SAT
VDL 3 / VDL E	●	●			●		VHF
B-VHF	●	●	●	●	●		DME
UAT				●			DME
Link16				●			DME

Note: List is ordered by technology family, and does not imply any preference





Pre-Screening Results - Summary



- **There is no technology that does all of the following:**
 - **Performs well over all evaluation criteria in all airspace domains, is mature, and is estimated to be low cost**
 - **There is no “silver bullet”**
- **Regardless, some technology recommendations could be made**
 - **Pre-screening recommendations were made in the context of the aeronautical band where the system would function, and encompassed:**
 - **Technologies that might use VHF more efficiently**
 - **Satellite technologies with AMS(R)S spectrum**
 - **Technologies that could co-exist in the DME or MLS bands**





Pre-Screening Results - Recommendations in VHF Band



- **Because of the need for a practical transition, only one candidate (VDL 3 / VDL E) was recommended for the VHF band**
 - **However**
 - May not be transitionable in most congested regions (core Europe with it's 8.33 kHz analog channelization)
 - Does not appear to support the projected data link needs (functions and capacity)
- **It does not appear likely any technology candidate in the VHF band will provide a complete solution for both voice and data, even in continental airspaces**
- **This underscores the need to ensure that the DME, MLS and satellite spectrum options are explored**





Pre-Screening Results - Recommendations in DME Band



- **These recommendations assume that reallocation of the DME Spectrum to co-primary AM(R)S will occur**
 - **The primary recommendations for this band were**
 - B-VHF (band shifted custom broadband solution)
 - P34 (APCO Public Safety Wideband Data standard)
 - VDL 3 (band shifted with a redesigned physical layer to provide more capacity –referred to as LDL)
 - **A secondary recommendation – reservations include technical and institutional concerns – was WCDMA, a 3G cellular technology which might provide a good data solution.**
 - **Detailed studies of interference compatibility and propagation effects were recommended for all proposed technologies in this band**





Pre-Screening Results - Recommendations for SatCom



- **Recommended technologies for further study included Aero-BGAN and Iridium**
 - **Aero-BGAN is among the best solutions for data link, but concerns exist**
 - Availability for critical services not supported
 - US reliance on foreign soil based infrastructure
 - **Iridium is a unique system with its global coverage and low equipage cost**
 - However, the data rate that it provides is low
 - **Recommend satellite technology for**
 - Broadcast services
 - Communications to remote regions





Pre-Screening Results - Recommendations in MLS Band



- Because of the severe omni-omni antenna path loss in the MLS band, technologies in this band are recommended only for the airport surface and immediate terminal area
- The 802 family, and its ETSI counterparts, have potential applications for airport surface networking and should be explored further
 - 802.16 was recommended for further study
 - Provides the opportunity for a COTS system to support a broad scope of communications needs over the entire airport surface
 - Particularly applicable if high data rate requirements on the airport surface cannot be met by a future system in the DME band

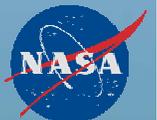




Deliberation Support



- **Technology pre-screening results and recommendations were**
 - Presented to Eurocontrol and FAA (December 2004)
 - Published NASA Contractor Report (May 2005)
 - http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20050180618_2005179929.pdf
- **Deliberation support was provided for the first part of this year, including ICAO ACP coordination**
 - Presented evaluation process and criteria to ACP WGC-9 in Montreal Canada (April 2005) and then to ACP WG of the Whole for approval (June 2005)
 - <http://www.icao.int/anb/panels/acp/WG/W/WGW01/wgw01.html>

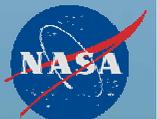




Deliberation Results



- **The results of FAA and Eurocontrol deliberations is the following high level guidance**
 - **Remove voice as a requirement of AP17**
 - Voice will be provisioned in the VHF band using current systems for the foreseeable future
 - Focus study on defining the next generation data link
 - **Investigate the use of satellites as elements of a hybrid system**
 - **Investigate and characterize the issues with DME Band**
 - **Look at C-Band for surface applications, but concentrate on the DME and Satellite studies**





Planned Technology Evaluation Activities



- **Establish the traceability of the evaluation criteria from finalized Concept of Operation and Communications Requirements**
 - Evaluate candidates against these criteria. If necessary, revisit pre-screening decisions
- **Explore issues for DME Band recommendations**
 - Characterize propagation and interference effects for enroute and terminal applications
 - Analyze costs and business case for commercialization





Planned Technology Evaluation Activities (Continued)



- **Explore issues for SatCom recommendations**
 - Analyze applicability of SatCom single thread and multi-thread systems to classes of A/G communications (ATS Advisory, ATS Safety, AOC) and develop architectures that could provide these services
- **Explore issues for C-Band recommendations**
 - Evaluate 802.16 performance in the surface environment, leveraging the channel characterization activities of Ohio University





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Questions?

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