

Summary of Meeting #3, of RTCA SC-186, Working Group 5 For the Development of a MOPS for UAT

The meeting was held on 2 – 5 April 2001, at the Headquarters of Eurocontrol in Brussels, Belgium, hosted by Nikolaos Fistas. The meeting was called to order at 9 a.m. on April 2, 2001 by Co-Chairman George Ligler. George provided introductory remarks, welcomed all attendees and asked that each one introduce themselves and their organization. The attendees included:

Larry Bachman – JHU – APL	James Higbie – JHU – APL	Tom Pagano – FAA Tech Center – ACT-350
John Barrows – FAA Tech Support	Richard Jennings FAA (AIR-130)	Robert Prill – BAE Systems CNI
Mike Biggs – FAA (ASR-200)	Stan Jones – Mitre CAASD	Terry Stubblefield – FAA (AFS-430)
Andrew Comba – BAE Systems	Ian Levitt – Titan Corp (FAATC – ACT-350)	Costas Tamvaclis – Eurocontrol Exp. Center
George Cooley – UPS Aviation Technologies	George Ligler – PMEI	Hartmut Uhr – Infosys for Avitech, Germany
Nikos Fistas - Eurocontrol	Chris Moody – Mitre CAASD	Richard Weathers – JCS J6I
Gondo Gulean – Eurocontrol – AMNU	Al Muaddi – JHU – APL	Warren Wilson – Mitre Corp.

1. Following introductions, regrets were announced as follows:
 - Jerry Anderson was at the SC-186 WG-4 meeting running in parallel to the WG-5 meeting
 - R.H. “Bob” Saffell was working high priority items at Rockwell
 - Tom Mosher was not able to attend, but was represented by others from UPS-AT
 - Tom Elledge, FAA Alaska, Ground Systems unable to attend
 - Bill Flathers, was unable to attend, but submitted Draft 1 of Section 1 of the MOPS
 - Gary Furr had to return to the US on Monday morning because of family illness
2. The Working Group was asked to review and approve the Minutes to Meeting #2. It was pointed out that on page one (1) of those Minutes, in paragraph #3, Eurocontrol is not a member state, and should not be included with the list of states. With this notation made, the Minutes of Meeting #2 were approved.
3. Moving to Agenda Item 3a, WG-5 began the review of Action Items 2-7 through 2-14. Action Item 2-7 was to refine the investigation of possible enhancements to UAT by providing performance and cost feasibility considerations for each conclusion/recommendation previously presented in Working Paper UAT-WP-2-03. In response to this Action Item, Warren Wilson suggested that the increase in cost of the proposed implementation is negligible except possibly the new filter. UPS-AT suggests that the filter idea needs to be tested to ensure that any ISI is within acceptable limits.
4. In Action Item 2-8, Rich Weathers and Mike Biggs were to provide Link 16 Scenarios, 2 for high density and 2 for low density. The scenarios provided under Action Item 2-8 are documented in Working Paper UAT-WP-3-08. The Baseline scenario similar to GPS-L5 is reported in WP-3-JTIDS_Scenario. There was discussion on the impact of multi-net on bunching of the pulses. There was consensus that evenly distributed L-16 pulses represent a worst case for UAT. Though in real life, the severity of this scenario may last for only an instant or so, for modeling, we assume that this scenario is persistent. The Working Group will use the scenario presented in UAT-WP-3-08 with these options as the baseline for its analyses. Rich Weathers and Mike Biggs accepted **Action Item 3-12** to provide two more L-16 scenarios, one to represent a lower level than the baseline and one to represent a higher JTIDS level (coordinated operation).
5. Action Item 2-9 requested that a team led by Mike Biggs look at both directions UAT-DME effects to include a 1 MHz bandwidth effect on adjacent channels. In one response to Action Item 2-9, Working Paper UAT-WP-3-10 was presented as a plan to test DME in the presence of UAT interference. Some preliminary data was discussed. One conclusion drawn was that UAT would not

interfere with DME ramp test operations, leaving 978 MHz as a promising frequency assignment. Nikos Fistas agreed to accept **Action Item 3-9** to investigate the viability of this channel for use in Europe. The FAA Technical Center personnel agreed to accept **Action Items 3-1** and **3-3** to both verify current results and expand the test to include additional DME interrogator units. It was agreed to reconfigure the test plan presented in UAT-WP-3-10 to provide results with the objective to create a DME receiver model.

Stan Jones presented the expected UAT self interference power distribution in LA-2020 in Working Paper UAT-WP-3-14. This paper also showed expected UAT performance for alternative Link budgets in the presence of JTIDS and DME interference.

Warren Wilson presented Working Paper UAT-WP-3-02 on the UAT performance in the presence of DME interference. Performance was sensitive to the UAT receive filter shape, which motivates a potential change to 1 MHz bandwidth or less. It was not clear whether assumptions in UAT-WP-3-02 represented a worst case DME environment. Warren offered to rerun the simulation once an environment is agreed upon.

In Working Paper UAT-WP-3-11, Al Muaddi presented another assessment of DME interference to UAT and vice versa, in the context of the LA-2020 traffic distribution of UAT interferers.

James Higbie gave a presentation in Working Paper UAT-WP-3-12, which explored the impacts of lengthening the Reed-Solomon code and implementing erasures. It was shown, at least in theory, that there could be some benefit to erasure decoding; however, the Working Group agreed that it would be undesirable to require erasure declaration in the avionics. Even so, James pointed out that erasure declaration, at least from a technical and cost perspective, would be more desirable than a multi-channel approach if it is shown that the current UAT design (hard-decision decoding) could not survive the expected interference environment. Warren Wilson agreed to **Action Item 3-15** to determine the optimum Reed-Solomon code that the Working Group can agree on for future simulation work.

6. In conjunction with Agenda Item #4, Costas Tamvaclis presented results of the EEC flight tests performed on Capstone equipment in October 2000. This presentation was later assigned as Working Paper UAT-WP-3-17. The test involved two aircraft, a ground station, and a ground vehicle. The presentation focused on air-air and air-ground performance. Costas noted that there will be further tests focusing on the airport surface environment, addressing all three data link candidates.
7. Bob Prill presented in WP-3-03 BAE's response to the Working Groups discussion at Meeting #2 that minimal DME frequency shifting is highly desirable. The idea involves a multiple channel parallel receiver, with transmitter selecting a channel to avoid DME in a local area. The Working Group discussed the cost and technical viability of this idea. There were questions about the practicality of a database to control ADS-B channel selection to avoid DME assignments in the local area. The group decided that development of ideas such as this would be pursued only in the case that the single channel solution was shown to be unable to successfully coexist with JTIDS and DME when no more than one channel will need to be vacated. Bob accepted **Action Item 3-10** to focus on the necessity of database, frequency selection to avoid DMEs, and cost feasibility of the BAE proposal for presentation at the June meeting at MIT Lincoln Laboratories in Lexington MA.
8. Next, the Working Group addressed Agenda Item 6d, with the review of Working Paper UAT-WP-3-01, which presented several sample link budgets, for use in discussions of the equipment classes defined in Section 2.1 of the UAT MOPS. There was some concern over changing power budgets from what was assumed for the TLAT. There was a proposal to run simulations using the TLAT assumptions as one case, and a second case as below:

Equipage Class	Minimum power at antenna end of cable (ERP)	Range
A0/A1	5 W	-0, +4 dB
A2	12.5 W	-0, +4 dB
A3	100 W	-0, +4 dB

9. George Cooley presented Working Paper UAT-WP-3-06 with measurements made over temperature of the current UAT at 981 MHz with a 1.5 MHz IF bandwidth. It was shown that at production level, the receiver is sensitive to at least -91 dBm at the antenna end of the cable. George Cooley accepted **Action Item 3-16** to provide like measurements for a tighter IF filter for the May meeting, with the expectation that the narrower filter will support -93 dBm sensitivity for the purposes of simulation.
10. Chris Moody presented a Working Paper, which later was assigned the number UAT-WP-3-16, a simulation of uplink message error rates on the NEXTRAD graphical weather image. Chris recommended that we have a target message error rate of the uplink of between 10 and 20 percent.
11. Ian Levitt presented Working Paper UAT-WP-3-13, a study of the viability of independent range measurement from test data recorded during the October 2000 EEC flight tests. Though some aspects of the measurement need to be investigated, it appears to be a promising capability for UAT. There will be further work ongoing.
12. Chris Moody presented a Working Paper, which later was assigned the number UAT-WP-3-15, wherein a summary of some points were made by representatives from Garmin, UPS, and UPS-AT on the implications of separate GPS sensors and UAT avionics boxes on the timing accuracy achievable for independent ranging.
13. During the 1st meeting of WG-5, December 18, 2000, the Working Group reviewed the sections of the proposed UAT MOPS and worked through the identification of individuals and organizations that would be responsible for writing drafts of those sections. The following table is the result of the assignments of those writing actions. The asterisk (*) beside a name indicates the lead person or organization.

UAT MOPS Writing Assignments

Section	Version / Filename	Date / Due	Primary Author(s)	Status/Comments
1.0 Introduction	Sec_1a.pdf	3/27/01	Bill Flathers * Jerry Anderson	
2.1 General Requirements	Sec_2-1b.pdf	3/27/01	Tom Mosher	
2.2 Equipment Performance Requirements	Sec_2-2a.pdf	02/12/01	Chris Moody * Bob Saffell Rich Weathers Jim Maynard JHU-APL (?)	
2.3 Environmental		Due after 2.4	Small 2.4 group	

Section	Version / Filename	Date / Due	Primary Author(s)	Status/Comments
2.4 Equipment Test Procedures			Tom Pagano * Bob Saffell UPS-AT Chuck LaBerge JHU-APL (?)	
3.0 Installed Equipment Performance				
4.0 Equipment Performance Characteristics	Sec_4a.pdf	02/13/01	Greg Kuehl	
A. Glossary & Acronyms	App_A2.pdf	03/27/01	Rich Jennings Terry Stubblefield	
B. MASPS Cross Reference Matrix	App_B1.pdf	01/03/01	Greg Kuehl Jim Maynard Nikos Fistas JHU-APL (?)	
C. Example ADS-B Message Encoding			Chris Moody + 2.2 writers	
D. UAT Ground Infrastructure	App_D1.pdf	02/14/01	Ed Valovage * Paul Gross	
E. Aircraft Antenna Characteristics				
F. Link Budgets & Scenario Dependent Ranges			Larry Bachman	
G. Standard Interference Environments			Mike Biggs	

14. The following table indicates the agreed upon meeting dates and places for meetings of Working Group #5 through August 2001. It was agreed not to set meetings later than August until the Working Group has had a chance to assess progress over the next several meetings. The Working Group will consider setting a date and place for one additional meeting as part of the Agenda for Meeting #3 in Brussels.

Proposed dates and places for future meetings of the UAT MOPS Working Group 5:

Dates/Time	Meeting Place
February 20, 9:00 through noon February 23	Radisson Suite Hotel Oceanfront, 3101 North Highway A1A Indialantic, FL 32903 (321-773-9260) Hosted by Rockwell Collins
April 2, 9:00 through noon April 5	Eurocontrol Headquarters, Brussels Travel info and lodging details are available on the ADS-B/UAT web site
May 1, 9:00 through 5pm May 3	UPS-AT Headquarters, Salem, OR - Hosted by UPS-AT Travel info and lodging details are available on the ADS-B/UAT web site
June 19, 9:00 through noon June 22	MIT Lincoln Labs facility at Hanscom AFB, Lexington, MA Travel info and lodging details are available on the ADS-B/UAT web site

Dates/Time	Meeting Place
July 31, 9:00 through noon August 3	FAA WJH Technical Center, Atlantic City Airport, NJ Travel info and lodging details are available on the ADS-B/UAT web site
Week of Sept 24, 2001 Specific days TBD	George Ligler and Nikos Fistas to agree on European location and specific days for the meeting during the week of Sept 24, 2001

15. The following **Action Items** were identified during the course of this and previous meetings. The asterisk (*) beside a name or organization indicates that they are the lead for the resolution of that Action Item. Actions shown here are those Action Items that remain OPEN, and/or were just closed in this meeting as a result of Working Papers or other actions being reported on in these Meeting Minutes.

Action Number	Action Description	Assigned to	Status
2-1	Provide Brent Phillips with statement(s) received by RTCA from UK CAA with regard to starting UAT MOPS effort and SARPS development process.	George Ligler	By 4/16/01
2-2	Prepare a presentation on the plans and status of WG-5 to be presented at the May AMCP WG-C meeting.	George Ligler (*) Rich Jennings	To Brent Phillips by 20 April
2-3	Get together to work out an air transport configuration. Get words on an acceptable approach to extrapolation from the 1090 MHz MOPS.	Chris Moody (*) Greg Kuehl	Addressed by WP-3-15 CLOSED
2-4	Develop two charts based on slant range correction and perform some extrapolation, for presentation to WG-C	Chris Moody Ian Levitt (*)	Addressed by WP-3-13 CLOSED
2-5	Arrange a presentation for the Brussels meeting, by Costas Tamvaclis or someone else, on UAT flight trials/tests performed by EUROCONTROL.	George Ligler	Adressed by WP-3-17 CLOSED
2-6	Validate the -93 dBm receiver sensitivity over environment or propose a different number – measured at the receiver input, for report at the Brussels meeting.	Bob Saffell Cyro Stone George Cooley (*) James Higbie	Addressed by WP-3-06 CLOSED
2-7	Refine the investigation of possible enhancements to UAT by providing performance and cost feasibility considerations for each conclusion/recommendation presented in WP-2-03.	Warren Wilson Myron Leiter	Addressed at Mtg #3 CLOSED
2-8	Link 16 interference scenarios, 2 for high density, 2 for low density, due NLT 15 March.	Rich Weathers (*) Mike Biggs	Addressed by WP-3-08 CLOSED
2-9	Look at both directions UAT-DME effects to include 1 MHz bandwidth effect on adjacent channels.	Mike Biggs (*) Ian Levitt Al Muaddi Larry Bachman	Addressed by WP-3-10 & WP-3-11 CLOSED
2-10	Extract the worst case DME environment between 978 and 981. Will look at further range of frequencies as he can.	Mitre CAASD Chris Moody (*) Nikos Fistas	To be discussed at Mtg. #4

Action Number	Action Description	Assigned to	Status
2-11	Run these scenarios (In Actions 2-8, 2-9 & 2-10) versus the Mitre proposed changes to the UAT baseline. Make results available for Brussels meeting.	Myron Leiter (*) Warren Wilson James Higbie Al Muaddi	Addressed by WP-3-02 & WP-3-12 CLOSED
2-12	Take the DME Statistics from John Barrows, the scenarios from Rich and Mike and incorporate them into his analytic model of the baseline UAT, including LAX 2020 and low-density self-interference, for Brussels meeting.	Stan Jones	Addressed by WP-3-14 CLOSED
2-13	Quick addendum to Myron's previous work, e.g., up to 32 parity symbols for RS, for Brussels meeting.	John Barrows (*) Myron Leiter	To be discussed at 9am 4/2/01
2-14	Look separately at effects of different signaling alphabet and dual frequency approach for protection of DME/ATCRBS. Coordinate with Mike Biggs, Mitre/Bedford and JHU/APL.	Bob Prill	Addressed by WP-3-03 CLOSED
2-15	Derive to the degree possible, performance requirements for UAT delivery of FIS-B products, from the FIS-B MASPS. By 15 March 2001	George Ligler Bill Flathers Stan Jones	Provide at Mtg #4
2-16	FIS-B MASPS – HDLC issue - prior to the document being presented to the RTCA PMC.	George Ligler (*) Bill Flathers Rich Jennings	Done. CLOSED
2-17	Look at a couple different error rates impact on the NEXRAD FIS-B display.	Chris Moody Jeff Giovino (*)	Addressed by WP-3-16 CLOSED
2-18	Recommendation on whether to use 5 or 6 bits for ground station identification, including rational taking into account needed anti-spoofing, and division of up-link labor between ground stations. We need to support TIS-B/ADS-B fusion, if possible. Report at Salem Meeting, 1-3 May.	Stan Jones Ed Valovage (*) Hartmut Uhr Mike Biggs Bill Thedford	
2-19	All members of WG-5 - provide comments to Greg Kuehl on Appendix D prior to Salem meeting.	All WG-5 members	
2-20	Get a person(s) from FAA-ASD, and potentially FAA-Capstone, to provide support for the development of Appendix D similar to that supplied for DO-260.	Rich Jennings	Brent Phillips and either Tom Elledge or Carl Gleason CLOSED
3-1	Validate bench test results taken at FAATC. Verify the previous measurements taken prior to additional testing to be made for model development of DME operation with UAT overlaps.	Ian Levitt	
3-2	Interchange of FAATC work product into APL simulations. Addition of ground uplinks into APL full-scale simulation.	Larry Bachman Tom Pagano	Preliminary data on the first DME by Mtg. #4. Larry with a status report at same meeting.
3-3	Additional data collection on DME equipment: Honeywell, General aviation unit, and additional equipment as has been specified by Eurocontrol	Tom Pagano Ian Levitt	Status report for Mtg. #4

Action Number	Action Description	Assigned to	Status
3-4	Ian to supply Nikos and Gondo with model numbers of DME equipment available at FAATC for testing	Ian Levitt (ASAP)	Done-4/16/01 CLOSED
3-5	Larry to provide UAT power distributions for refinement of UAT-DME bench testing to FAATC and Mike Biggs.	Larry Bachman	13 April
3-6	Mike and Gondo to determine criteria for acceptable DME performance in the presence of UAT interference	Mike Biggs Gondo Gulean	Report for Mtg. #4
3-7	Mike to determine what is meant by "Emergency Use" in relation to DME channel 978. Supports Action 3-9.	Mike Biggs	Report for Mtg. #4
3-8	George to discuss results of measurements on the narrower filter being tested at UPS AT for Mtg. #4	George Cooley	
3-9	Nikos to investigate the DME usage of 978 MHz in Europe, with results to present if possible in the May or, alternatively, the June meeting.	Nikos Fistas Gondo Gulean	
3-10	Bob to focus on necessity of database, frequency selection to avoid DMEs, and cost feasibility (using single channel implementation as baseline cost) of BAE proposal for the June meeting	Bob Prill	
3-11	Larry to send a copy of LA 2020 scenario and low density scenario to Warren by 13 April for use in simulation.	Larry Bachman	
3-12	Mike and Rich will agree on a low density JTIDS scenario for incorporation into LA 2020 self-interference model, and a high density JTIDS scenario for incorporation into the low density self-interference scenario. To be provided to Larry and Warren by April 20.	Mike Biggs Rich Weathers	
3-13	Warren and Larry will provide simulation results of the following scenarios: -Baseline JTIDS and each UAT self-interference scenario (LA 2020 and low-density) -High density JTIDS and low-density UAT self-interference -Low density JTIDS and LA 2020	Warren Wilson Larry Bachman	Preliminary results at Mtg. #4
3-14	Larry to coordinate with Mike to ensure that the model of DME antenna being used by APL is correct. To be done by Mtg. #4	Larry Bachman Mike Biggs	
3-15	Warren et. al will calculate the integrity on various encoding schemes (for both long and short ADS-B messages) and will provide at least those encodings that meet 10^{-8} PUME. An agreed-upon code will be provided by early in the week of April 9 th .	Warren Wilson (*) James Higbie John Barrows Tom Mosher	Sent out for review 4/10/01
3-16	George Cooley will provide code/no code sensitivity measurements over temperature for 1MHz and 700 KHz IF filters, evaluate oscillator requirements measure adjacent channel rejection for those filters, minimizing ISI.	George Cooley	Report on Mtg. #4
3-17	George Ligler and Nikos to decide on a location in Europe, and specific dates for the meeting during the week of September 24th	George Ligler Nikos Fistas	

Action Number	Action Description	Assigned to	Status
3-18	Mike, in coordination with Nikos and Chris, will provide core Europe DME scenario(s), including DME location, frequency, and power data to AI.	Mike Biggs Nikos Fistas Chris Moody	
3-19	AI will run the scenarios provided from action 3-18, and do additional analysis on UAT performance in the presence of DME adjacent channel interference only.	AI Muaddi	
3-20	Tom to re-run the Mode-S transponder ATCRBS reply scenarios on the 981 MHz/new FEC UAT receivers. Additionally to present data reported to TLAT on ATCRBS co-site testing.	Tom Pagano	Mtg. #5
3-21	Ian and Ei-Mon to continue analysis of independent range validation, with new information from Costas. Possibly provide input to timing requirements.	Ian Levitt Ei-Mon Phyu	Mtg. #4
3-22	Stan to examine impacts of compensated and uncompensated latencies of up to 1.5 seconds	Stan Jones (*) Chris Moody George Ligler Ian Levitt	Mtg. #4
3-23	Warren will present initial cut at items 3 and 4 from WP-2-06	Warren Wilson	Update for Mtg. #4
3-24	Establish a bin item for orphan actions, i.e. issues raised in WP-2-06. Possible repository for similar unresolved issues.	Rich Jennings George Ligler Gary Furr	
3-25	Perform an initial investigation to define and develop an RF UAT message generator to simulate high density scenarios. Determine the schedule and resource requirements to complete.	Ian Levitt Tom Pagano (*)	Status report at Mtg #4

16. The **Working Papers** shown in the following table are specifically for the Meeting being reported in these Meeting Minutes. Working Papers for all WG-5 Meetings, as well as the Meeting Agendas, Meeting Minutes, Meeting Schedules and files leading to the production of a UAT MOPS are posted on the ADS-B UAT web site at: <http://adsb.tc.faa.gov>

SC-186 Working Group 5 – MOPS for UAT – Working Papers

Working Paper	Size	Description	Introduced At:
UAT-WP-3-01	30KB	Example Link Budgets for use in discussions of the equipment classes defined in Section 2.1 of the UAT MOPS, presented by Tom Mosher	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-02	80KB	UAT Performance in the Presence of DME Interference, presented by Warren Wilson and Myron Leiter in support of Action Item 2-11	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-03	KB	DME Circumvention and Signaling Alphabet allows DME to Coexist with UAT, presented by Bob Prill, in support of Action Item 2-14	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-04	23KB	Draft 2 of Section 2.1 with new material primarily in Section 2.1.11, presented by Tom Mosher	Meeting 3, 04/02/01 Brussels, Belgium

Working Paper	Size	Description	Introduced At:
UAT-WP-3-05	59KB	Draft 2 of Appendix A, Acronyms and Definitions of Terms, presented by Terry Stubblefield	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-06	33KB	UAT Receiver Sensitivity over Temperature, presented by George Cooley, UPS-AT, in support of Action Item 2-6	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-07	27KB	Comparing hard decision decoding with erasure decoding for each of 3 UAT messages recommended as UAT enhancements, presented by Myron Leiter	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-08	6KB	Link 16 Interference Scenarios, presented by Rich Weathers in support of Action Item 2-8	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-09	48KB	Draft 1 of Section 1 of the UAT MOPS, presented by Bill Flathers	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-10	19KB	Looking at UAT - DME Interference Testing, presented by Chris Moody, Mike Biggs, Ian Levitt, and David Thomas, in support of Action Item 2-9	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-11	227KB	Looking at DME/UAT Interference, presented by Albert Muaddi, in support of Action Item 2-9	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-12	123KB	Investigations of UAT Options for Worst-Case Link 16 Scenario, presented by James Higbie, in support of Action Item 2-11	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-13	131KB	Validating the Independent Range Validation, presented by Ian Levitt and Ei Mon Phyu, in support of Action Item 2-4	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-14	63KB	UAT Performance in LA-2020 Traffic Levels with JTIDS Interference and some DME Compatibility Considerations, presented by Stan Jones in support of Action Item 2-12	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-15	11KB	GPS-UAT Coupling, presented by Chris Moody in support of Action Item 2-3.	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-16	235KB	Examination of Message Error Rates for UAT Uplink, presented by Chris Moody and Jeff Giovino in support of Action Item 2-17	Meeting 3, 04/02/01 Brussels, Belgium
UAT-WP-3-17	1,879KB	Eurocontrol ADS Programme, ADS Technology Assessment Task, UAT Bretigny Trial Data Analysis, presented by Constantine Tamvaclis, in support of Action Item 2-5	Meeting 3, 04/02/01 Brussels, Belgium