

Findings of the ADS-B Technical Link Assessment Team

TLAT Co-Chairs
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Evaluation Criteria - 1

- Applications from the Joint Government/Industry Plan for Free Flight Operational Enhancements
 - 7 ADS-B air-to-air applications
 - Traffic Information Services-Broadcast (TIS-B)
 - Flight Information Services-Broadcast (FIS-B)
 - plus the simultaneous approach application
- Technical Requirements
 - RTCA ADS-B MASPS (DO-242)

Evaluation Criteria - 2

- Additional applications from Eurocontrol
 - overlay of monopulse Secondary Surveillance Radar (SSR) with ADS-B
 - overlay of Mode S Enhanced Surveillance with ADS-B
- Additional technical requirements or assessments
 - extension of long-range deconfliction from Eurocontrol
 - multiple ADS-B link considerations
 - any link dependent criteria resulting from ADS-B Operational Safety Assessment
 - expandability and excess capacity

Traffic Scenarios

- Los Angeles Basin in 2020
- Core Europe in 2015
- Low Density

Membership

- Co-chairs
 - Constantine Tamvaclis, EEC
 - Ann Tedford, FAA
- Facilitator
 - George Ligler, PMEI
- Team Members
 - Larry Bachman, JHU/APL
 - Nikos Fistas, Eurocontrol
 - John Gonda, DoD/USAF
 - Stan Jones, MITRE
 - Vince Nyugen, FAA/AND-500
 - Tom Pagano, FAA/ACT-300
 - Rich Weathers, DoD/JCS
 - Don Willis, FAA/ASR-100
 - Ray Yuan, JHU/APL
- Subject Matter Experts
 - 1090 MHz Extended Squitter
 - Jonathan Bernays, LL
 - Bill Harman, LL
 - UAT
 - Chris Moody, MITRE
 - VDL Mode 4
 - Christian Axelsson, Swedish CAA
 - Johnny Nilsson, Swedish CAA
 - Armin Schlereth, DFS

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Application Performance Results - 1

Low Density Scenario

	1090 Extended Squitter	UAT	VDL Mode 4
SF21 Performance Criteria			
Aid to visual Acquisition (SV Update Rates to 10 nm)	Supported (by analysis)	Supported (by analysis)	Not supported (by analysis)
Conflict and Collision Avoidance (SV Update Rates to 20 nm)	Supported (by analysis)	Supported	Not supported (all a/c in scenario are en route and above 10000ft)
Separation Assurance and Sequencing (SV and 1 TCP Update Rates to 40 nm)	Likely to be supported (by analysis)	Supported	SV updates supported in 20 to 40 nm and TMAs; TCP change is likely to be met (by analysis); Acquisition was not evaluated;
Flight path de-confliction planning (SV and 2 TCP Update Rates to 90 nm)	Likely to be supported (by analysis)	Supported	SV updates supported TCP change is likely to be met (by analysis); Acquisition was not evaluated;
Airport Surface	Not applicable	Not applicable	Not applicable
Simultaneous approaches (SV Update Rates based upon physical runway separation)	Not applicable	Not applicable	Not applicable

Application Performance Results - 2

Low Density Scenario - continued

	1090 Extended Squitter	UAT	VDL Mode 4
Additional Eurocontrol Criteria			
ATS Surveillance a/g			
TMA (SV and 4 TCP Update Rates to 60 nm)	Not applicable	Not applicable	Not applicable
En-Route (SV and 4 TCP Update Rates to 150 nm)	Not addressed	Not addressed	Not addressed
ATS Enhanced Surveillance a/g	Not applicable	Not applicable	Not applicable
TMA (SV and 4 TCP Update Rates to 60 nm)			
En-Route (SV and 4 TCP Update Rates to 150 nm)			
A-SMGCS	Not applicable	Not applicable	Not applicable
Taxi (0-5 nm)			
Approach (5-10 nm)			
Autonomous air to air operations – long range (SV and 4 TCP to 150 nm)	Unlikely to be met to 150 nm; may be possible to <120 (by analysis)	Supported	SV updates supported TCP change is likely to be met (by analysis); Acquisition was not addressed

Application Performance Results - 3

Core Europe 2015

	1090 Extended Squitter	UAT	VDL Mode 4
SF21 Performance Criteria			
Aid to Visual Acquisition (SV Update Rates to 10 nm)	Supported (by analysis)	Supported (by analysis)	Not supported except in Approach and Climb-out areas (by analysis)
Conflict and Collision Avoidance (SV Update Rates to 20 nm)	Supported	Supported	For ranges above 3nm, supported within RSC and supported outside RSC when below 10000ft
Separation Assurance and Sequencing (SV and 1 TCP Update Rates to 40 nm)	Inconclusive	Supported	SV Updates are supported; Proposed TCP scheme not evaluated
Flight path deconfliction planning (SV and 2 TCP Update Rates to 90 nm)	Not supported	Requirement is met only up to 70 nm	Inconclusive
Airport Surface	Not addressed	Not addressed	Not addressed
Simultaneous approaches (SV Update Rates based upon physical runway separation)	Supported (by analysis)	Supported (by analysis)	3sec SV update req. met (by analysis)

Application Performance Results - 4

Core Europe 2015 - continued

	1090 Extended Squitter	UAT	VDL Mode 4
Additional Eurocontrol Criteria			
ATS Surveillance a/g			
TMA (SV and 4 TCP Update Rates to 60 nm)	Met with a 6-sector antenna	Likely to be met (by analysis)	Not supported with one Ground Station
En-Route (SV and 4 TCP Update Rates to 150 nm)	Met up to 100 nm with 6-sector antenna	Not addressed	SV Update Requirement met up to 70 nm with one omnidirectional antenna inside the RSC. TCP update method provided in Appendix E but not evaluated
ATS Enhanced Surveillance a/g	Not addressed for the transmission of CAP information	All parameters were addressed	Not addressed for the transmission of CAP and TCP information
TMA (SV and 4 TCP Update Rates to 60 nm)	Met with a 6-sector antenna	Likely to be met (by analysis)	Not supported with one Ground Station
En-Route (SV and 4 TCP Update Rates to 150 nm)	Met up to 100 nm	Not addressed	SV Update Requirement met up to 70 nm with one omnidirectional antenna inside the RSC
A-SMGCS			
Taxi (0-5 nm)	Not addressed	Not addressed	Not addressed
Approach (5-10 nm)	Not addressed	Not addressed	Not addressed
Autonomous air to air operations – long range (SV and 4 TCP to 150 nm)	Not supported	Not supported	Not supported

Application Performance Results - 5

Los Angeles Basin 2020

	1090 Extended Squitter	UAT	VDL Mode 4
SF21 Performance Criteria			
Aid to visual Acquisition (SV Update Rates to 10 nm)	Supported (by analysis)	Supported (by analysis)	Not supported except in Approach and Climbout areas (by analysis)
Conflict and Collision Avoidance (SV Update Rates to 20 nm)	Supported	Supported	Supported beyond 3 nm
Separation Assurance and Sequencing (SV and 1 TCP Update Rates to 40 nm)	Unlikely to be met	Supported	SV Updates are supported; Proposed TCP scheme not evaluated
Flight path de-confliction planning (SV and two TCP Update Rates to 90 nm)	Not supported	Supported	Inconclusive
Airport Surface	Not addressed	Not addressed	Not addressed
Simultaneous approaches (SV Update Rates based upon physical runway separation)	Supported (by analysis)	Supported (by analysis)	3 sec SV update requirement met (by analysis)

Application Performance Results - 6

Los Angeles Basin 2020 - continued

	1090 Extended Squitter	UAT	VDL Mode 4
Additional Eurocontrol Criteria			
ATS Surveillance a/g			
TMA (SV and 4 TCP Update Rates to 60 nm)	Not addressed	Likely to be met (by analysis)	Not supported with one Ground Station (by analysis)
En-Route (SV and 4 TCP Update Rates to 150 nm)	Not addressed	Not addressed	At least as good as Core Europe 2015 because of the higher transmission rates used (by analysis)
ATS Enhanced Surveillance a/g			
TMA (SV and 4 TCP Update Rates to 60 nm)	Not addressed	Likely to be met (by analysis)	Not supported with one Ground Station (by analysis)
En-Route (SV and 4 TCP Update Rates to 150 nm)	Not addressed	Not addressed	At least as good as Core Europe 2015 because of the higher transmission rates used (by analysis)
A-SMGCS			
Taxi (0-5 nm)	Not Addressed	Not addressed	Not Addressed
Approach (5-10 nm)	Not Addressed	Not addressed	Not Addressed
Autonomous air to air operations – long range (SV and 4 TCP Update Rates to 150 nm)	Not supported	Not supported	Not supported

Further Findings - 1

- TIS-B
- FIS-B
- Time until Implementation
 - Standards
 - Availability of Spectrum
 - Risk and Complexity

Further Findings - 2

- Time until Implementation - continued
 - Standards
 - Availability of Spectrum
 - Risk and Complexity

Further Findings - 3

- Integration/Coexistence with Existing Systems
- Operational Safety Assessment
- Expandability
- Multi-link

Areas for Potential Further Study

- Multipath
- Propagation in VDL Mode 4
- Range Limit of Core Europe Scenario
- Multi-link
- Co-site Interference
- Terrain Effects
- “Honeycomb” Channel Management Scheme for VDL Mode 4