VDL 2 capacity simulations

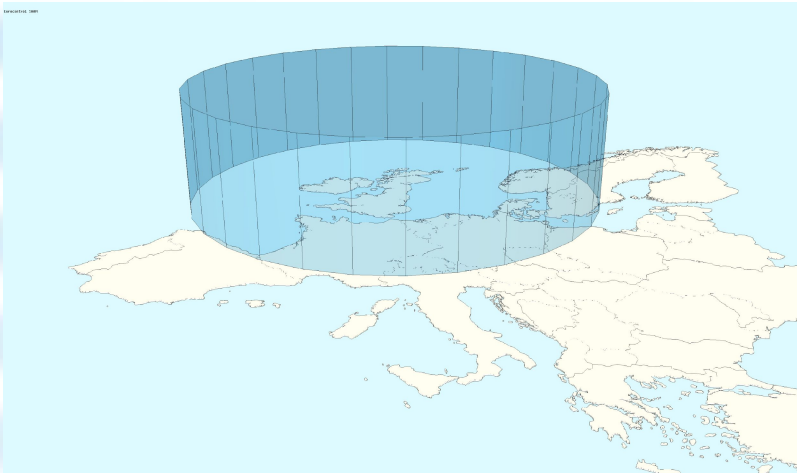## Conclusions on the capacity per VDL 2 channel

Presentation by P. Delhaise

Agenda

- **Total capacity per VDL 2 channel**
- **Comparison with Link2000+ requirements**
- **Recall on Frequency Managers deployment plan**
- **Brief look at Airborne Co-site study (integrated to ACTS simulations)**
- **Q&A**

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- **Using peak days-peak hour air traffic records in 600 NM –radius –busiest part of Europe**

- **Applying different % of aircraft equipment with AOC and ATS (Link2000+) applications**

- **Increasing % equipped as long as QoS is OK** (95% of Round Trip Tx within 8sec, as required for ACL)

- **Up to 1220 flights operating AOC + 670 flights operating Link2000+ can be connected on a single VDL2 channel**

- **Equivalent to 100% migration of 2004-ACARS traffic + 42% of flights in UA during peak hour already running Link2000+.**
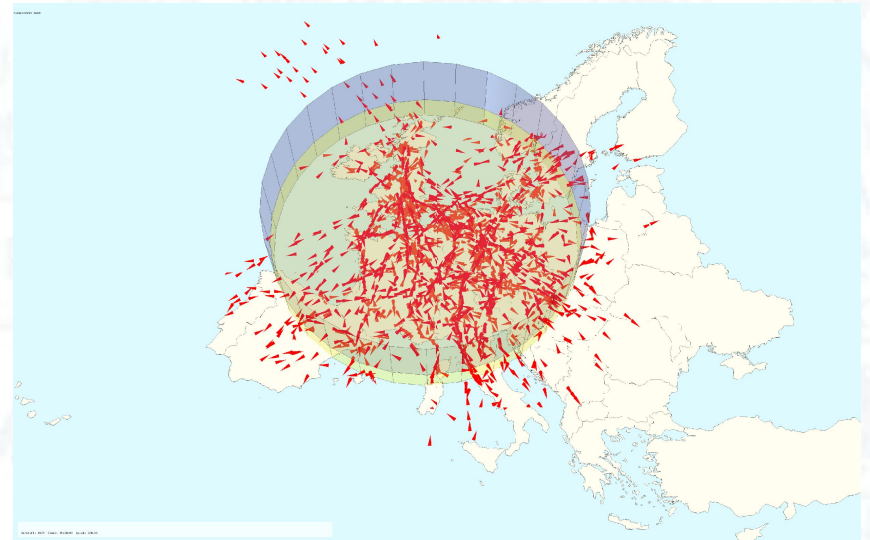
Comparison with Link2000 capacity requirements (1/2)

- **Link2000+ running on 40-45% of UA traffic : forecasted within 2008-2009**

- **At that time, full AOC migration (nearly) completed from ACARS to VDL 2 ?**

- **Air traffic increase for coming years =?**

Our best guess :

1rst Channel saturated within 2007-2010 in busiest areas

- **Final Link2000+ target: equipping 75% of UA traffic, forecasted in 2014**

- **At that time, assume full AOC migration from ACARS to VDL 2**

- **Peak hour (2004 traffic): 75% of UA flights ~ = 1600 flights for Link +, along 1220 flights equipped with AOC**

Final Link2000+ (2014) deployment requires :

2 – 3(*) VDL 2 channels for busiest areas

(*) Need revisiting/ simulating ENR sectors, H.O. algorithm and round-trip delay requirements to confirm

Target VDL deployment plan for ICAO FMG EUR

Since ST-15 study, coordination wih FMG EUR for provision of 4 VDL-2 channels

	136.575	136.600	136.625	136.650	136.675	136.700	136.725	136.750	136.775	136.800	136.825	136.850	136.875	136.900	136.925	136.950	136.975
2002	A	A	A	A	A	A	A	A	A	O	O	O	O	Ac Si	Ac Ar	M4	M2

Migrated to 131.825 MHz

Migrated to 136.750MHz

Oct 04- next actions are : re-allocate OPC and move M4 to 136.925 MHz, and envisage next steps

	136.575	136.600	136.625	136.650	136.675	136.700	136.725	136.750	136.775	136.800	136.825	136.850	136.875	136.900	136.925	136.950	136.975
Step 2 2005 a	A	A	A	A	A	-	-	Ac Si	-	-	M2	-	M2	-	M4	-	M2
Step 2 2005 b	A	A	A	A	A	-	-	-	M2	-	O	-	M2	-	M4	-	M2

OR

	136.575	136.600	136.625	136.650	136.675	136.700	136.725	136.750	136.775	136.800	136.825	136.850	136.875	136.900	136.925	136.950	136.975
Step 4 2008	A	A	A	A	A	-	M2	-	M2	-	M4	-	M2	-	M4	-	M2
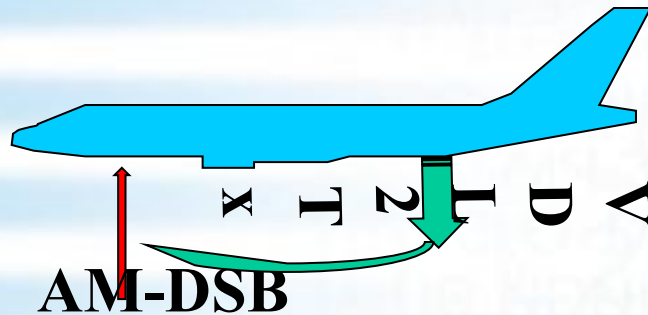
AM-DSB voice Rx
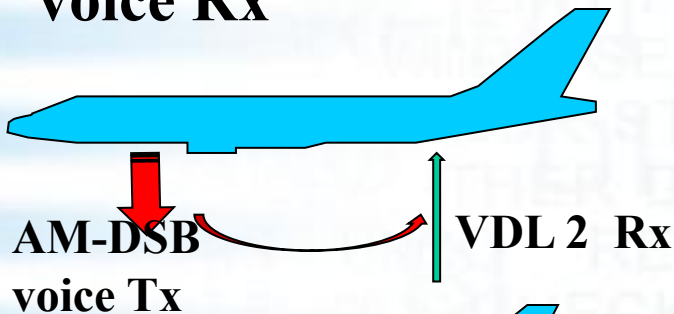
AM-DSB voice Tx — **VDL 2 Rx**
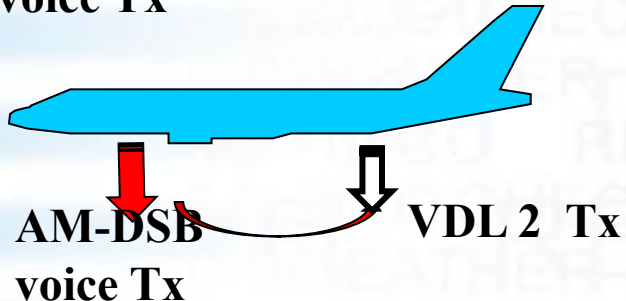
AM-DSB voice Tx — **VDL 2 Tx**

- Analysis of 3 airborne interf. cases (VDL 2 < > VHF- voice)
- Analysis made use of :
  - Lab aircraft,
  - 700-flight records to describe VHF voice traffic (ATC and OPC)
  - ACTS-simulations for impact on CPDLC applications
- Impact confirmed tolerable for Link2000+ or any CPDLC –like application, with significant margins

- Sounds really tolerable for voice operation
- Impact on total channel capacity ~= 1.8% of ATS traffic (unchanged AOC)

Conclusions

- **Detailed VDL2 simulator covering busiest part or Europe is now available and validated**
- **Results indicate that first VDL 2 channel will support full AOC migration +Link2000 traffic up to 2007 minimum**
- **Full Link2000 deployment (75% of UA traffic) requires 2 or 3 channels for busiest areas**
- **This matches expectations and ongoing channels deployment initiated at ICAO EUR FMG level since 2001**
- **Airborne co-site issue is clarified for VDL 2 and accounted in the achieved simulations.**

Link 2000+

EUROCONTROL

Questions ?

ACTS features and validation (1/2)

✔ **Air traffic model in 4D-positions based on real flights records in European area**

✔ **VDL 2 ground-stations topology in 3D according to commercial deployments**

✔ **AOC data traffic model based on service providers traffic statistics in Europe.**

✔ **ATS data-link traffic tuneable per flight phase, based on Link2000+ requirements**

✔ **Multi-path VHF propagation model validated by flight trials**

ACTS
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✔ **Accurate and SARPS compliant simulations of VDL 2 physical layer, CSMA and AVLC, each one validated per specific programs with independent developments**

✔ **ATN overhead and signalling inserted according to live –records of service providers.**

✔ **Airborne co-site interference simulated with interfering voice traffic model based on live statistical records.**

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contacts

- **Patrick DELHAISE, Eurocontrol DAS/CSM**
patrick.delhaise@eurocontrol.int

    VDL 2 Project manager
    +32 2 729 34 78

- **Massimiliano ESPOSITO, Eurocontrol DAS/CSM**
massimiliano.esposito@eurocontrol.int

    VDL 2 Engineering
    +32 2 729 34 90

- **Bertrand DESPERIER, ISA TELECOMS**
bertrand.desperier@isa-telecoms.com

    (ACTS – simulation designer)
    38 rue des Gravilliers
    F-75003 PARIS France

    +33 1 44 54 57 81
    +33 1 69 88 76 09