

# **VDL 2 capacity simulations**

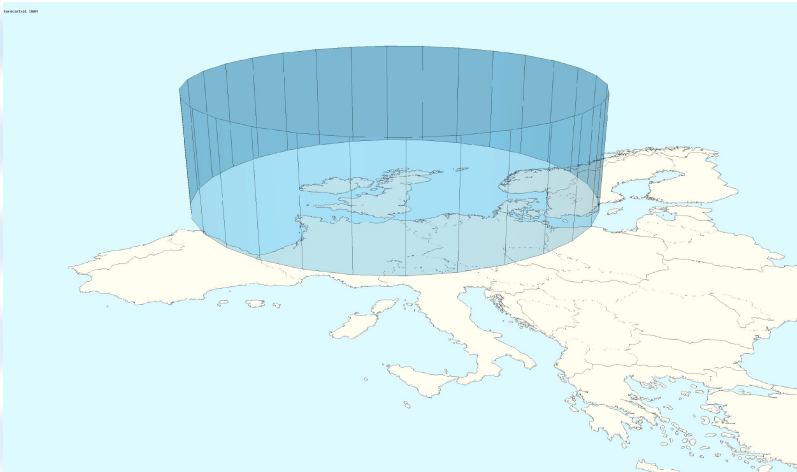
## **Conclusions on the capacity per VDL 2 channel**

**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**

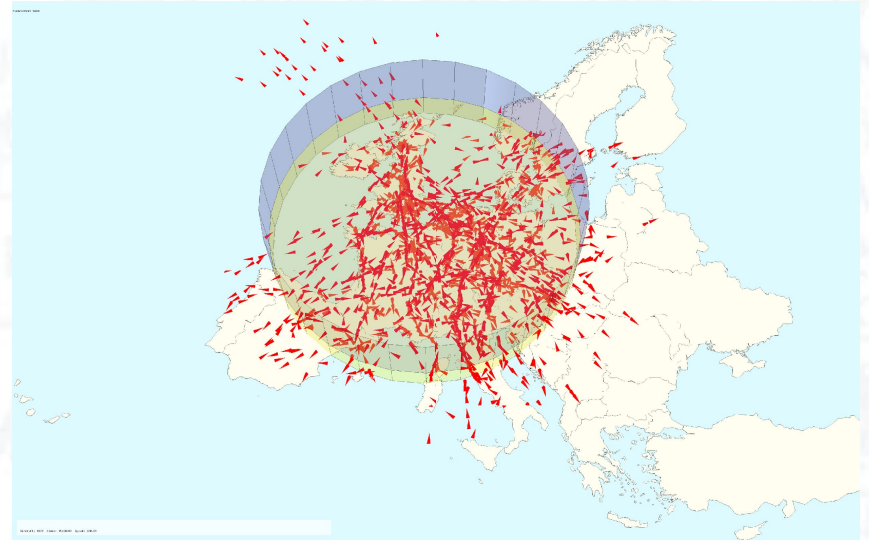
# In search for total capacity/ VDL 2 channel



- 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 )

# Total Capacity/VDL 2 channel

- **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 :

1st Channel saturated within 2007-2010 in busiest areas

## Comparison with Link2000 capacity requirements (2/2)

- **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 with 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

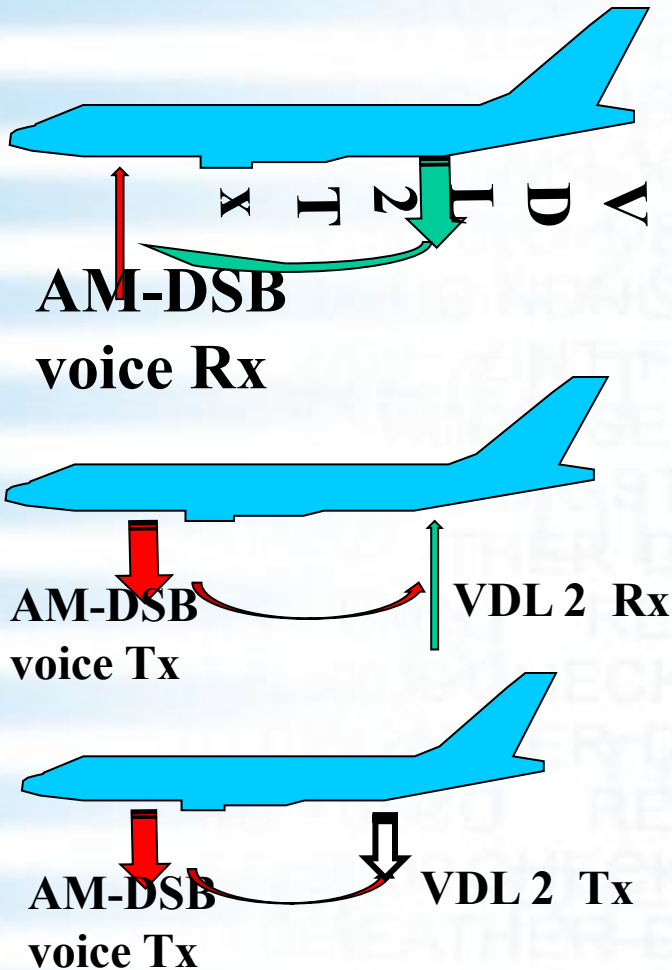
Oct 04- next actions are : re-allocate OPC and move M4 to 136.925 MHz, and envisage next steps

Step 2 2005 a	A	A	A	A	A	-	-	Ac Si	-	-	M2	-	M2	-	M4	-	M2
OR Step 2 2005 b	A	A	A	A	A	-	-	-	M2	-	O	-	M2	-	M4	-	M2

Step 4 2008	A	A	A	A	A	-	M2	-	M2	-	M4	-	M2	-	M4	-	M2
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# Analysis of Airborne co-site impact

(presentation to ICAO ACP end October 04)



- 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 of 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.**

# 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 –features (2/2)

- ✓ **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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