

# Developments in Noise Protection Technologies for Military Aircrew

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# Background & Acknowledgment

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- An overview of new technologies being developed for the UK's MOD under the Lightweight Noise Protection (LINP) Technology Demonstrator Programme (TDP) was presented at SAFE Europe 2011 and SAFE National 2013
  - A range of COTS earplug technologies developed to TRL6
  - Two emerging technologies developed to TRL4
    - Adaptive Digital Active Noise Reduction
    - Comms Stripping (removal of unwanted noise on the comms line)
- This presentation will provide an overview of the continued development of the two TRL 4 technologies that has been conducted under funding from UK MOD's Aircrew Systems Research (ASR) Programme

TRL = Technology Readiness Level

TRL4 = Concept validated in a laboratory environment

TRL6 = Technology demonstrated in a relevant environment

# Research Requirements

- MOD need to demonstrate compliance with the CNAWRs
- Short term solution - double protection system using CEPs™ under standard flight helmets
  - Fit, Comfort and situational awareness issues
- Mid term solution – 2nd generation In Ear Comms Device (IECD) – competed procurement currently underway
- Longer term solution – revert to a single protection system (i.e. no earplug) incorporating ADANR & CS

## Control of Noise At Work Regulations (CNAWRs): 2005

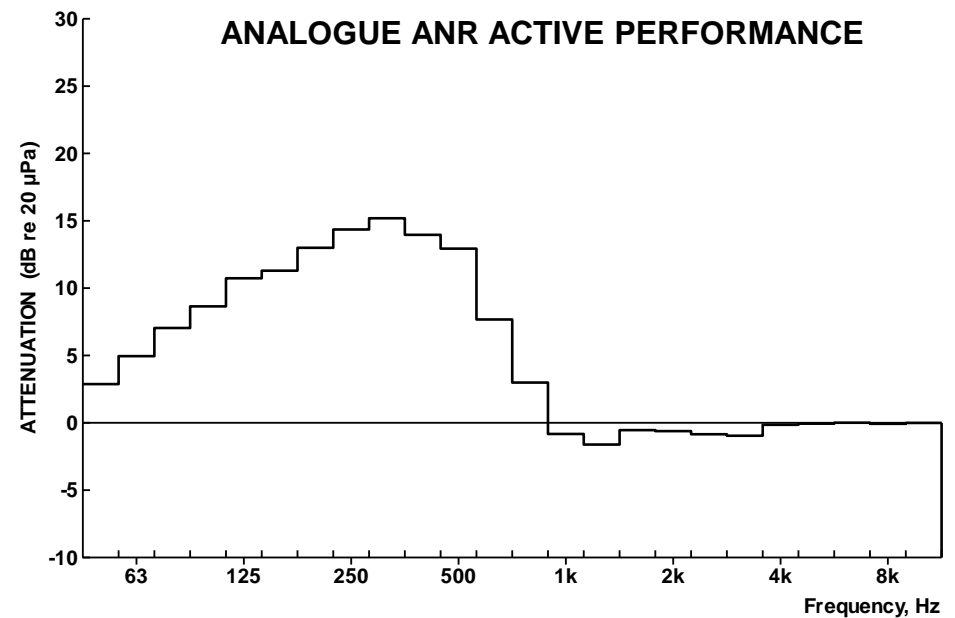
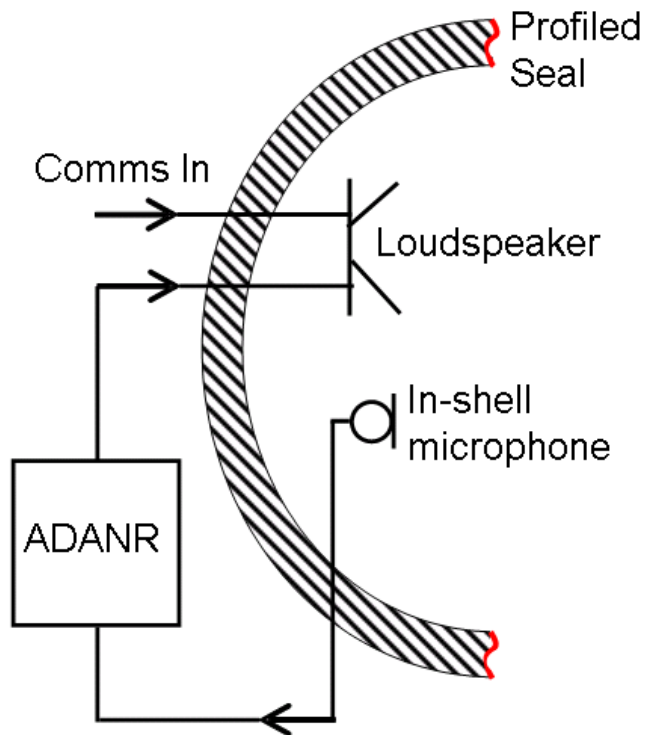
.....imposes a duty on employers to reduce the risk of noise induced hearing damage to the lowest level reasonably practicable

Provision	CNAWR - introduced April 2006	
	Continuous	Peak
<b>Lower Exposure Action Value (LEAV)</b> <i>(ambient noise) Hearing protection to be made available if requested</i>	80dB(A)	135dB(C)
<b>Upper Exposure Action Value (UEAV)</b> <i>(ambient noise) Hearing protection to be worn (mandatory)</i>	85dB(A)	137dB(C)
<b>Exposure Limit Value (ELV)</b> <i>(at ear under hearing protection) Prohibitive, must not exceed level</i>	87dB(A)	200Pa/140dB(C)

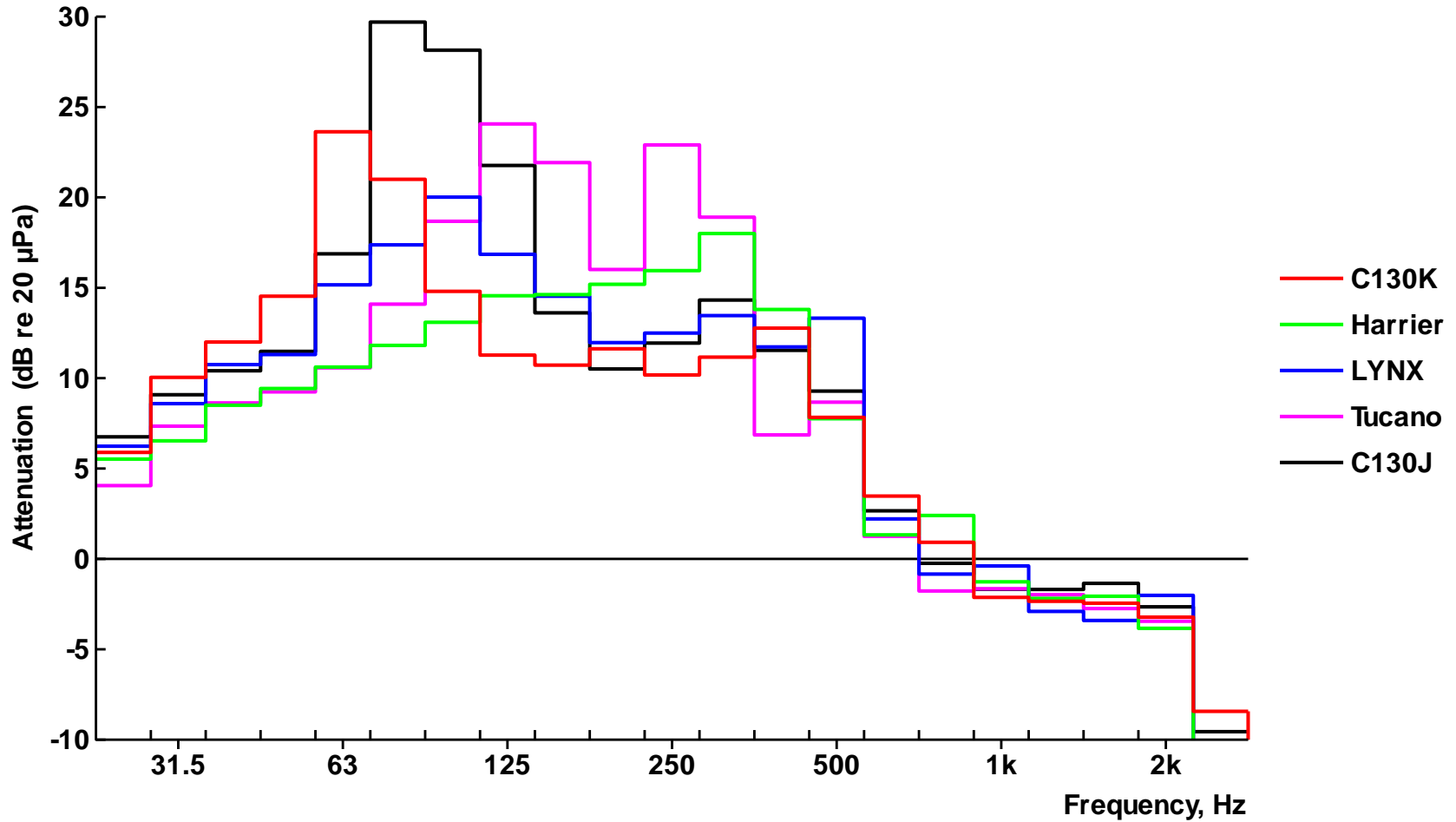
CNAWR state that ‘overprotection’ will isolate personnel from their environment and protection that reduces noise at the ear to below 70dB should be avoided

# Adaptive Digital Active Noise Reduction

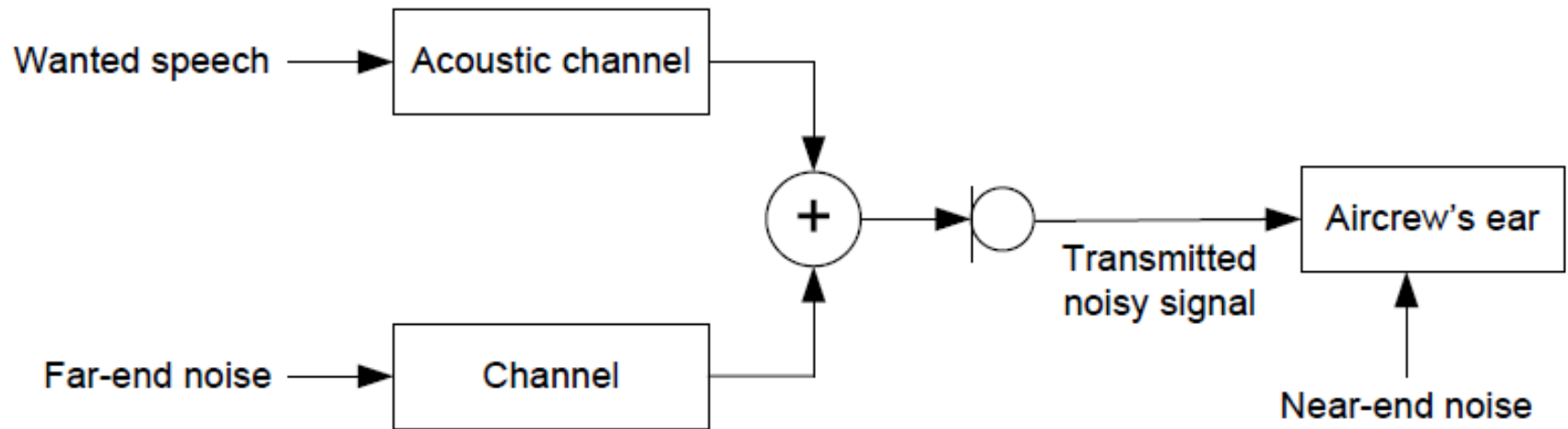
ADANR development under the TDP has built on a series of QinetiQ held patents (P2058) that describe an adaptive digital ANR system in a hearing protector earshell



# ADANR - TRL4 solution



# Comms Stripping (CS)



# TDP Summary

- **End of TDP (2011)**
  - ADANR developed to TRL4 – concept demonstrated
    - in realistic noise environments showing variable levels of
    - active attenuation in the different noise fields
  - CS developed to TRL4 – concept demonstrated to
    - remove significant levels of ‘hiss’ from real aircrew comms
    - recordings without effecting the speech intelligibility
- Hardware – still on two large development boards linked to PC



# Aircrew System Research

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- **Aim of ASR development work (commenced 2012) – develop a wearable system**
  - Miniaturise the ADANR hardware and upgrade electronic components, whilst maintaining the performance of the ADANR algorithm
  - Further develop the ADANR system to support future flight evaluation
  - Develop a real-time CS system and define the algorithm parameters that provide optimal noise reduction without introducing distortions into aircrew speech
  - Integrate the comms stripping capability into the new ADANR hardware.
  - Ensure that the miniaturised ADANR hardware designed and built for airworthiness approval and clearance for use in flight trials



# ADANR & CS Demonstrator 2015



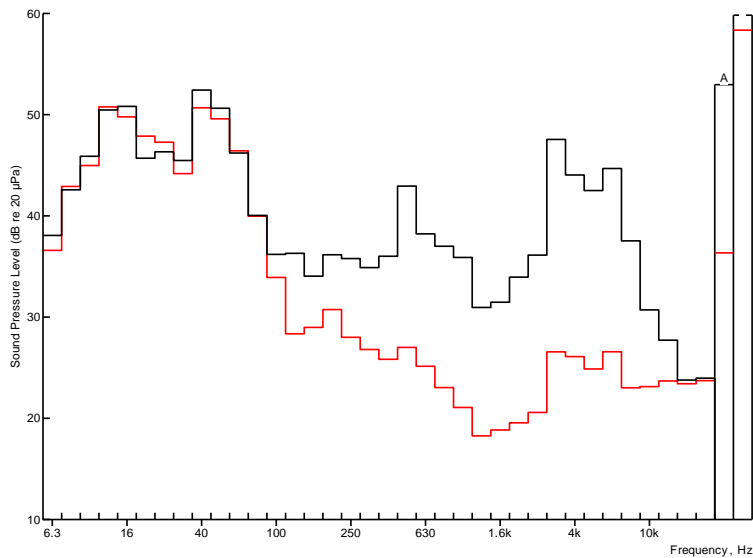
# ADANR performance 2014

Noise Field	LINP TDP active attenuation (dB)	ASR active measured mean attenuation (dB)	Difference (dB)
C130J	14.1	15.6	+1.5
Tucano	17.4	18.9	+1.5
Hawk	11.9	10.1	-1.8
Sea King	11.2	13.1	+2.0

Comparison of the mean active attenuation (over and above the passive protection) afforded by the development ADANR system during the LINP TDP (2011) and the miniaturised ADANR system (2014) - in the four different aircraft noise fields.

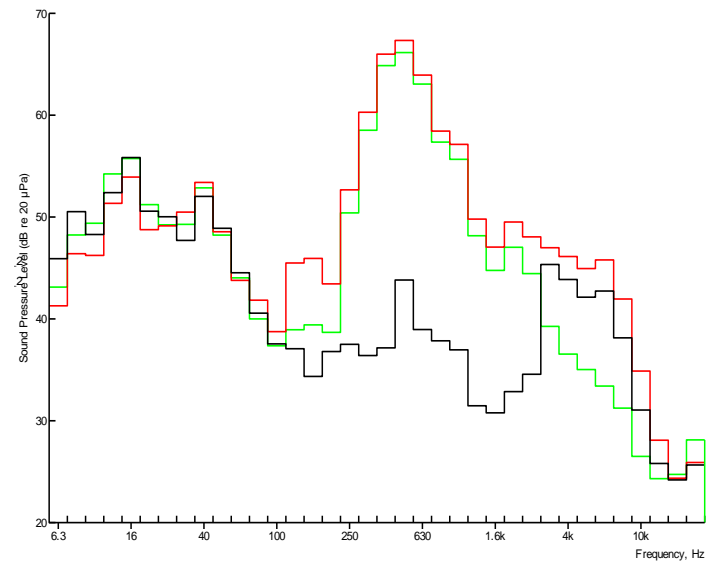
# CS performance 2014

## Hiss only



Black = unprocessed  
Red = processed

## Speech & hiss



Black = unprocessed hiss  
Red = unprocessed speech & hiss  
Green = processed speech & hiss

# Going forward

- Preliminary assessments show that for some platforms (e.g. C130J) the headset demonstrator is now at TRL6/7 and could go forward for flight assessment
- For other platforms (particularly fast jets) additional protection is still required in the mid frequency band (1-3kHz)
  - the new hardware has been designed to support new software architectures
  - under future ASR programme previously untried techniques and architectures will be investigated to extend the upper performance limit towards 3kHz
- Preliminary figures show implementation of CS is working correctly and algorithm is capable of significantly reducing unwanted noise (i.e. 'hiss') in the comms signal which improves the listening environment
  - Measurements made to date have not shown a reduction of A-weighted noise at ear
  - Indirect benefit - aircrew will be able to reduce their comms levels due to the improved listening environment and this will be enhanced if CS and ADANR are used in combination
  - Currently there are no standardised methods for assessing CS and ADANR individually or in combination - future ASR programme will develop methodology for robust performance measures

*QinetiQ*