Dedicated to innovation in aerospace

Airplane noise in Europe

Harry Brouwer

Why looking at aircraft noise from a European perspective?

- **Since 1993 a considerable part of the aircraft noise research within Europe has been carried out in the Framework Programmes for Research of the EU**
- **Cooperation of Industry, Research Establishments and Academia**
- **Starting in 1998 the submission of project proposals has been co-ordinated by the X-Noise Thematic Network and its successors**
- **Additional objectives of X-Noise:**
  - Develop a common strategy
  - Compile roadmaps
  - Dissemination of results
  - Support national networks (National Focal Points)

X-Noise Thematic Network and its successors

- **X-Noise: 1998 – 2002**
- **X^2-Noise: 2002 – 2006**
- **X^3-Noise: 2006 – 2010**
- **X-Noise EV: 2010 – 2015**

Continuation as part of a Coordinated Research and Innovation Action is now discussed.

X-Noise Thematic Network and its successors

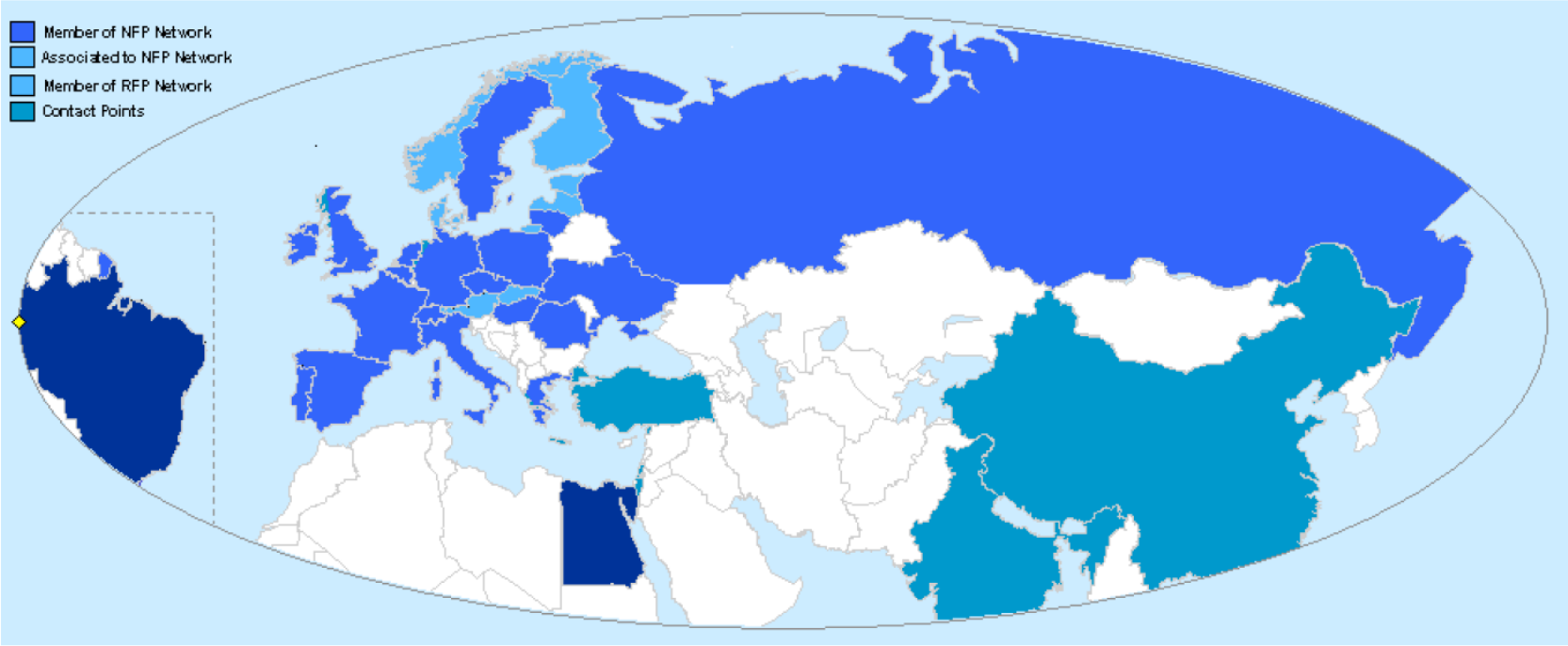


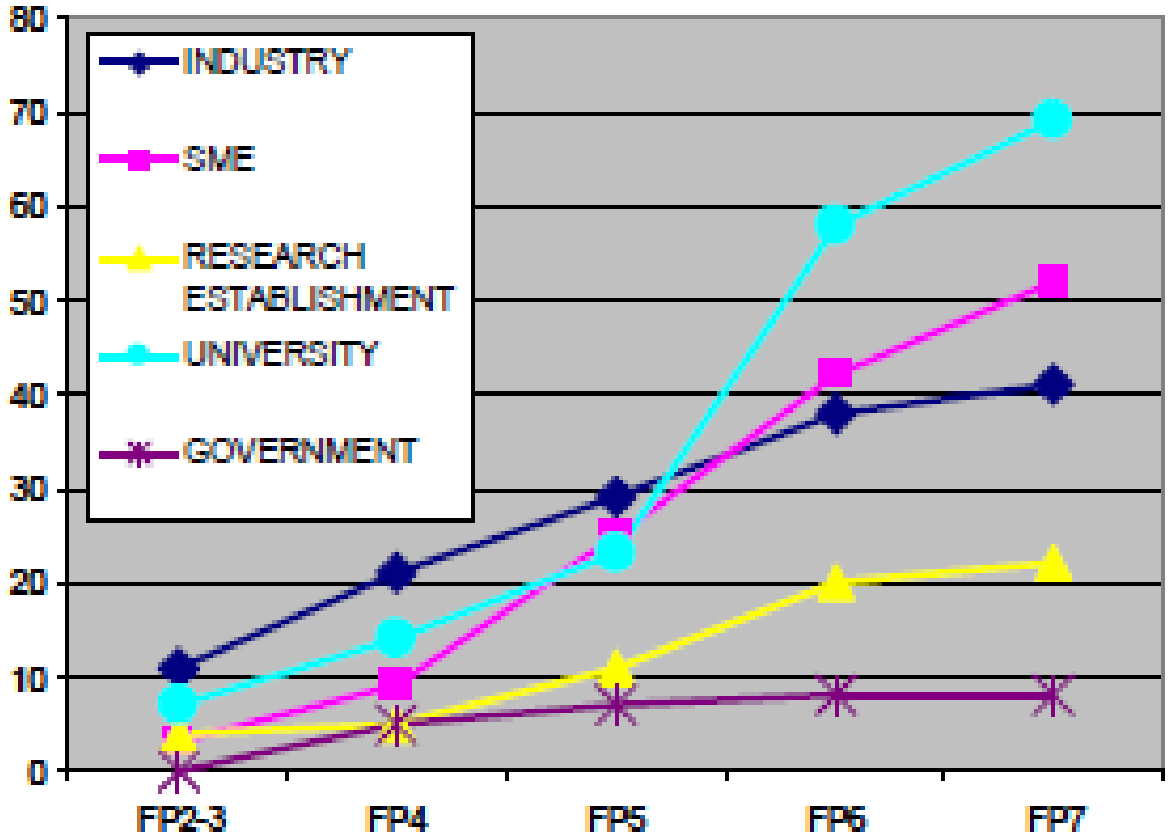
Figure 1.4 – Geographic Scope of X-Noise Network

Involvement from NL:

- **NLR (X-Noise Management Team, NL Focal Point)**
- **TO70**
- **Fokker (SILENCER)**
- **Microflown (TEENI)**

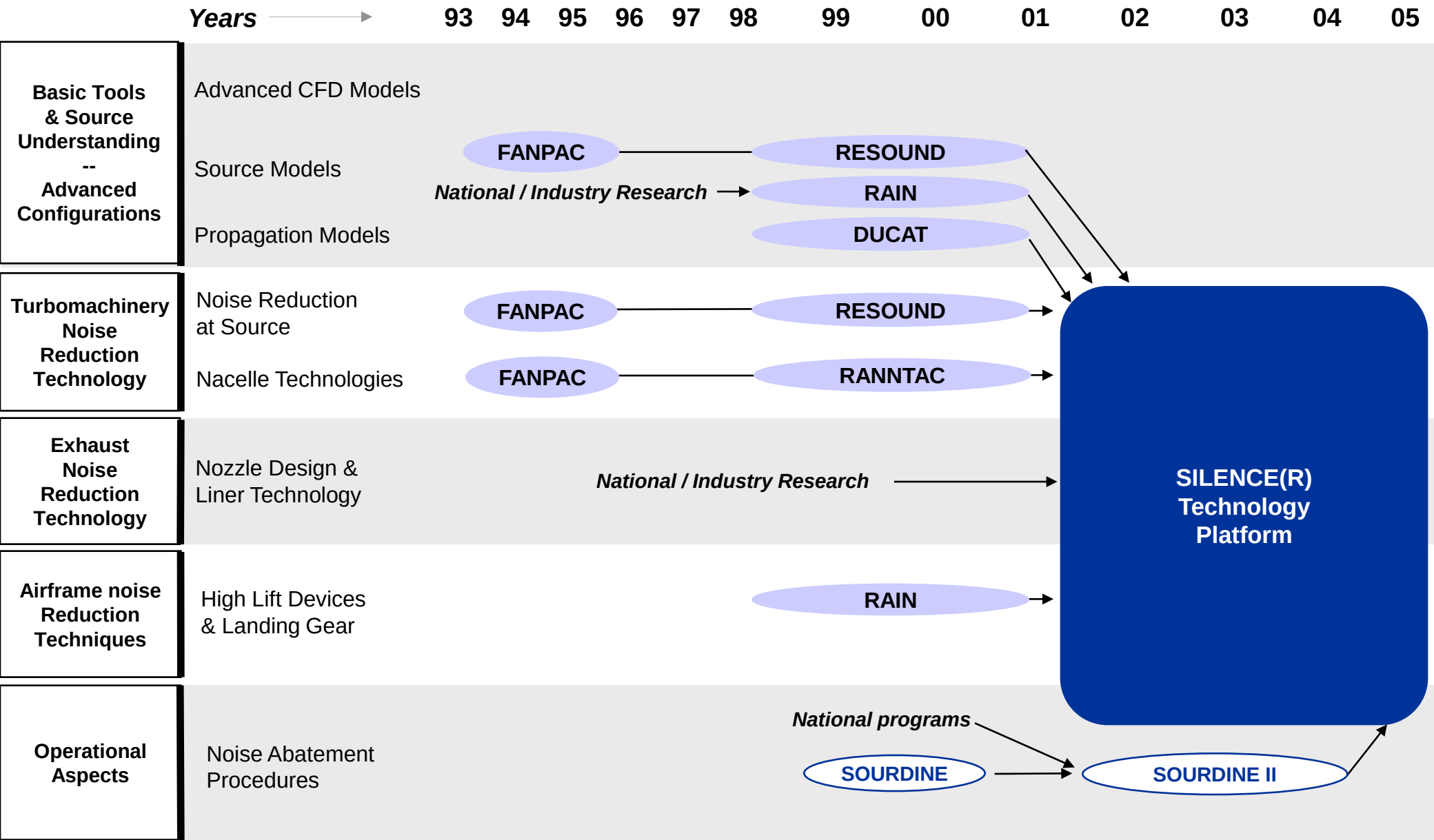
X-Noise Thematic Network and its successors

Organizations participating to related projects:



X²-NOISE

Projects Roadmap for 2010 Solutions



Aircraft Noise Projects Roadmap

X–Noise EV

Generation 1 Solutions

Generation 2 Solutions

Years → 00 01 02 03 04 05 06 07 08 09 10 11 12

Basic Tools & Source Understanding

- Propagation Models: DUCAT, MESSIAEN, TURNEX
- Source Models and Advanced CFD/ CAA — Jet: JEAN, COJEN, COJEN II
- Turbomachinery: RESOUND, TurboNoise CFD, PROBAND
- Core Airframe: RAIN, TEENI, CORE

Advanced Configurations

- Aircraft Architectures: ROSAS, NACRE IP
- Engine Architectures: VITAL II, DREAM IP

Turbomachinery Noise Reduction Technology

- Noise Reduction at Source: RESOUND
- Nacelle Technologies: RANNTAC

Exhaust Noise Reduction Technology

- Nozzle Design
- Liner Technology

National / Industry Research

SILENCE(R) Technology Platform

FLOCON

OPENAIR

Airframe noise Reduction Techniques

- High Lift Devices & Landing Gear: RAIN
- TIMPAN

Operational Practices

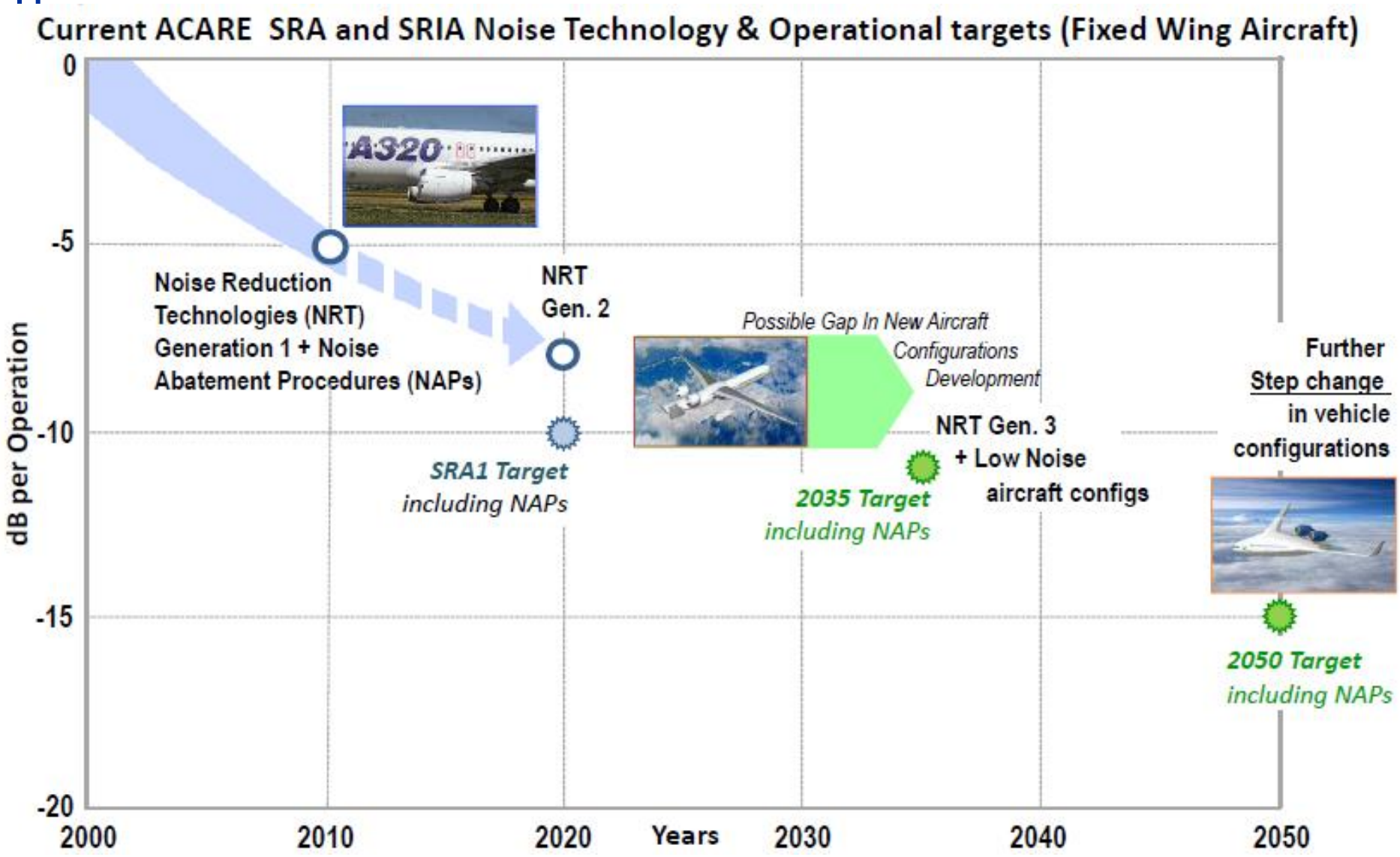
- Noise Abatement Procedures
- *National programs*: SOURDINE, SOURDINE II, ERAT, OPTIMAL IP

Impact Management Tools

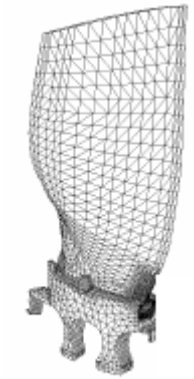
- Noise / Emissions Tradeoffs Evaluation
- Noise Mapping — *International Effort* → IMAGINE → *International Effort*
- Virtual Neighbourhood: SEFA

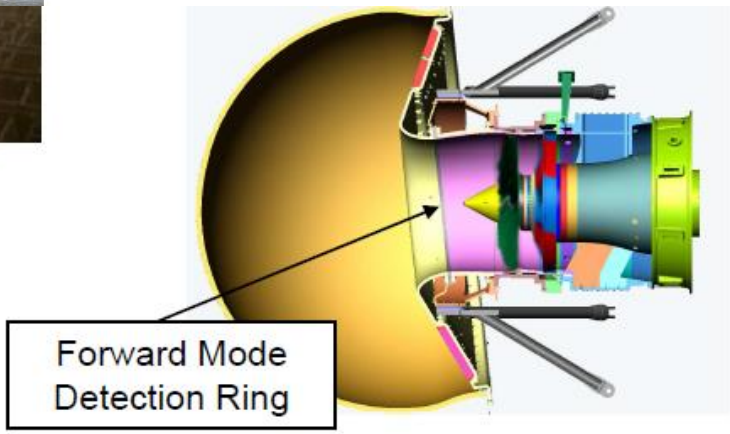
TEAM

TOPAS


Current ACARE SRA and SRIA Noise Technology & Operational targets (Fixed Wing Aircraft)
dB per Operation
0
-5
-10
-15
-20
2000
2010
2020
Years
2030
2040
2050
A320
Noise Reduction Technologies (NRT) Generation 1 + Noise Abatement Procedures (NAPs)
NRT Gen. 2
SRA1 Target including NAPs
Possible Gap In New Aircraft Configurations Development
NRT Gen. 3 + Low Noise aircraft configs
2035 Target including NAPs
Further Step change in vehicle configurations
2050 Target including NAPs

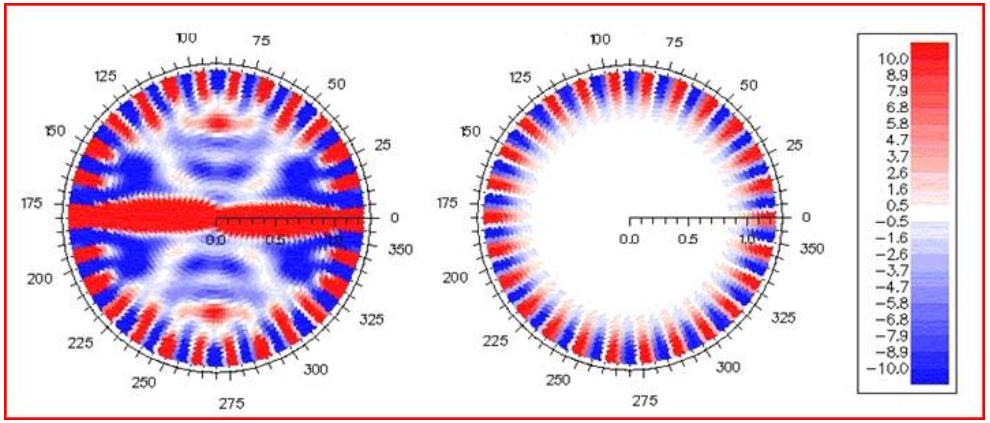
Technology Highlights from EU funded external aircraft noise projects: Fan design





Technology Highlights from EU funded external aircraft noise projects: Spliceless Inlet Liner

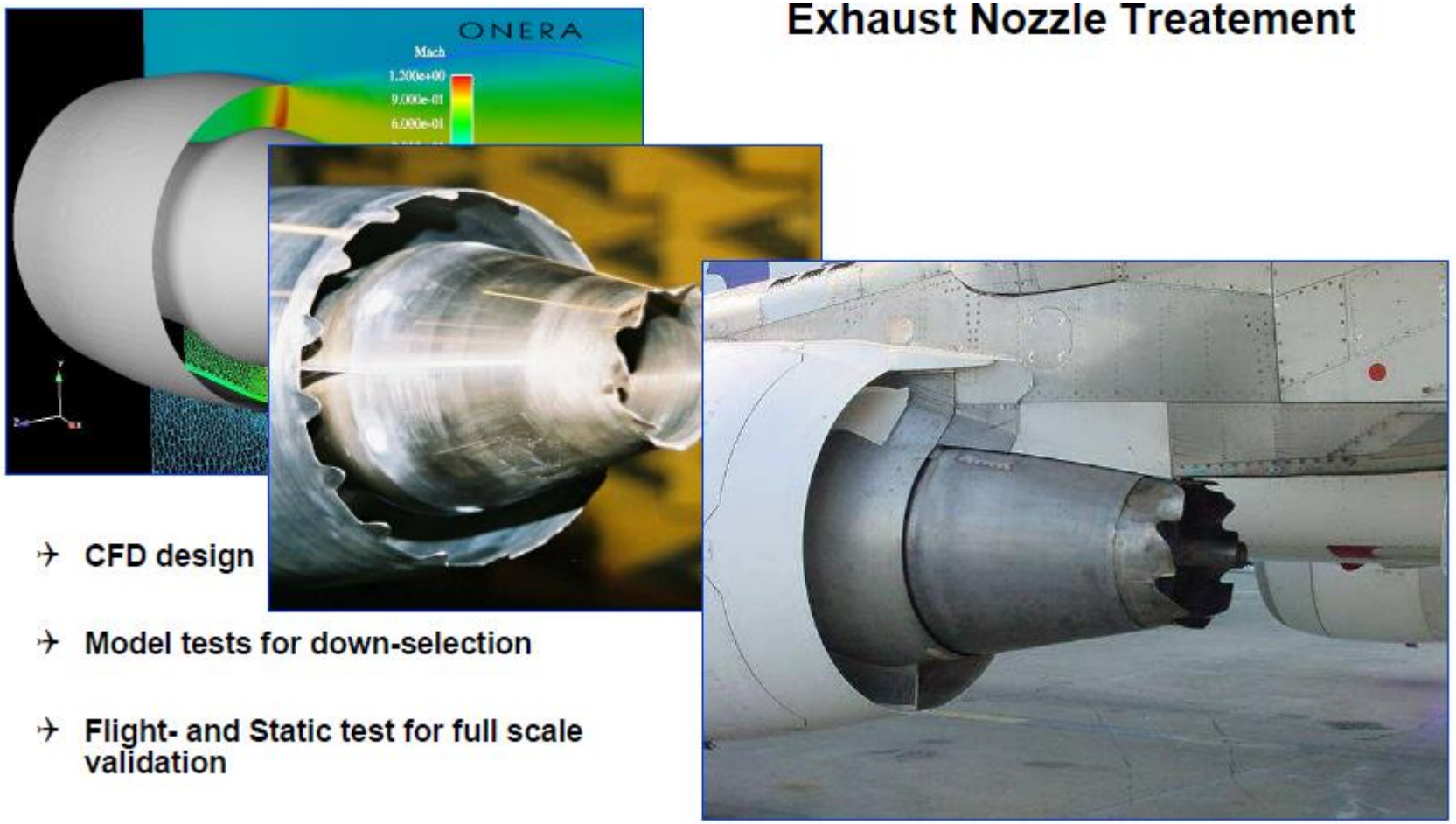
Technology applied in A380



Difference in Pressure Distribution with and without Splices

Technology Highlights from EU funded external aircraft noise projects: Negatively Scarfed Intake

Technology Highlights from EU funded external aircraft noise projects: Serrated Nozzle

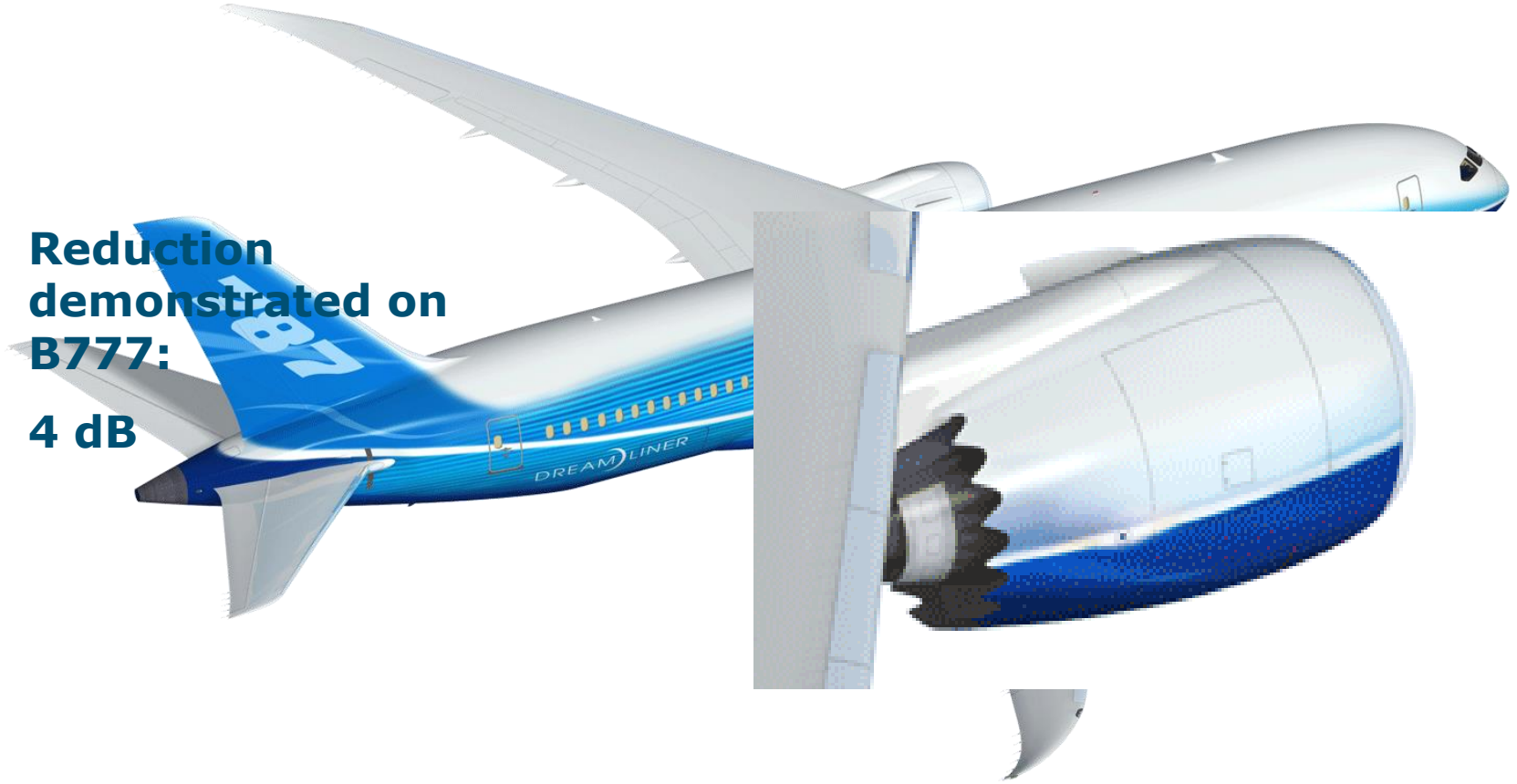


Technology Highlights from EU funded external aircraft noise projects: Serrated Nozzle

Not only in Europe: application on Dreamliner

Reduction demonstrated on B777:

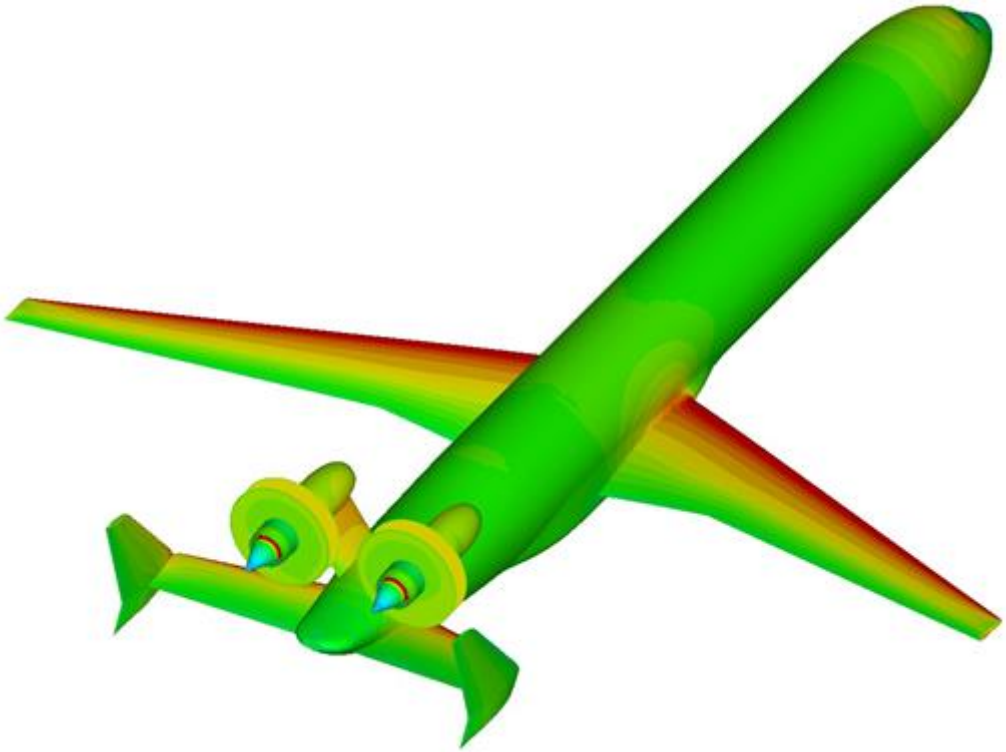
4 dB

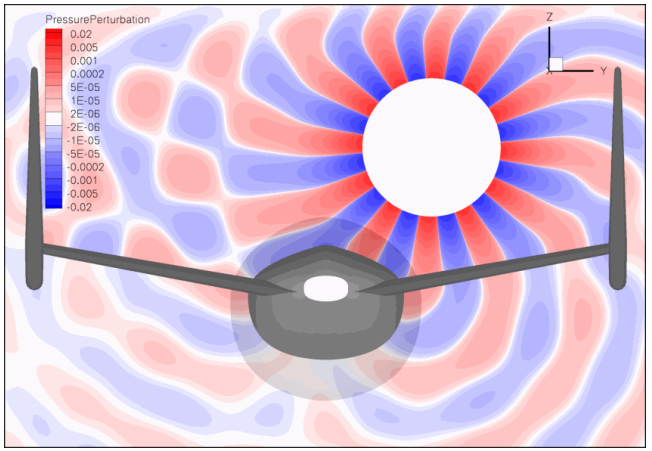


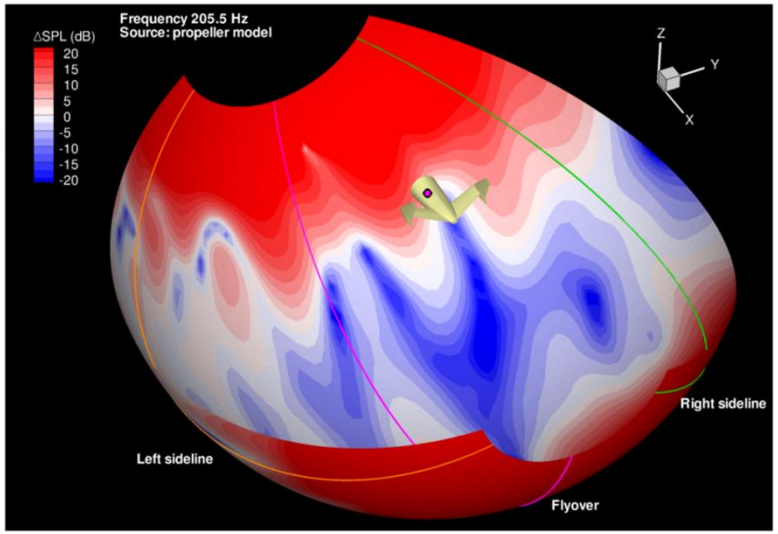
Technology Highlights from EU funded external aircraft noise projects: Landing Gear Noise

Wind tunnel test and flight test

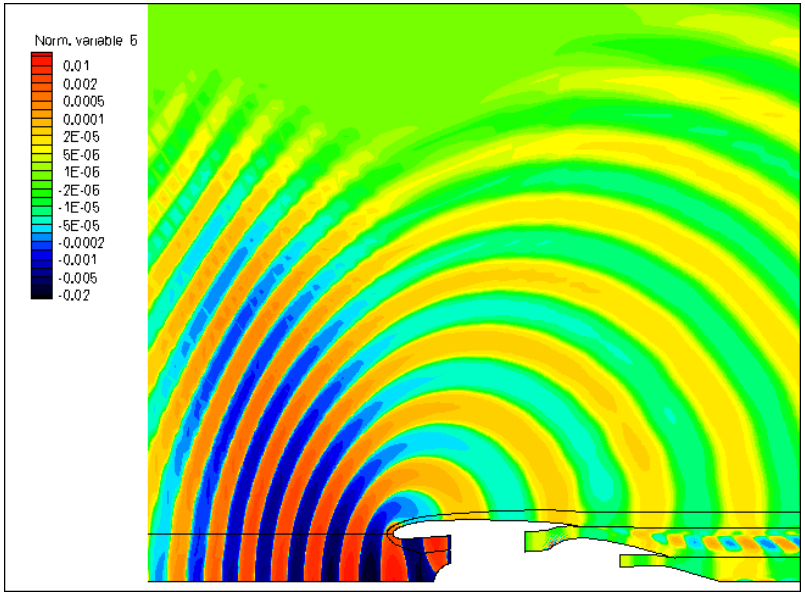
Technology Highlights from EU funded external aircraft noise projects: New Aircraft Configurations

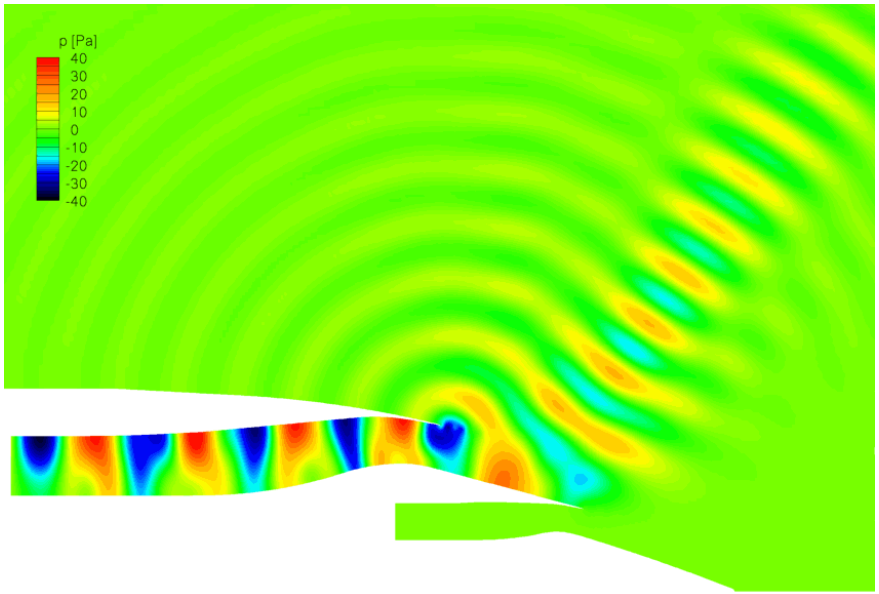






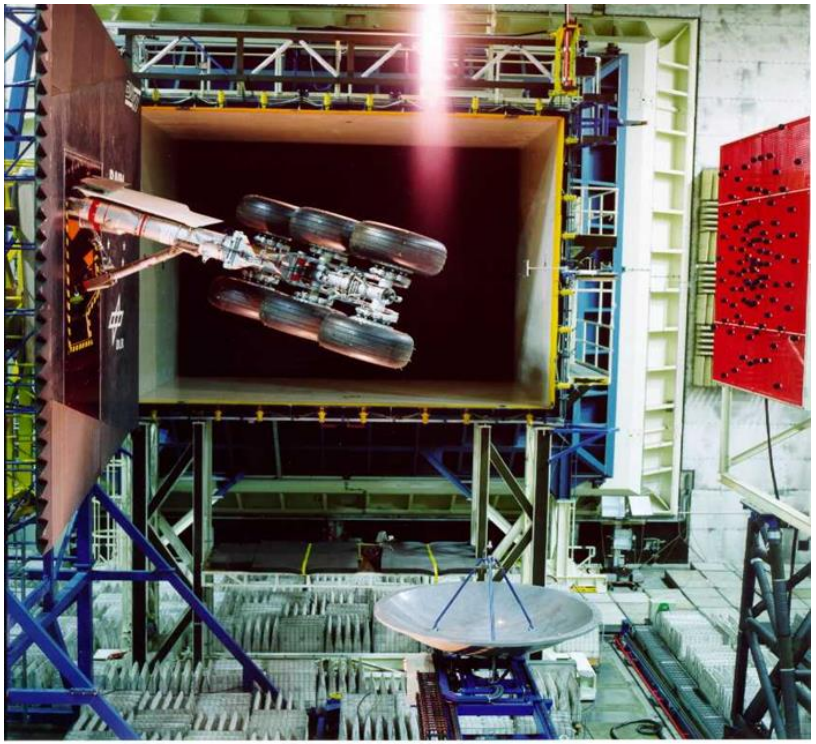
Technology Highlights from EU funded external aircraft noise projects: Computational Methods

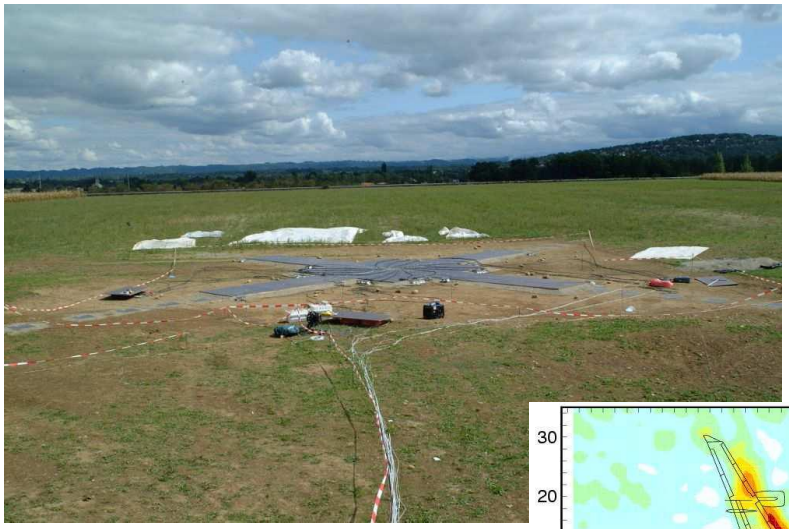


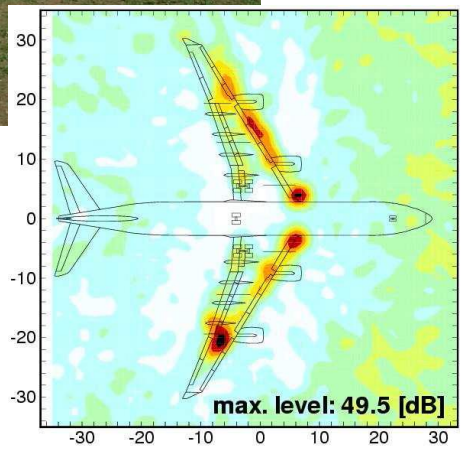


Technology Highlights from EU funded external aircraft noise projects: Measurement Techniques

Phased arrays: now routinely used in outdoor and wind tunnel masurements



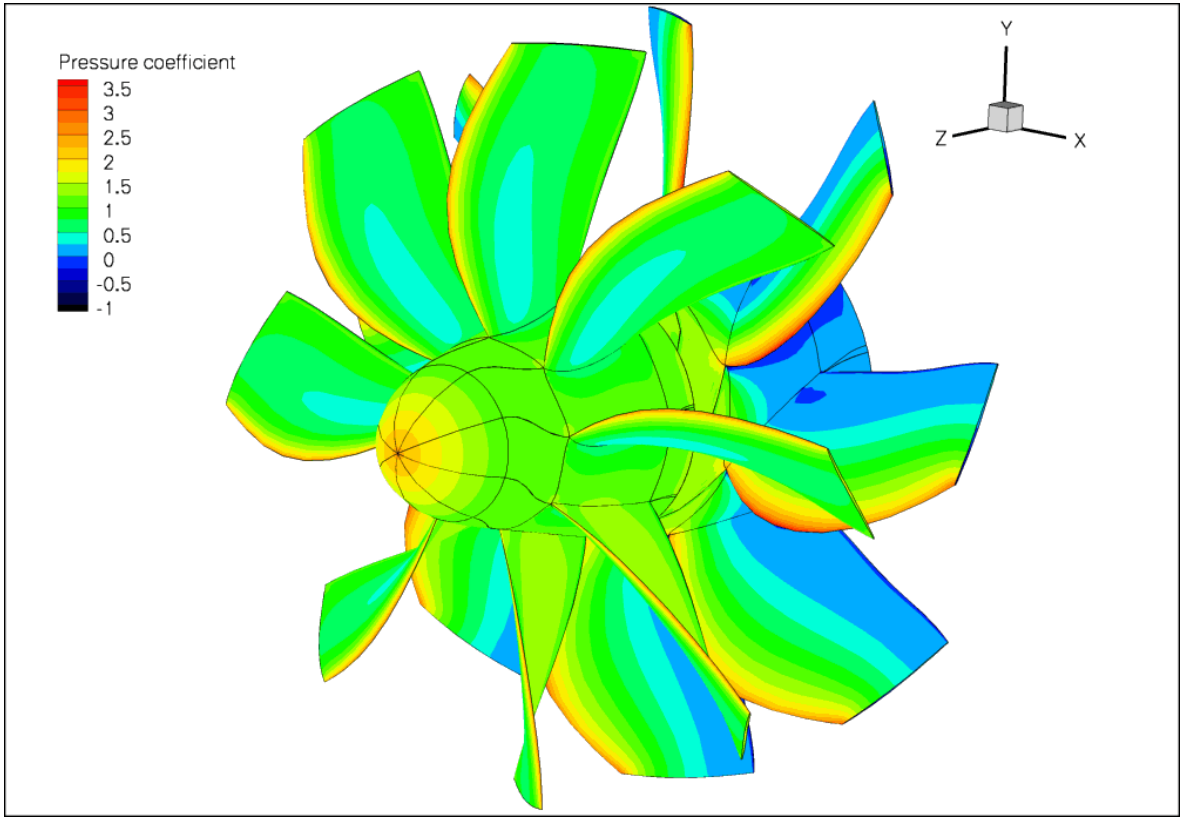




Recent development in propulsion systems

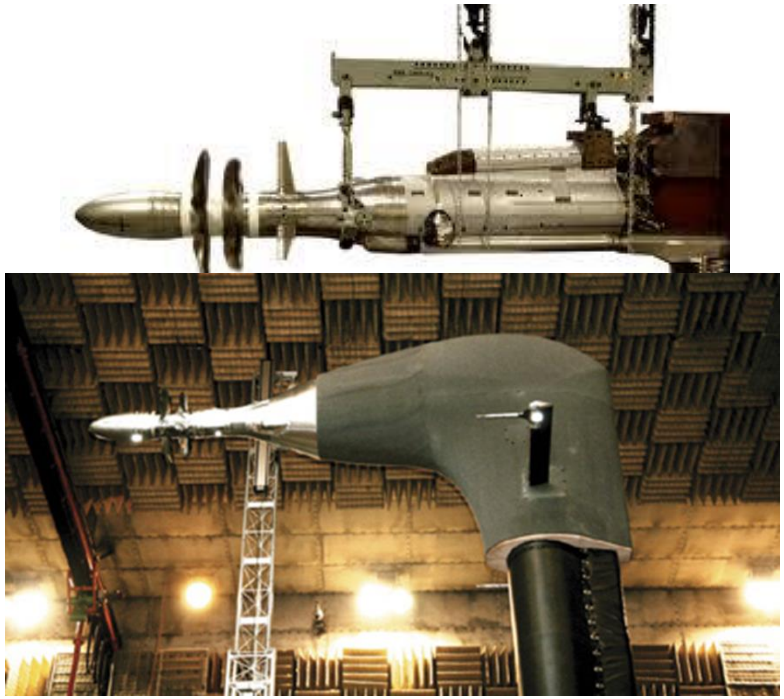
Contra-Rotating Open Rotors (CROR)

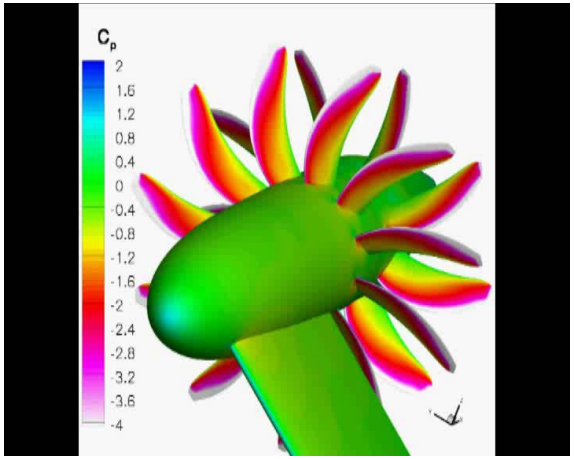
- ~25% less fuel consumption
- Noise?

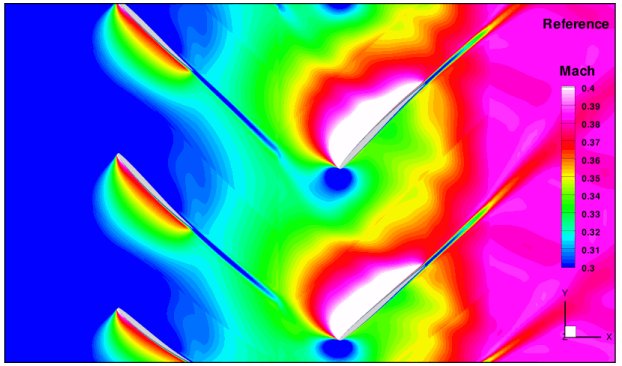


Recent development in propulsion systems

Wind tunnel test and computations on CRORS





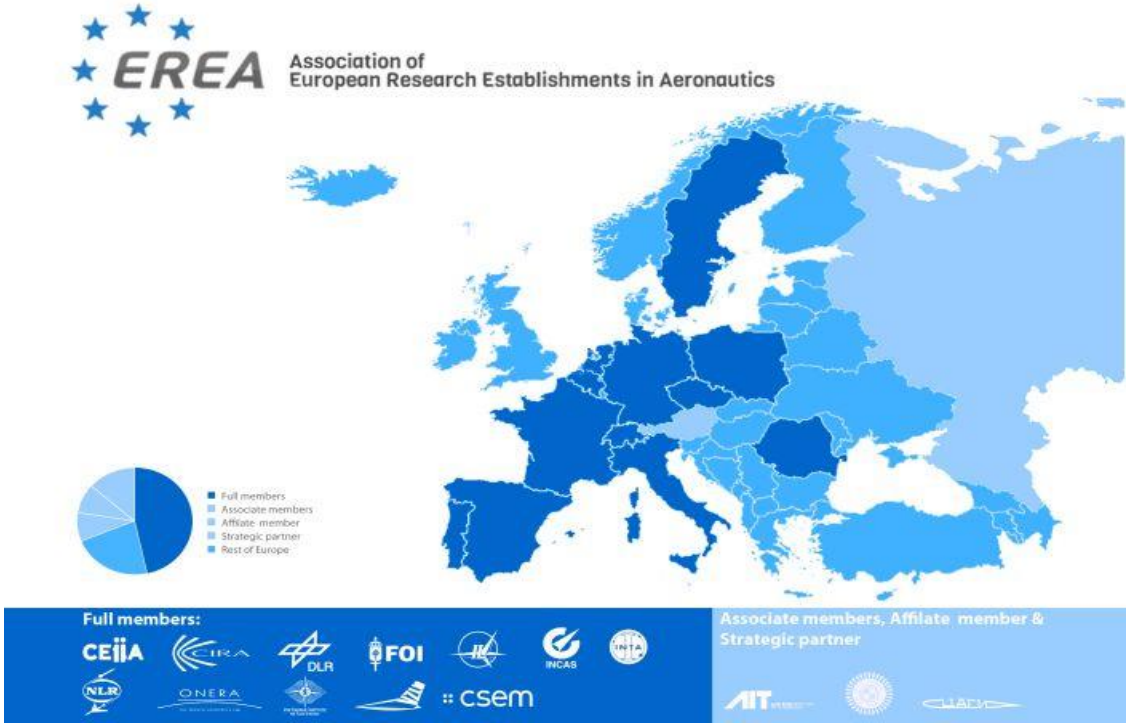


Continuation of X-Noise

- **Successor of FP7: HORIZON 2020**
- **No calls for Coordination Actions like X-Noise**
- **Budget for research in aeronautics largely assigned to Clean Sky 2 (High-TRL research, defined by industry)**
- **In 2015 call (MG.1.2-2015) for "Level 2" projects (successor of OPENAIR)**
- **Suggested by EC for low TRL research: Coordinated Research and Innovation Action (CRIA), as proposed by EREA:**
  Quiet Air Transport

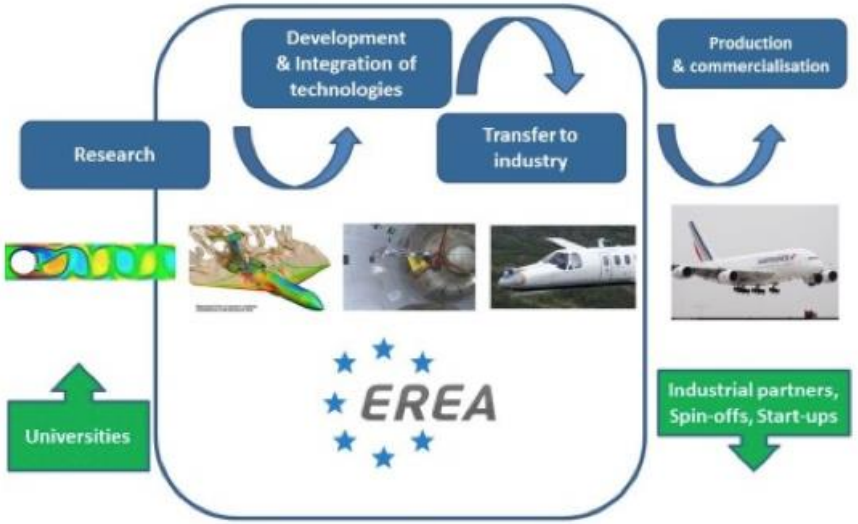
EREA's commitment to Aerospace Research

- EREA gathers the major EU aerospace research establishments
- It coordinates unrivalled research capacities in skillful manpower and dedicated facilities
- It brings its unmatched expertise to provide collaborative assessment of large EU initiatives (CS2, SESAR, H2020)



Future Sky at a glance

- Future sky addresses 4 key-challenges related to air transport:
  - Safety (TSE 1)
  - Quiet Air Transport (TSE 2 - noise issues)
  - Air Transport Integration (TSE 3)
  - Energy (TSE 4)



- It fills the gap between academic research and industries-led demonstrators
- It upholds European long-term competitiveness in addressing relevant breakthroughs identified by the ACARE SRIA 2035

http://www.futuresky.eu/

European Commission

Possible Budget & Framework

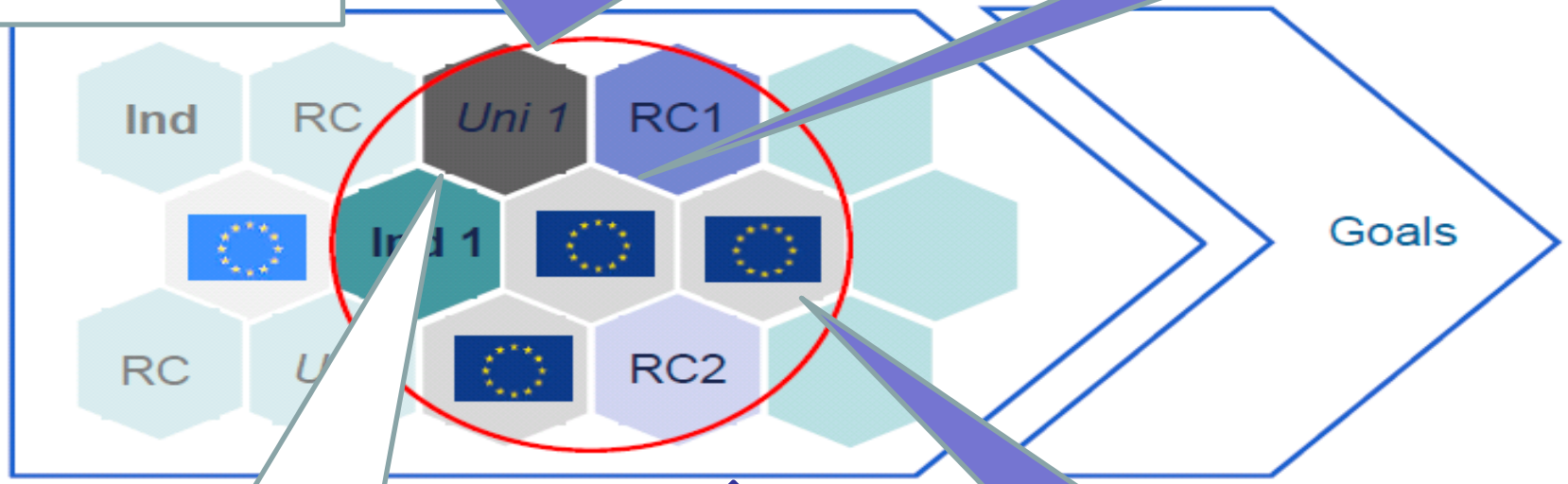
- 15 – 25 M€ EU funding
- 4 to 5 years
- Strong focus on RE and Univ. labs

Coordination

- Coordination with nat. programmes
- Common Roadmap
- Network activities (inc. Int. Coop.)

Noise Reduction Technologies after 2035

- ACARE SRIA list



National + In-House Effort
To provide equivalent efforts

- EREA partners + UK + Univ. (PhDs?)

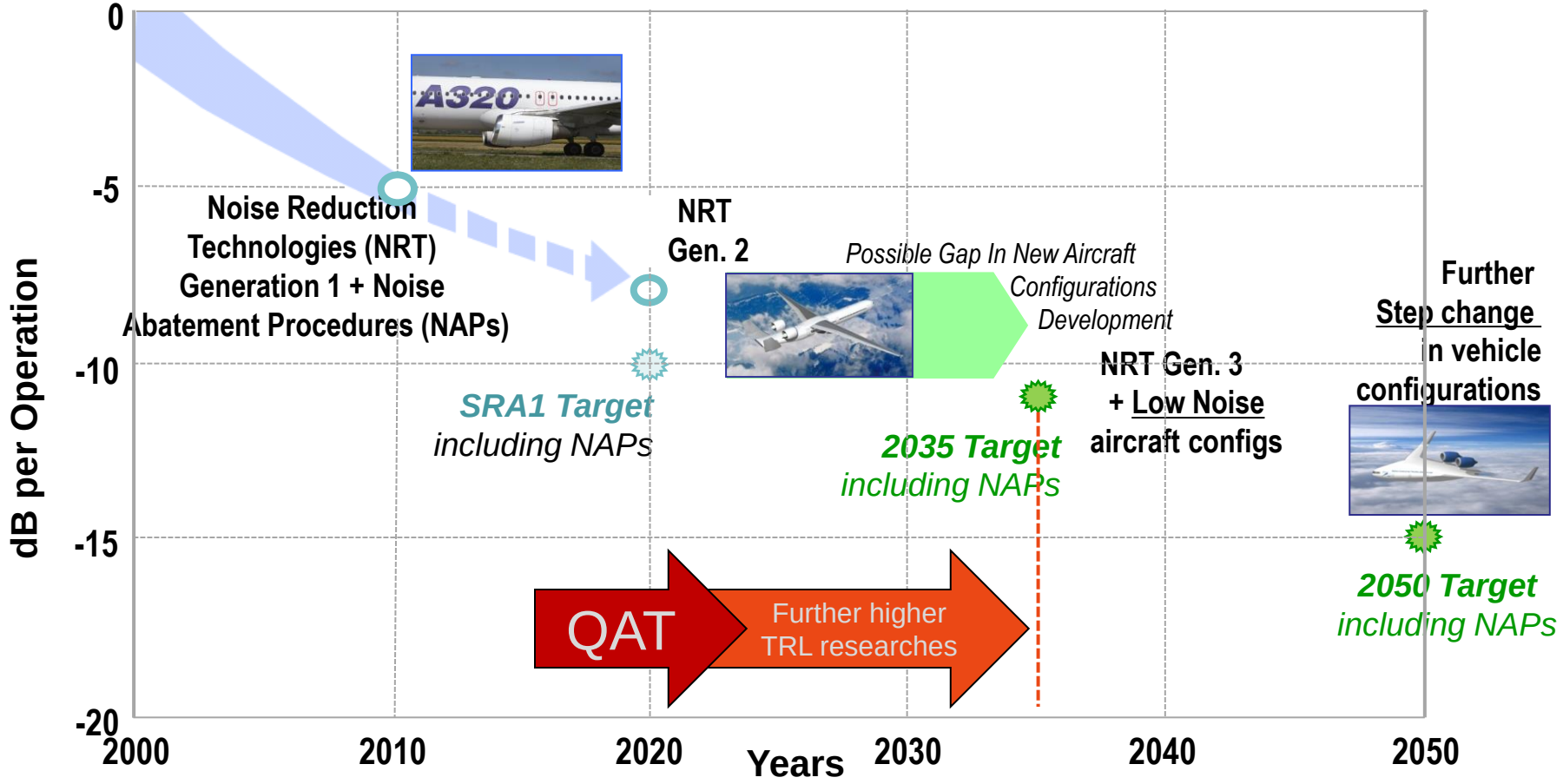
Relation with Roadmaps on Novel Architectures and Environmental Modelling

Management of Noise Impact after 2035

- ACARE SRIA minus Environmental Modelling

European Commission

QAT & ACARE Technology & Operational Goals



EREA initiative (Future Sky TSE2)
Draft White Paper on Quiet Air Transport

1st Axis

Objective: To enhance the European competitiveness through fresh ideas.

- Low TRL enablers
- Novel Methods

Overview of relevant areas

Source and near-field propagation:

- Turbomachinery
- Duct Acoustics (Liners)
- Jet
- Airframe
- Core
- Installation effects
- Ground operations

Enablers:

- Computational methods
  - High-fidelity (components)
  - Mixed-fidelity (full aircraft)
- Experimental work
- Research infrastructure
  - Computers
  - Test Facilities

Needs in computational methods

- Improvement of current CFD-CAA techniques, e.g.
  - Meshing techniques
  - Hybrid methods
- Development of alternative techniques, e.g.:
  - Lattice Boltzmann Methods
  - Ultra-fast CAA
- Capablities to model noise reduction techniques, e.g.
  - Porous materials
  - Active/adaptive systems
- Validation data on components level, with and without noise control applied
- Benchmarks

.. and need to work on:

- Low-TRL Technologies
- Innovative ideas
- Emerging Technologies

Examples

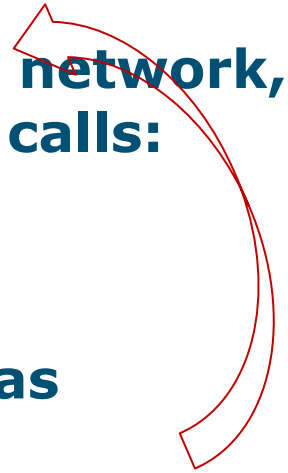
- Alternative HLD's
- Acoustically tailored materials such as porous materials
- Fan designed to low broadband noise
- Novel liners
- Alternative aircraft design to avoid installation sources
- Active flow and source control for engine and airframe noise

Planning

- 2015 Q1: Targeted call for novel ideas towards Academia, RE's, SME's, and Industry through EREA, X-Noise SC, CEAS-ASC, and other networks (supplemental to OPENAIR call)
- 2015 Q2: ranking of priorities

Possibilities to participate in Aircraft Noise research in Horizon 2020

- **Respond to calls in Clean Sky 2**
- **Participate in Netherlands X-Noise NFP network, and receive information on forthcoming EU calls:**
  - MG.1.2-2015 of Horizon2020
  - CRIA, 2016?
- **Respond to upcoming call for novel ideas**



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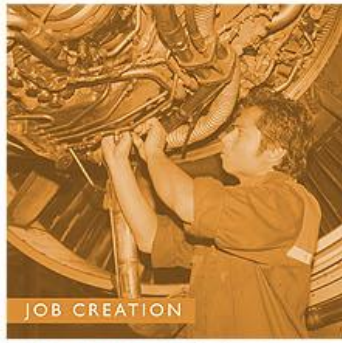
Dedicated to innovation in aerospace

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