Global Supersonic Initiatives Overview and the Russian Approach

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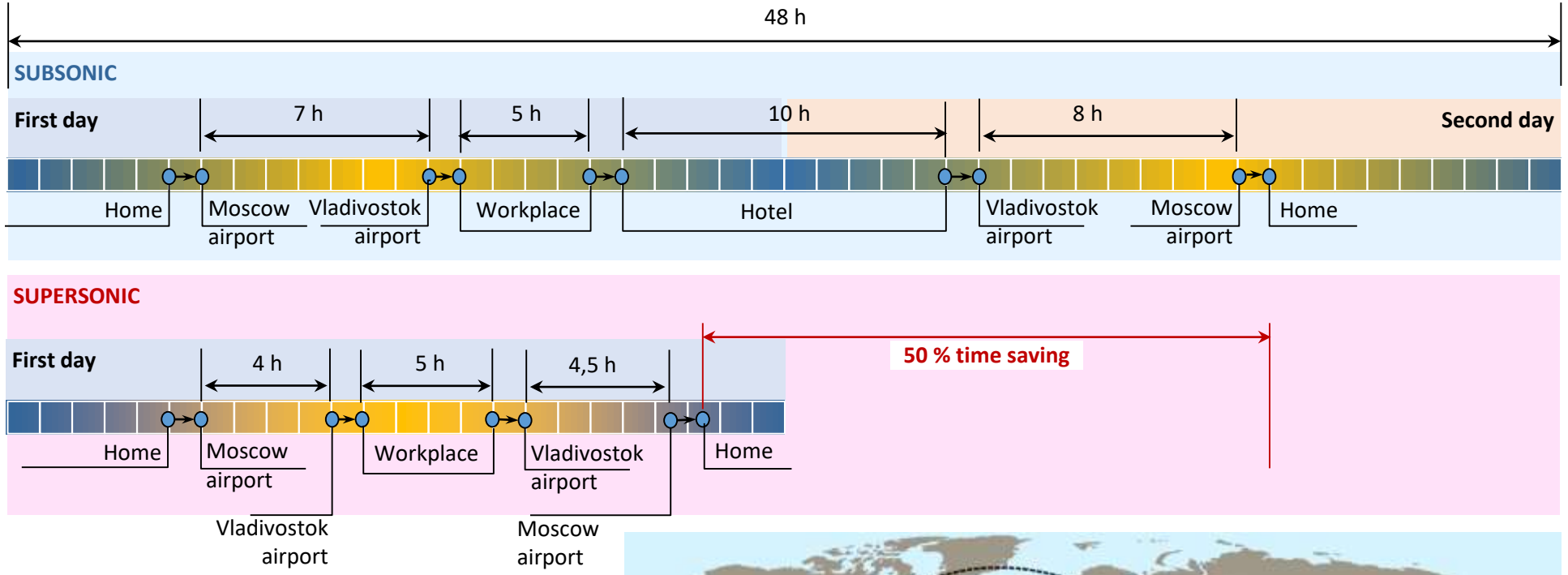
Supersonic Flight — a New Quality of Aviation Mobility
Case Study: Moscow–Vladivostok Flight



The one-day trip flight range for subsonic aircraft is limited to 3,500 km

Supersonic aircraft expands the one-day trip flight range up to 7,500 km and halves the flight time and better

First Generation of Supersonic Passenger Aircraft

Tu-144 (USSR, 1968—1978)


Concorde (Great Britain—France, 1969—2003)

Key Problems	Tu-144, Concorde	Current Requirements
Unacceptable level of sonic boom, dBA	96—106	Less than 65
High level of initial shock overpressure, Pa	120—140	7—10 times less
High level of noise near airport, exceeding current standards, EPNdB	By 25 EPNdB	ICAO Ch.14 – 2 EPNdB
High level community noise, EPNdB	Chapter 3 ICAO + 30	less 2 EPNdB to ICAO Ch.14
High level LTO NOx EI, g/kN	50, CAEP6	60%—75% reduction
High level NOx EI, g/kN	More than 20	Less than 10

Global Projects of Supersonic Business Jets

	Flight Mach Number	Range, km	Q-ty PAX	First Flight
Aerion AS2, USA	0.95 — 1.4	9300	9	First flight in 2023
Gulfstream QSJ, USA	1.6	7500	8	
SAI & LM QSST, USA	2.0	7500	8	
SpikeAerospace S-512, USA	1.6	10300	18	First flight in 2021
Boom Supersonic, USA	2.2	8800	55	Demonstrator in 2019
UAC / Sukhoi, Russia	1.8	7500	12	First flight —in late 2020's

Global Technological Demonstrators

Test aircraft (X-Plane) NASA, USA

Model in WT

Flight Mach Number	Flight Altitude, km	Propulsion	Project start	Current status	First fly
1,4	17	from F-18	2016	In progress	In early 2020s

Global Technological Demonstrators

Japan Aerospace Exploration Agency (JAXA)

Flight Mach number	Flight altitude, km	Propulsion	Project start	Current status
1.39	8	—	2011	Tests from 2013 — 2015

Research and Technological Basis on Russian Supersonic Business Jet

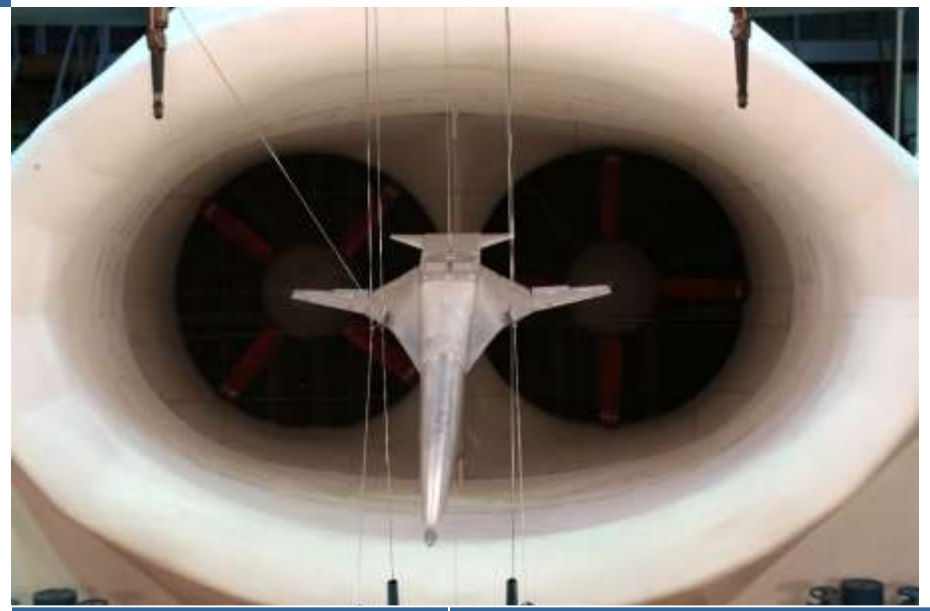
Aerodynamic concept of Supersonic Business Jet with low level of sonic boom

Flight Mach Number	Flight Altitude, km	Weight, t	Sonic Boom	Current Status	Lead Time
1.8	A/C – 15…17 Demo – 14-16	A/C – 55 Demo –27	65 dBA	State Funding **2017—2019**	Demonstrator Tech Proposal **Dec 2019**

Key Technology Challenges

- ✓ Low sonic boom and low community noise
- ✓ High fuel efficiency and low DOC
- ✓ External visualization via artificial vision system
- ✓ Variable-cycle powerplant design
- ✓ Composite/composite-metal isogrid (bionic) fuselage
- ✓ Artificial intelligence
- ✓ 4D trajectory / traffic management

International Supersonic Technology Projects



Acronym:	HISAC
Project Title	Environmentally-friendly high-speed aircraft
Objective	Research on supersonic business jet providing low sonic boom and noise near airport areas
Coordinator	Dassault Aviation (France)
Time Frame	01.05.2005 — 31.10.2009
Partners	38 partners, incl. TsAGI, Alenia Aeronautica, ONERA, EADS, SNECMA, Rolls-Royce, Sukhoi Civil Aircraft Company, CIAM and others

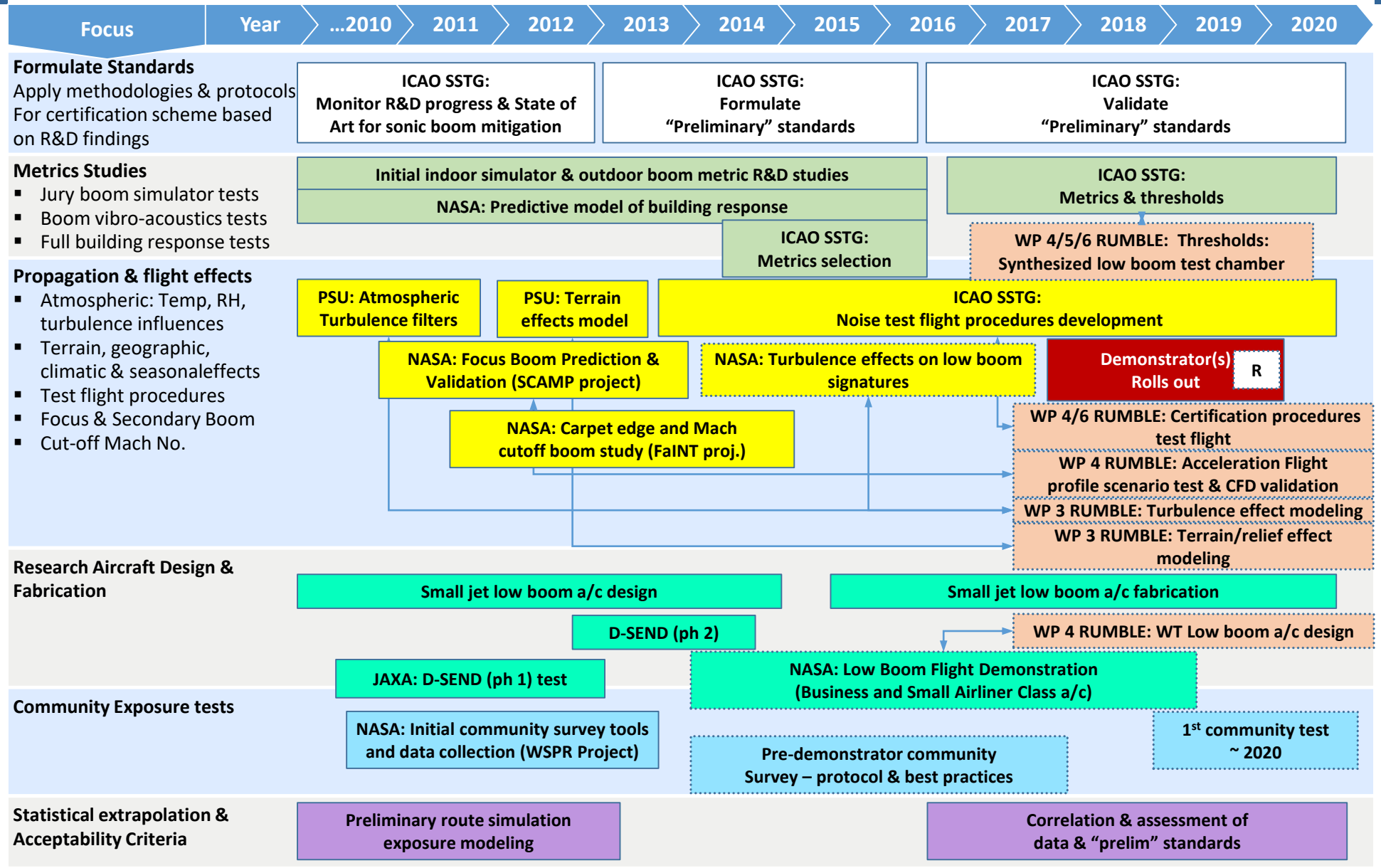
International Supersonic Technology Projects

Technic Museum
Sinsheim, Germany

RUMBLE

Acronym:	RUMBLE
Project title	Regulation and norm for low sonic boom levels
Objectives	Formulation of proposals to determine the permissible overland sonic boom level and the corresponding measurement methods
Coordinator	Airbus Group Innovations (AGI)
Time frame	2017—2020
Partners	18 partners, incl. ONERA, Dassault Aviation, TsAGI, Gromov Flight Research Institute, MAI, CIAM, SCAC, GosNIIAS, GkNIPAS

RUMBLE Contribution to ICAO Supersonic Research Roadmap



Key Challenges to be addressed for the New Generation Supersonic Transport

- International standards for acceptable sonic boom level for overland flight
- Ready-to-use jet engines that provide the required aircraft range and conform with ICAO Noise Standards near airport areas
- A difficult trade-off between high performance and low environmental impact
- Special aircraft operation conditions and its integration into the existing ATM system

Conclusion

The Success of New Generation Supersonic Passenger Aircraft Program Requires:

- Involvement and cooperation of all aviation leader organizations in supersonic (IFAR members)
- Advanced supersonic variable-cycle engines development on the basis of a modern or future core engines
- Development of a flight demonstrator
- Comprehensive R&D work to create full-size business and passenger jets

Thank you for your attention!