

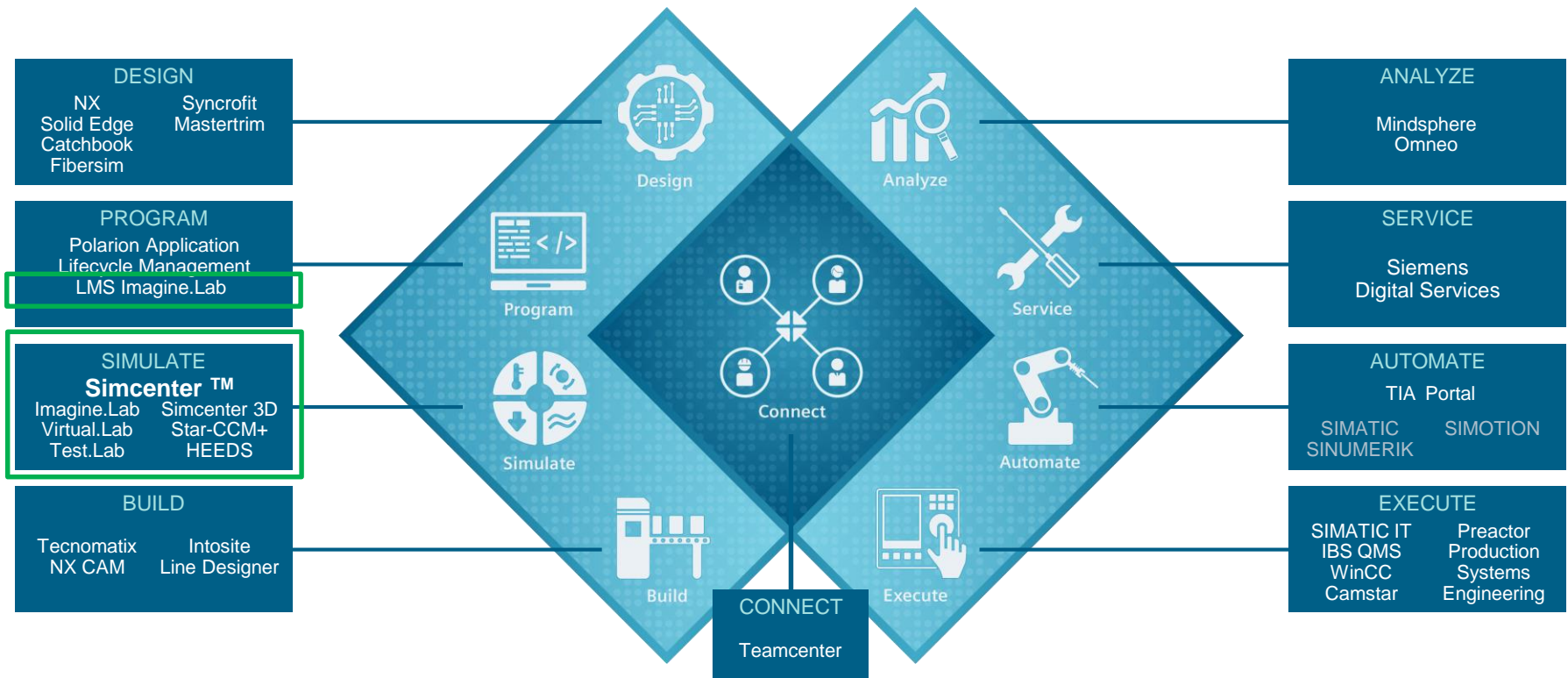
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Ingenuity for life

ADT SYSTEMS
INNOVATION DRIVEN

**Transfer Path Analysis Innovations for
Airborne Noise Problems with
Focus on Pass-By-Noise**

Automotive Summit 2017 – Bangkok
Henrique Abrão

Siemens DF PL STS – Simulation and Test Solutions Positioning



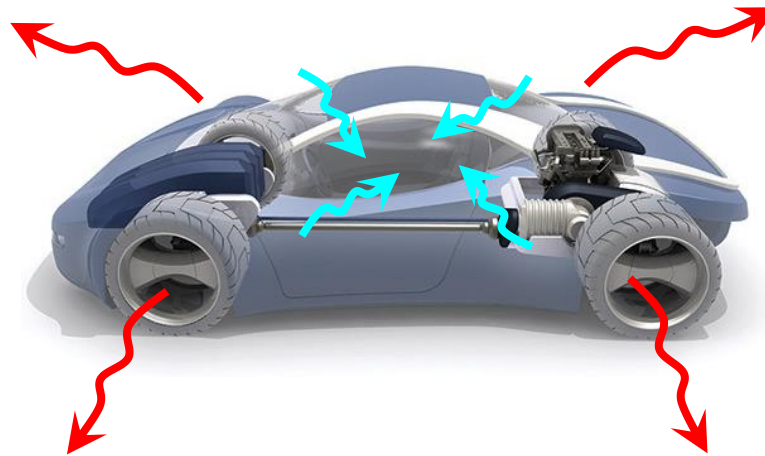
Noise reduction and increase acoustic comfort Engineering challenges

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Reduce noise emission



- More stringent noise regulations
- Protect the environment
- Reduce impact on health
- ...



Increase acoustic comfort



- Higher comfort expectations
- Creating branding value
- ...

Simcenter™ - LMS Testing Solutions

Engineering throughout the development process

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SPECIFICATION

DESIGN / ENGINEERING

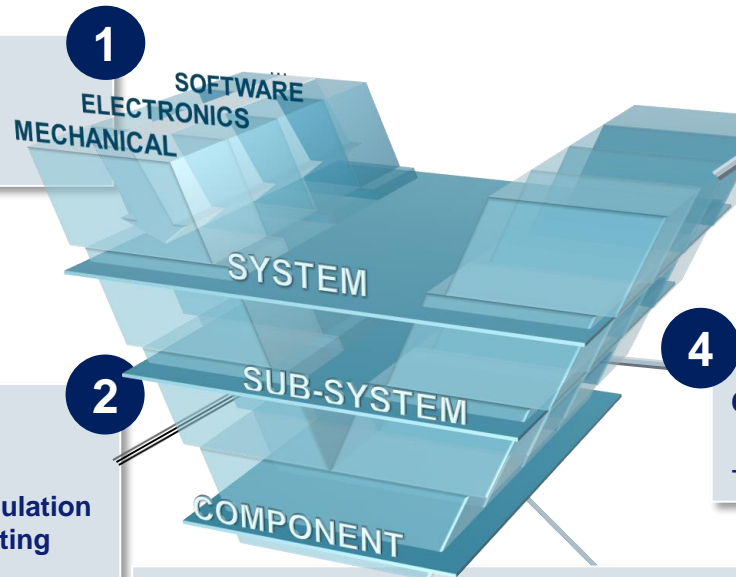
VALIDATION

CERTIFICATION

TROUBLESHOOTING

1 Specification & target setting:

- Measure competitive products
- Measure previous generation



5 Troubleshooting:

- Measure – analyze – fix

2 Design/Engineering:

- Measure input loads to drive simulation
- Comparison, Correlation & Updating

4 Certification:

- testing against (ISO) standards

3 Validation:

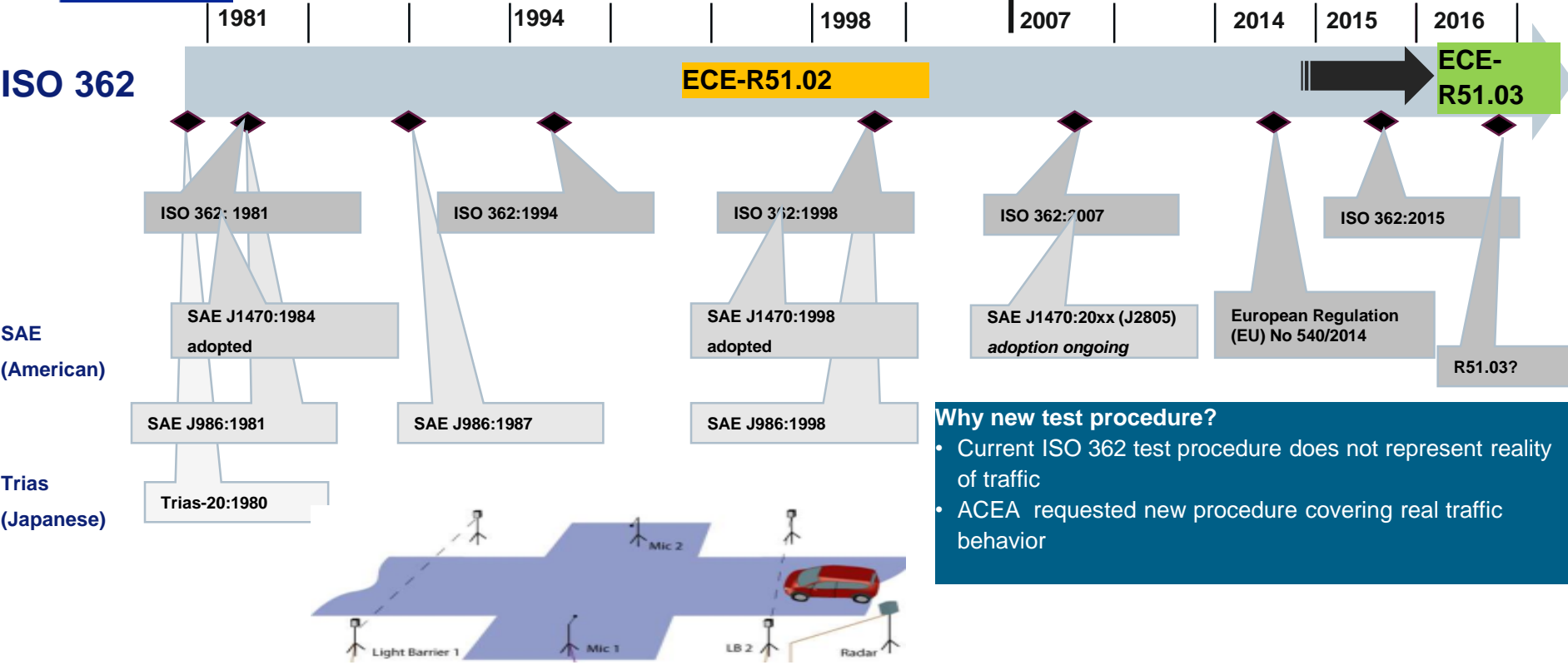
- Functional Performance verification
- Environmental testing
- Durability testing

Pass-by noise testing

Continues evolving testing procedures and limits



old ← | → new



Why new test procedure?

- Current ISO 362 test procedure does not represent reality of traffic
- ACEA requested new procedure covering real traffic behavior

More challenging than ever to meet regulations

Implications & Solutions of new Standard & Regulation

Implications

Test Method:

- **More measurements:** from 2 runs in the old standard, to up to 20 runs in the new standard
- More **complex** operational **test condition:**
- More vehicle **sub-categories**

New Regulation:

- New **lower** limits
- More stringent
- New Minimum noise standard & limits



Solutions

SW & HW solution:

- Easy to use
- Smart
- Data management system

Requires PBN Engineering

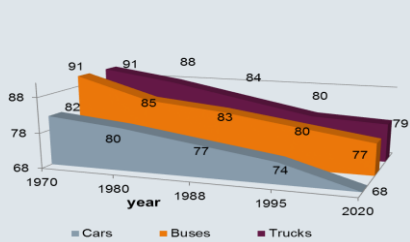
- Flexibility in switching configurations
- Tools & methods for source contribution analysis

Reduce exterior noise emissions to meet regulations

Innovating Pass-by Noise Testing



Innovative and Efficient Pass-by-Noise measurement technology



More stringent Pass-by noise limits

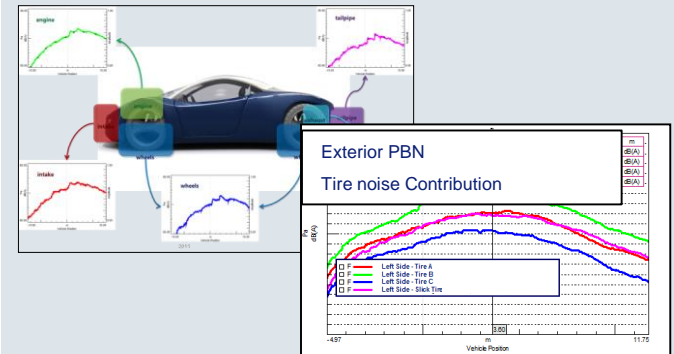


Outdoor and In-room

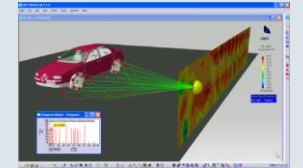
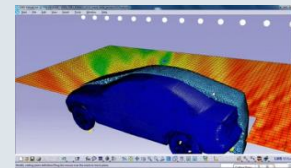


Pass-by Noise Engineering

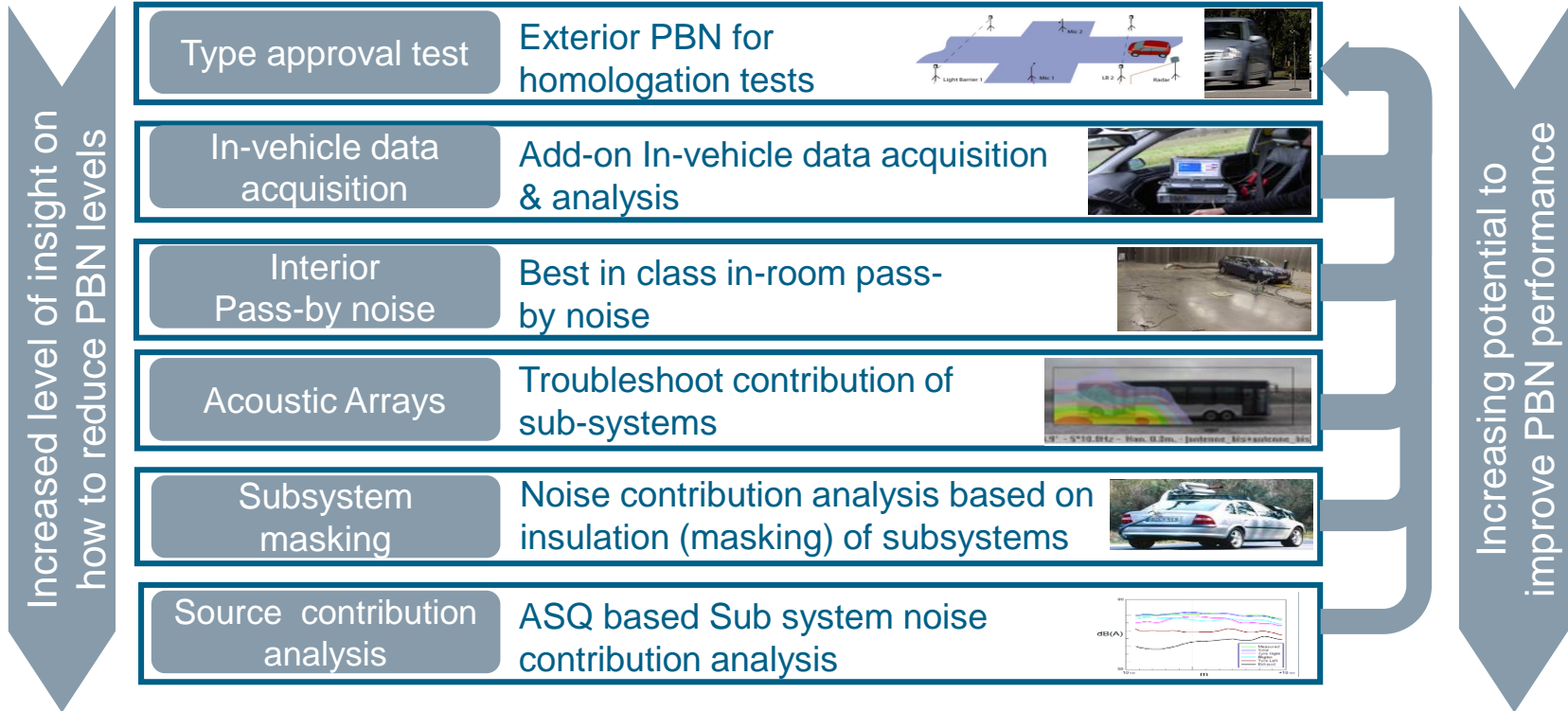
Acoustic Source Quantification



High Frequency Acoustic BEM and FEM – Ray-Acoustics

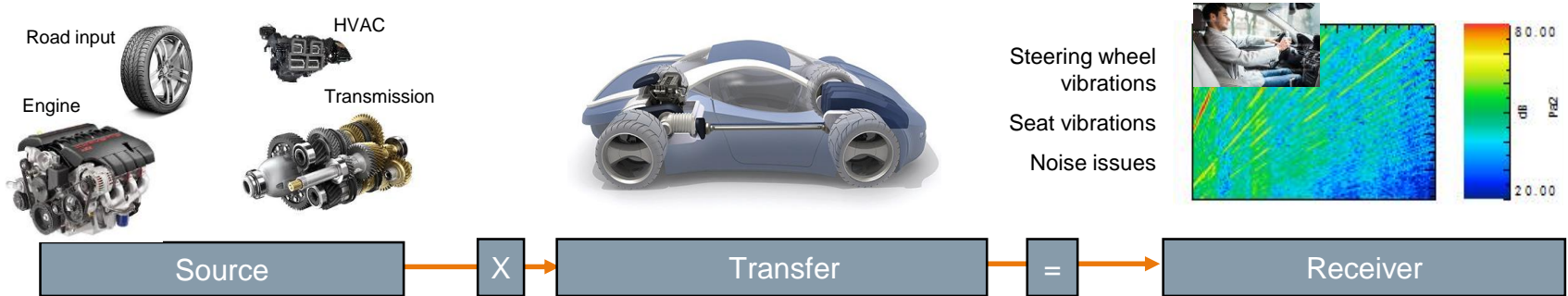


Pass-by noise engineering solutions



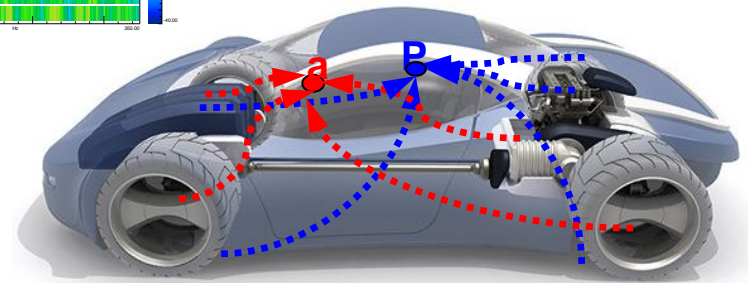
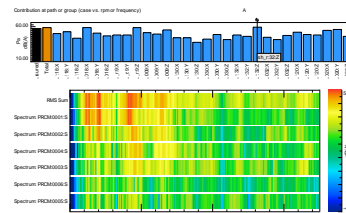
Optimize acoustic comfort by looking to the root cause

Transfer Path Analysis – a way to breakdown NVH issues



Quantifying the structure borne sources Transfer Path Analysis

- **Structured way** of approaching noise issue instead of time consuming try-and-error approaches
- **Identification** of weak panels and **sensitive paths** for noise issue
- **Deeper insights** in load strength and noise transfer sensitivity
- Reusability of identified loads for **simulation**



Reduce exterior noise to meet regulations

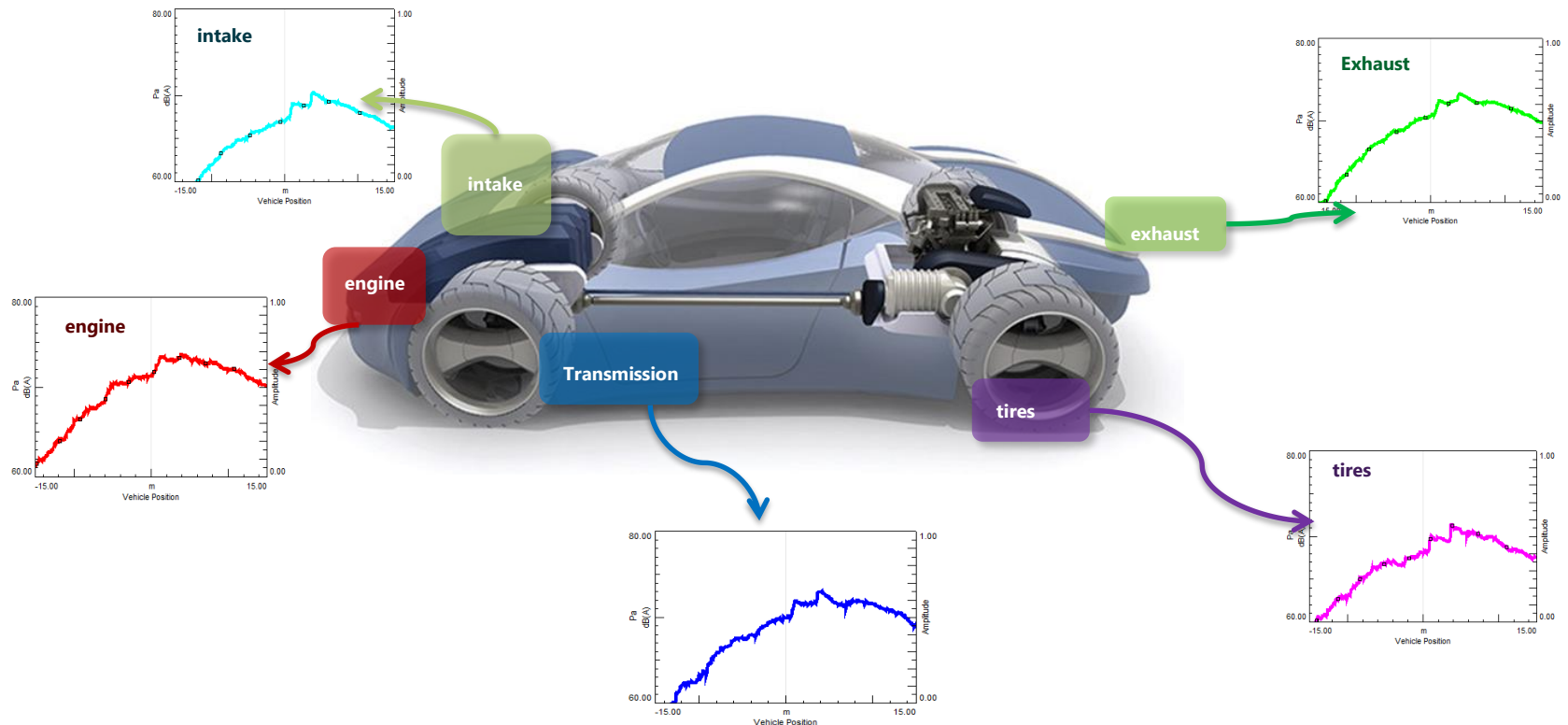
Pass-by Noise Engineering – Contribution Analysis

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Excessive Pass-by noise levels

Pass-by noise engineering

- Understand subsystems contributions
- Subsystem target setting



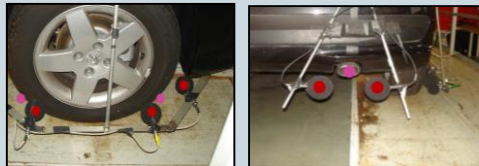
Pass-by noise Airborne Source Quantification (ASQ) in a nutshell

Sources

Engine – Exhaust – Tires – Intake

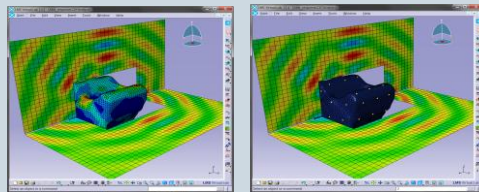
Test Based

Based on ASQ technology



Simulation based

Identify equivalent monopole sources based on simulated response



Transfer

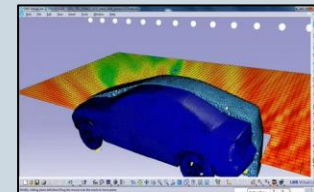
Test Based

Use Volume Velocity source to measure transfer functions (NTFs)



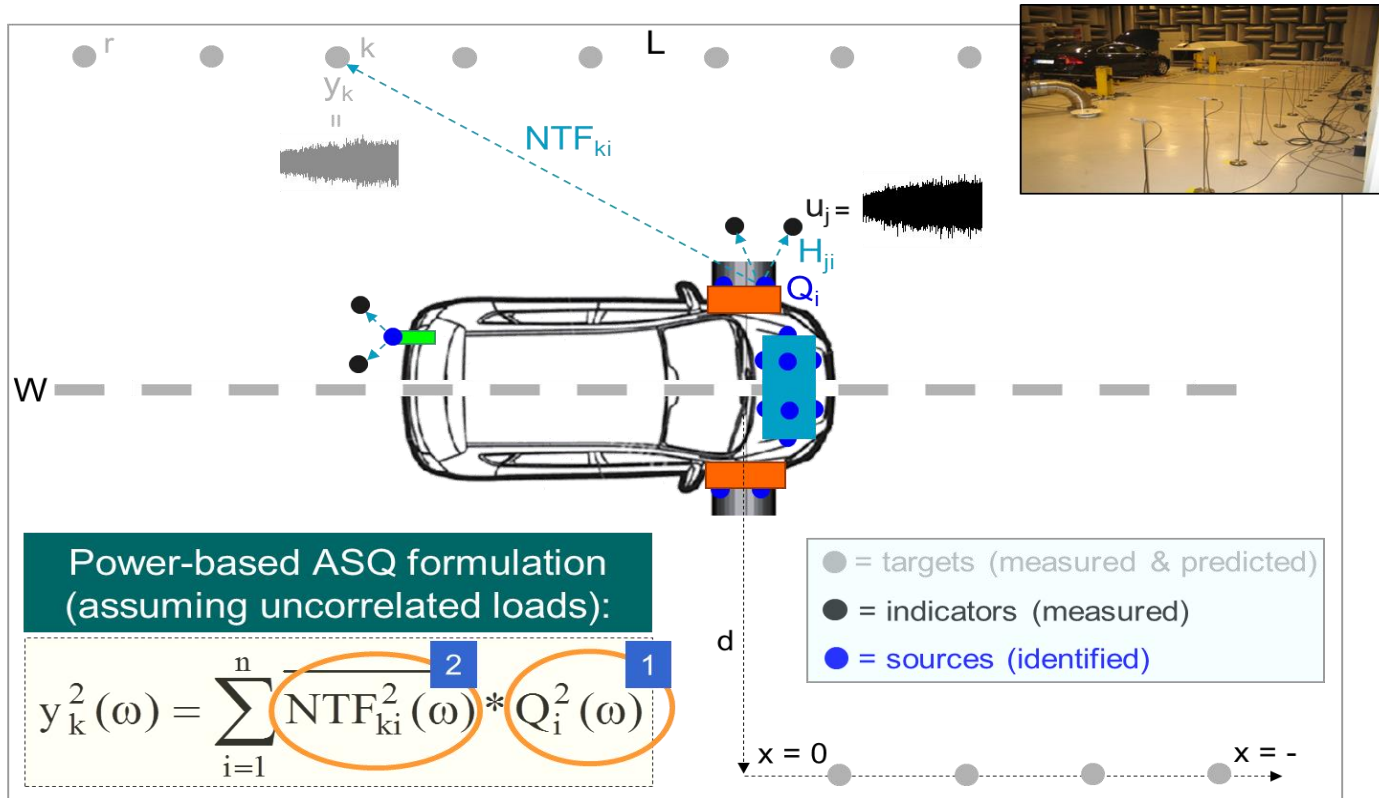
Simulation Based

Compute NTFs for a specific acoustic engine bay design (FEM AO solver)



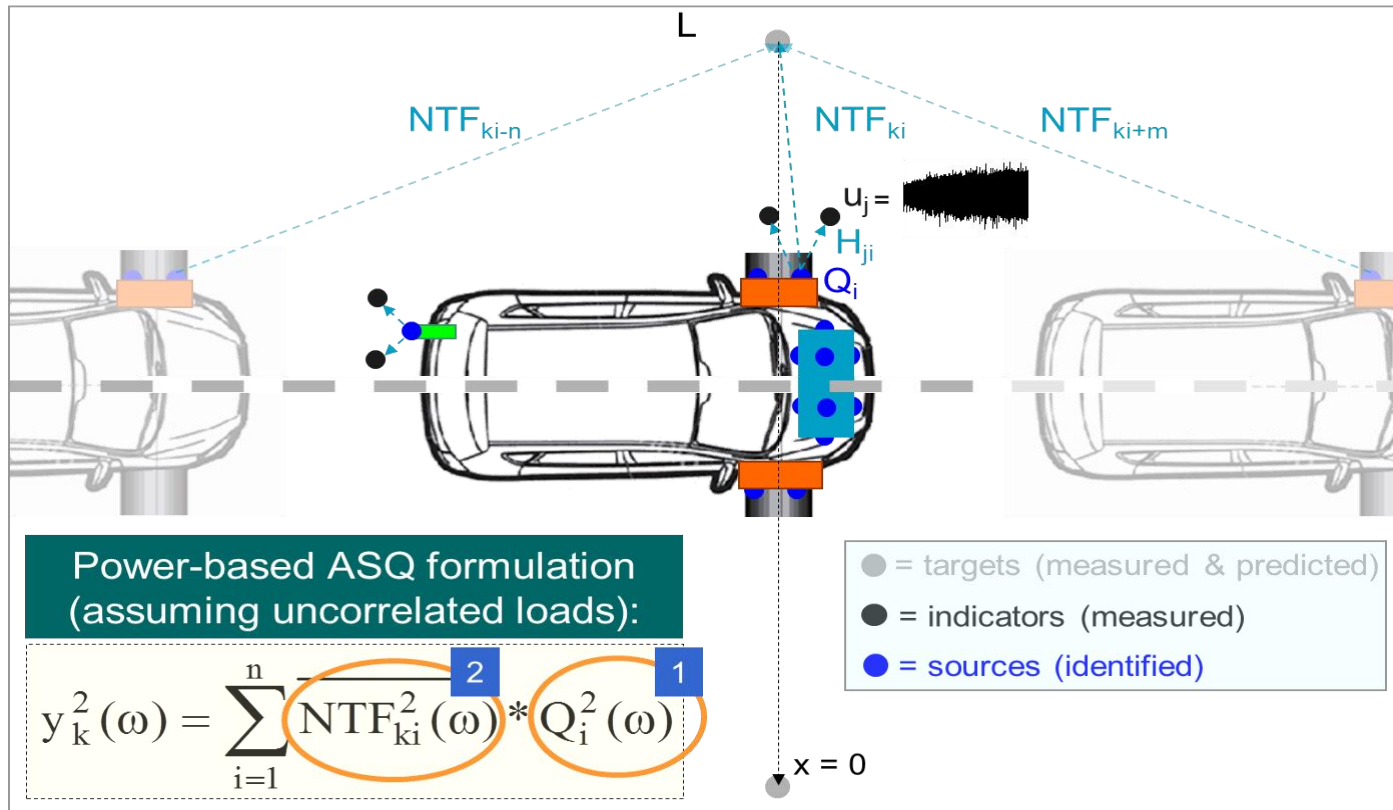
Pass-by noise engineering – Interior

Time domain source contribution analysis



Pass-by noise engineering – Exterior

Time domain source contribution analysis

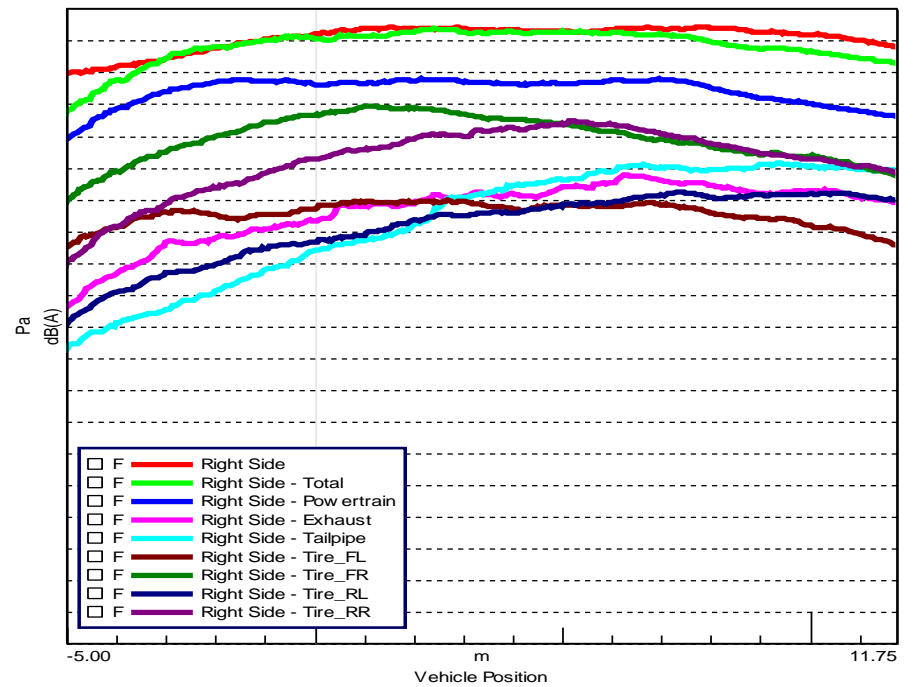
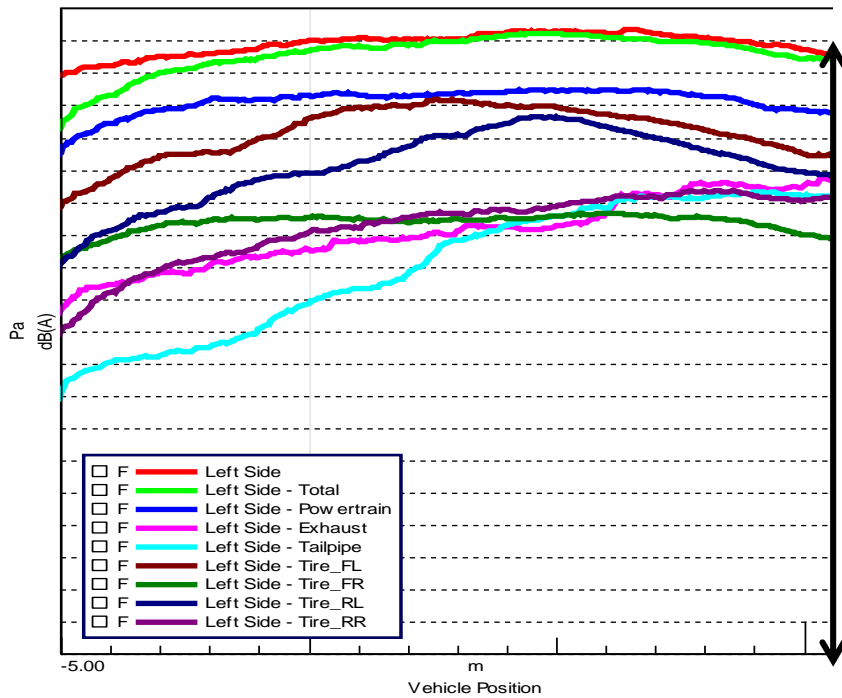


Pass-by source contribution analysis

Contribution plots



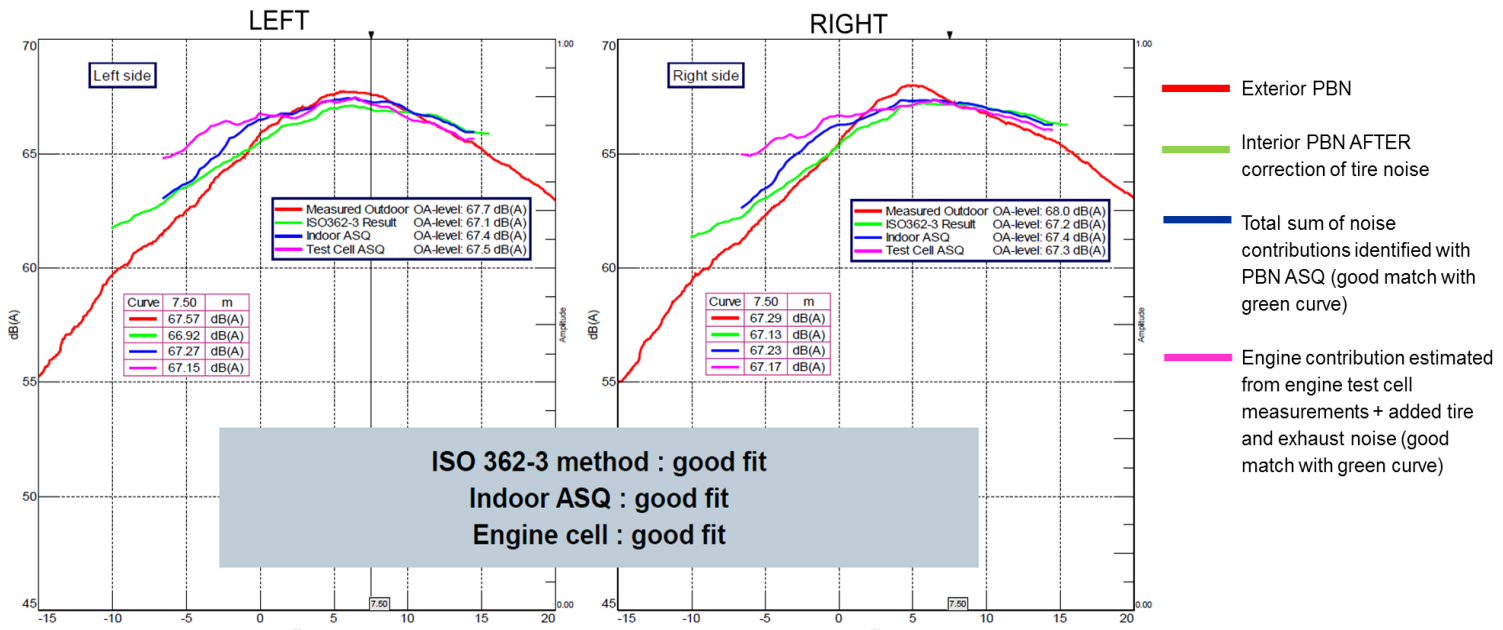
tire type A – Gear 3 Acceleration



On the road to Pass-by noise synthesis ...

Why Pass-by noise ASQ is the right technology to control?

Built upon the Pass-by noise ASQ technology
Make Early predictions of Pass-by noise based on engine test bench measurements



Simcenter solutions for Automotive NVH & Acoustics



Legislation and regulation



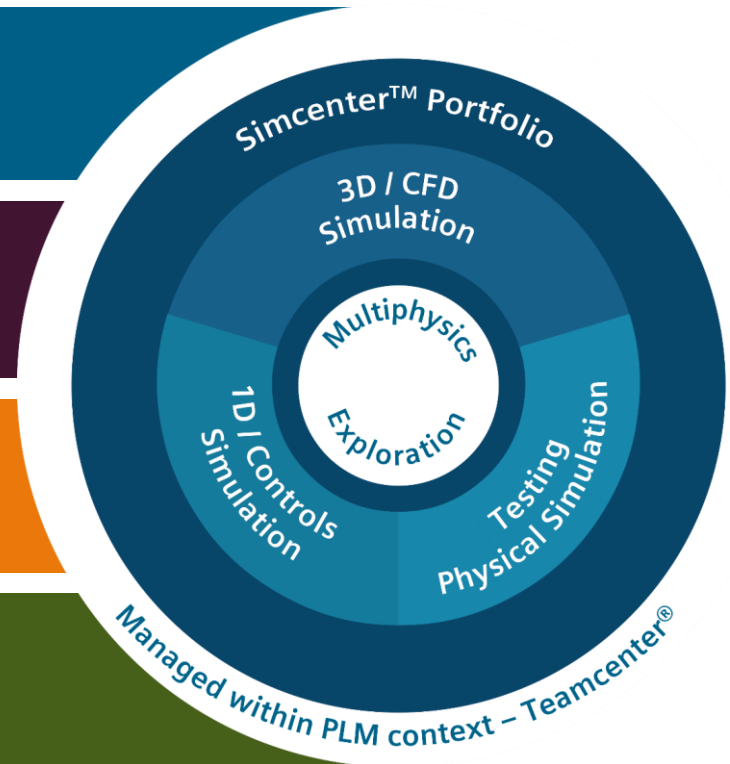
New powertrain concepts



Lightweight structures



Increase vehicle performance



Thanks!!!

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