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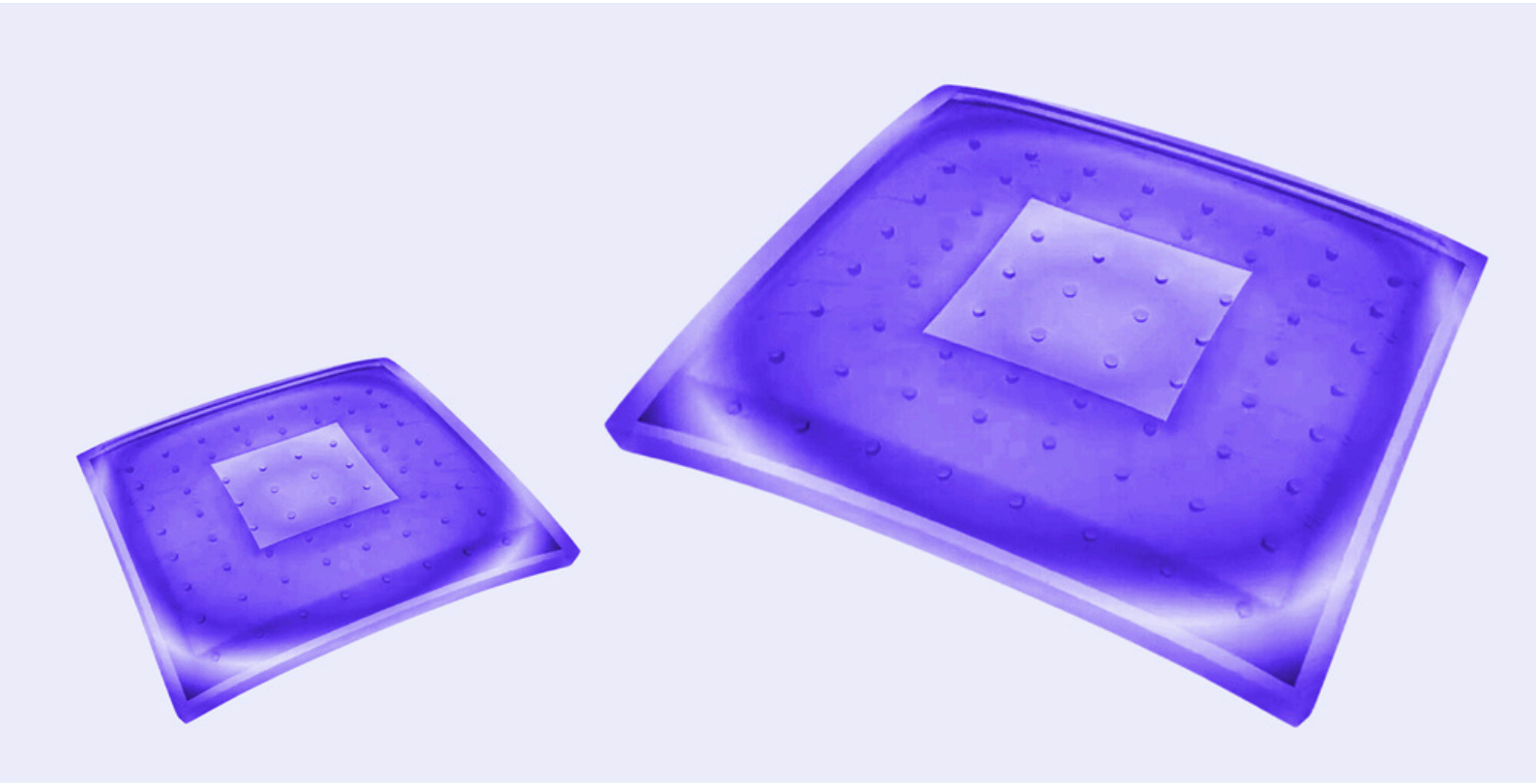

Quanscient Webinar 19th Nov 2024 | Executive summary

# Accelerating semiconductor packaging design with cloud-based simulations

See how cloud computing with modern algorithms enable efficient design space exploration and optimized package performance

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# Overview

This webinar showcased how Quanscient Allsolve accelerates semiconductor packaging design through cloud-based simulations. It highlighted the challenges of traditional simulation tools and demonstrated how cloud computing and the Domain Decomposition Method (DDM) can address these issues by significantly reducing simulation runtimes and enabling large-scale parametric studies.

Through a live demonstration on the thermomechanical packaging simulation of a flip-chip ball grid array by **Rahul Nagaraja,** attendees gained insights into the software's capabilities for efficient and accurate multiphysics simulations. The webinar emphasized the benefits of cloud-based simulation, including speed, scalability, flexibility, and automation, and showcased how Quanscient Allsolve can improve semiconductor packaging design processes.

# About the speakers

### Rahul Nagaraja

Application Engineer

Rahul has extensive experience in applying advanced numerical techniques to complex multiphysics simulations and provided insights into the benefits of cloud-based simulation for semiconductor packaging design.

### Jukka Knuutinen

Head of Marketing

Jukka has a background as a digital marketer specializing in lead acquisition through automated marketing funnels and served as the host for the event.

# Introduction to Quanscient Allsolve
# A cloud-based multiphysics simulation software

Through cloud computing and the advanced numerical techniques such as the Domain Decomposition Method (DDM), Quanscient Allsolve enables

**Speed:** Reducing runtime from weeks to hours, and days to minutes

**Flexibility:** Python scripting interface enabling customization, unlimited number of users with every plan with the hardware and all features included, and a usage-based pricing structure

**Scalability:** Thousands of simulations in parallel with zero added computational time enabling optimization studies, parameter sweeps, and manufacture-aware design

**Automation:** Programmatic control of simulations, proprietary design workflows, removing lengthy manual setups and repetitive tasks

Overall, Quanscient Allsolve enables increased simulation throughput and more reliable designs through the ability to run more simulations faster with more accurate results.

# Introduction to semiconductor packaging design with Quanscient Allsolve

Quanscient Allsolve offers a powerful solution for semiconductor packaging design, addressing the challenges posed by increasing miniaturization and complexity.

## Challenges in packaging

### Continued miniaturization and advanced packaging

The increasing complexity and density of advanced packaging technologies, such as system-in-package (SiP) and 3D integrated circuits (ICs), demand highly detailed simulations to accurately capture the behavior of intricate interconnects, multiple dies, and diverse materials.

### Requiring fine-scale resolution since simplified models are becoming inadequate

As package designs become more complex, simplified models may no longer adequately represent the intricate interactions between various components and physical phenomena. Full 3D simulations with fine-scale resolution are necessary to capture these complexities and ensure accurate analysis.

### No geometric symmetry

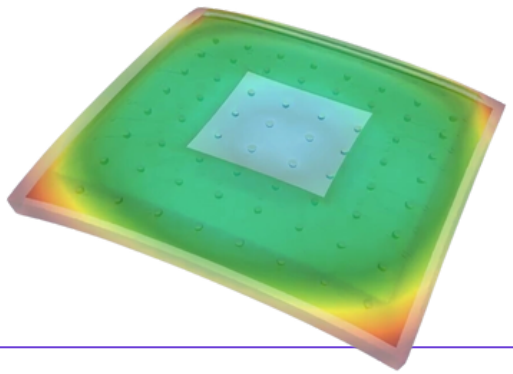
Advanced packaging designs often lack geometric symmetry due to the integration of multiple dies, irregular shapes, and complex interconnect structures. This makes it difficult to simplify models and reduce computational requirements, leading to longer simulation times and increased computational burden.

### Determining thermal stresses at interconnects are critical

The reliability and performance of semiconductor packages are highly sensitive to thermal stresses at interconnects, such as solder joints, copper pillars, and through-silicon vias (TSVs). Accurate prediction of these stresses is crucial for ensuring package integrity and avoiding premature failure.

### Considering each layer in the substrate and resolving the interconnects

Modern semiconductor packages often involve complex substrate structures with multiple layers, each with unique material properties and thermal characteristics. Detailed modeling of these layers and the interconnects passing through them is essential for capturing their impact on the overall package performance and reliability.



# Introduction to semiconductor packaging design with Quanscient Allsolve

## How Quanscient Allsolve can help in packaging simulations

### Strong coupling of multiphysics

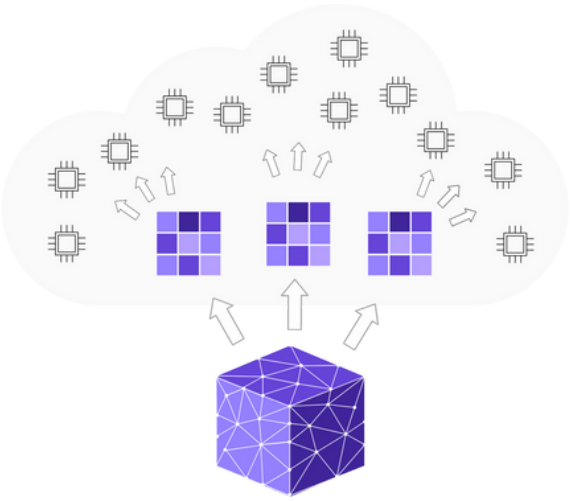
All the different physics simulations are available within a single platform and are strongly coupled. This means that the different physics simulations can interact with each other in a realistic way. This leads to more accurate and efficient simulations.

### Domain Decomposition Method (DDM)

This method speeds up large-scale simulations. It works by breaking down a large simulation into smaller subdomains. These smaller subdomains can then be solved independently on different processors. This can lead to significant speedups, especially for very large simulations.

### Parallel parametric sweep simulations

Users can run multiple simulations in parallel with different input parameters. This allows for faster Design of Experiments (DoEs) and optimization studies.



Quanscient Allsolve's optimized DDM solution splits the simulation into multiple smaller subdomains

### API for Integration

Quanscient Allsolve has an API that allows it to be integrated into existing simulation workflows. This gives users more flexibility and control over their simulations.

# Live demo
# Thermomechanical simulation of FCBGA

## 640x speedup with Quanscient Allsolve

The live demonstration showcased Quanscient's ability to accelerate semiconductor packaging design through cloud-based simulations. The specific problem involved simulating the thermal and mechanical behavior of a flip-chip ball grid array (FCBGA) package to ensure its reliability and performance.

Using a thermomechanical simulation of FCBGA as an example, the demonstration highlighted the platform's ability to accelerate simulation runtimes significantly using the Domain Decomposition Method (DDM)

**The Domain Decomposition Method** (DDM) accelerates FCBGA simulations by partitioning the model into smaller subdomains for parallel processing

**The DDM's scalability** allows for extensive parametric studies, enabling design space exploration and optimization

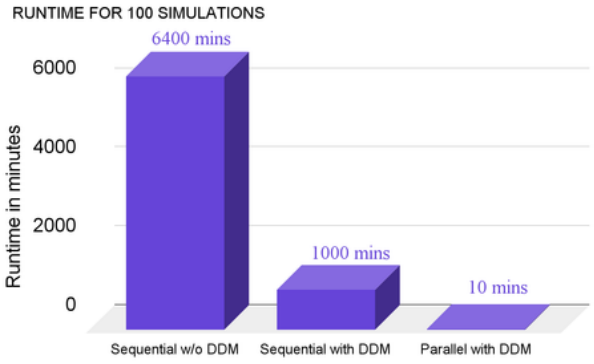
**The live demonstration** showcased DDM's ability to reduce FCBGA simulation runtimes from over an hour to under 10 minutes in one simulation

**DDM's parallelization and scalability** address the challenge of achieving both accuracy and speed in complex FCBGA simulations

The demonstration further highlighted the platform's capability to perform parallel parametric sweeps, a crucial aspect of Design of Experiments (DOE).

- By efficiently exploring a range of input parameters, such as stress-free temperature and substrate coefficient of thermal expansion, engineers can gain deeper insights into the relationship between these parameters and the package's performance.

- This enables making informed design decisions and optimize the package for reliability under various operating conditions.




Combining the speedups through DDM with the parallel capabilities, we demonstrated a **640x speedup in runtime**

# Conclusion and key takeaways

- The increasing complexity of semiconductor packaging, driven by miniaturization and advanced technologies, demands high-fidelity simulations to ensure performance and reliability. Traditional simulation methods often struggle to handle the computational demands of these intricate designs.
- As demonstarted live in the webinar, the DDM in Quanscient Allsolve provided a speedup of 6.4x for a single simulation. By running 100 simulations in parallel, a total speedup of 640x was achieved for the entire design of experiments study.
- Quanscient Allsolve leverages cloud computing to provide significant speed improvements and efficiency gains in the simulation process. By utilizing domain decomposition and parallel simulations, Allsolve accelerates analysis, enabling engineers to explore a wider design space and optimize package performance.
- The clear advantages of a cloud-based tool make multiphysics software such as Quanscient Allsolve an attractive option for increasing engineering throughput in semiconductor packaging design. With the ability to run more simulations, engineers can design more reliable products faster.

# Next steps

If you are interested in exploring the capabilities of Quanscient Allsolve and the Quanscient API, we encourage you to schedule a personal demo with our CRO, Mr. Nikola Strah.

**Schedule a 30-minute introductory call now.**

Book your session now!

During this meeting, you will:

- Learn how Quanscient Allsolve can address your specific simulation needs
- Learn how to integrate Quanscient Allsolve with your existing workflows
- Discover the platform's problem-solving capabilities and explore new possibilities for your use cases

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