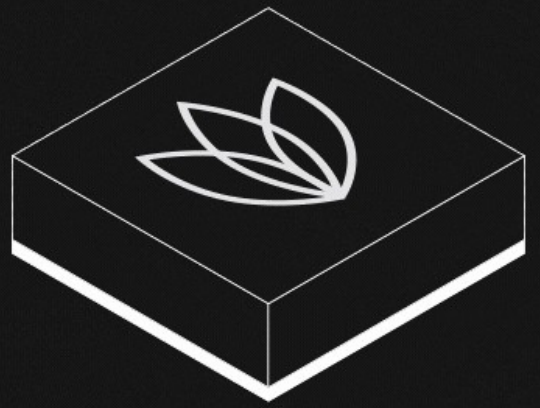
Cooling the Inferno

Rewriting the Rules of Power and



Martin Lantz – IC Design Manager – Lotus Microsystems

Data Centers Are Running Too Hot to Handle

- Data centers are projected to consume almost **1000 TWh** of energy annually in 2030, roughly equivalent to Japan's current electricity consumption.
- Cooling systems account for up to **40%** of a data center's energy consumption.
- AI workloads are expected increase their share of total data center power consumption from 10% in 2023 to **65%** by 2035.

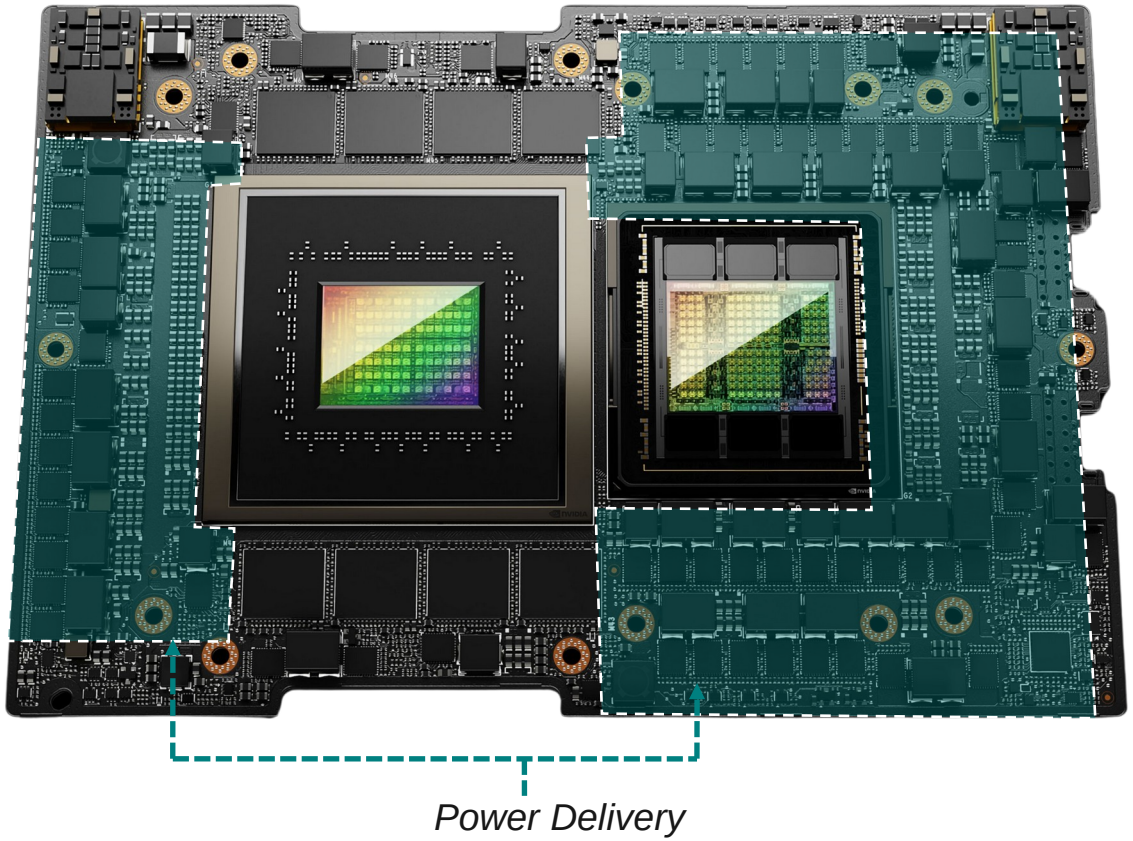
Why Existing Power Delivery Fails

Common GPU thermal challenges in AI systems:

- **Lateral power distribution** increases resistive losses and elevates thermal load.
- **Sub-optimal power-delivery efficiency** converts more electrical power into waste heat.
- Reliance on **discrete components** necessitates physically larger PDN implementations, which hinder thermal management.

❯ Resolving heat issues can boost performance by up to **100%**

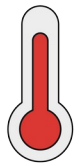
GPU processor board for AI computing



Heat and Size Challenge

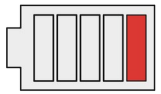
Current Power Conversion Technologies Face Significant Heat and Size Challenges

Advances in smaller chip nodes have outpaced the thermal and efficiency limits of current power converters.



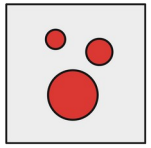
High operating temperature

Limits performance and efficiency of integrated circuits.



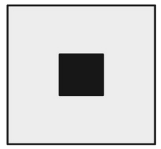
Low efficiency

Excess heat from poor power conversion reduces performance.



Hot spots

Localized overheating creates system bottlenecks.



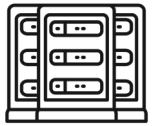
Large footprint

Current tech struggles with size constraints, causing integration challenges.

Affected applications

AI/ML Compute

High-perf. Computing



Data Center Servers

Optical Communications

Graphics/Gaming

Internet of Things

Mobile

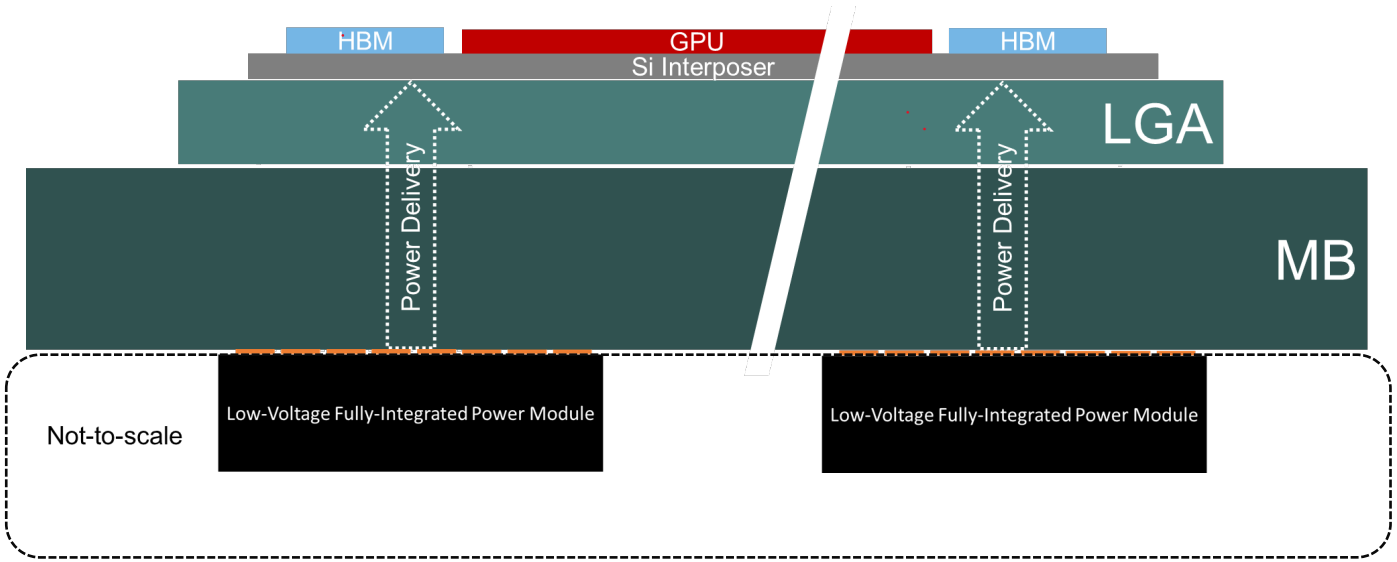
Telecom & WiFi


Our Solution

Power Supply in Package for AI/HPC Power

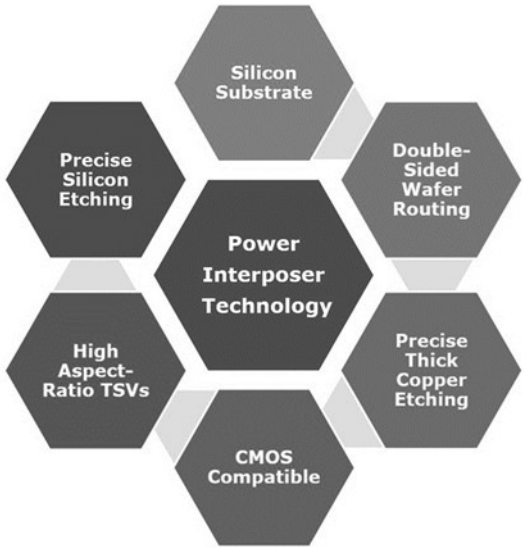
Lotus Microsystems is pioneering an **innovative hybrid power delivery architecture** (combining vertical and lateral approaches) by leveraging:

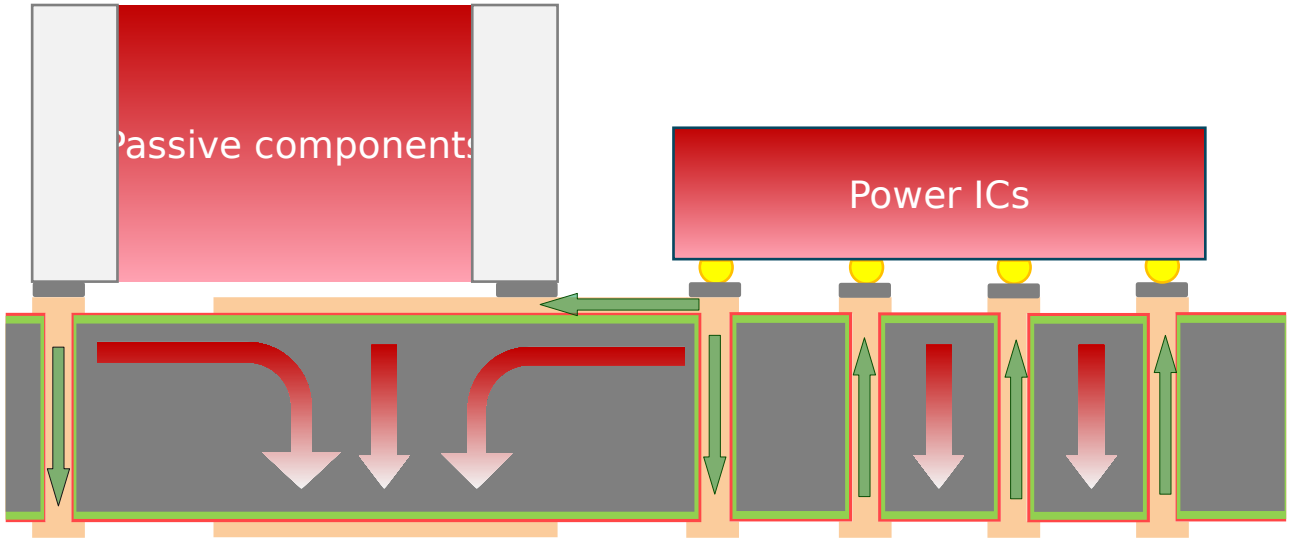
- Integrated thermal guides (Q-Guides)
- Extensive understanding and practical experience with “advanced” power converter topologies
- Advanced internal power IC design capabilities
- Innovative and extensive packaging expertise



Power Interposer Technology (PIT)

TSVs: Through-Silicon Vias
RDLs: Redistribution Layers





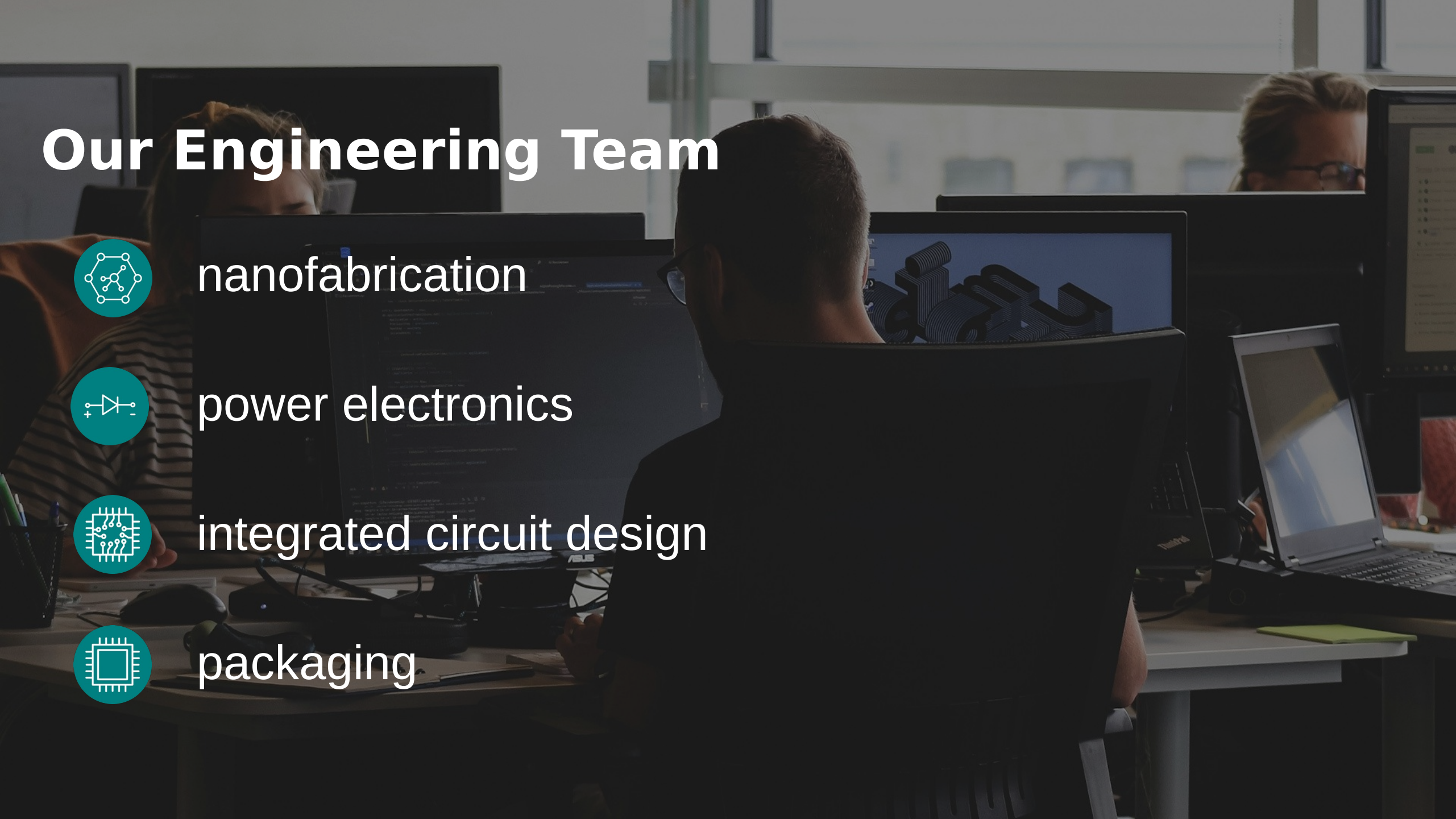
Two key functions of PIT

1. **Electrical: high current delivery** vertically (via TSVs) and horizontally (via routing RDLs) (**green arrows**)
2. **Thermal: heat transfer** vertically and horizontally between TSVs and pads that are not connected electrically (**red arrows**)

Four key features of PIT

1. High-thermal conductivity silicon body
2. High-density TSVs
3. Thick RDLs on both sides
4. High reliability dielectrics for electrical isolation and low thermal resistance contacts

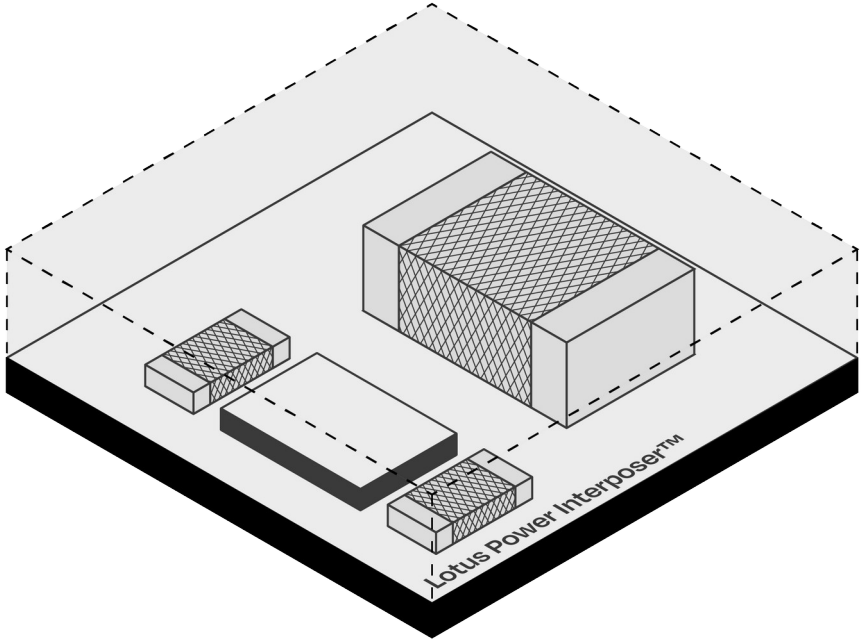
Our Engineering Team



- nanofabrication
- power electronics
- integrated circuit design
- packaging

Lotus Microsystems

- Founded in 2020
- HQ in Copenhagen. Subsidiary in Cairo
- 32 employees
- Cleanroom and prototyping facilities in Copenhagen



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