



Flash Memory Summit



Understanding High Performance NVMe BGA SSD and its Challenges

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Co-Founder and Chief Architect, TenaFe

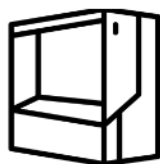
Storage Form Factors Trend

Enterprise/
Data Centers



U.2 E1.x E3.x

Mainstream
PCs



U.2 M.2

Entry Level
PCs



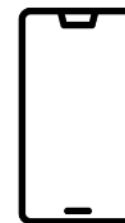
M.2 eMMC UFS
BGA SSD

Emerging
Applications



eMMC UFS
BGA SSD

Mobile
Phones



eMMC UFS
BGA SSD

Removable/
Cards

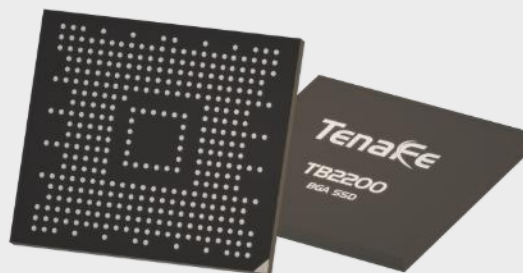


USB SD CF

SSDs

- Security
- Performance
- Reliability

BGA SSD



Memory Cards

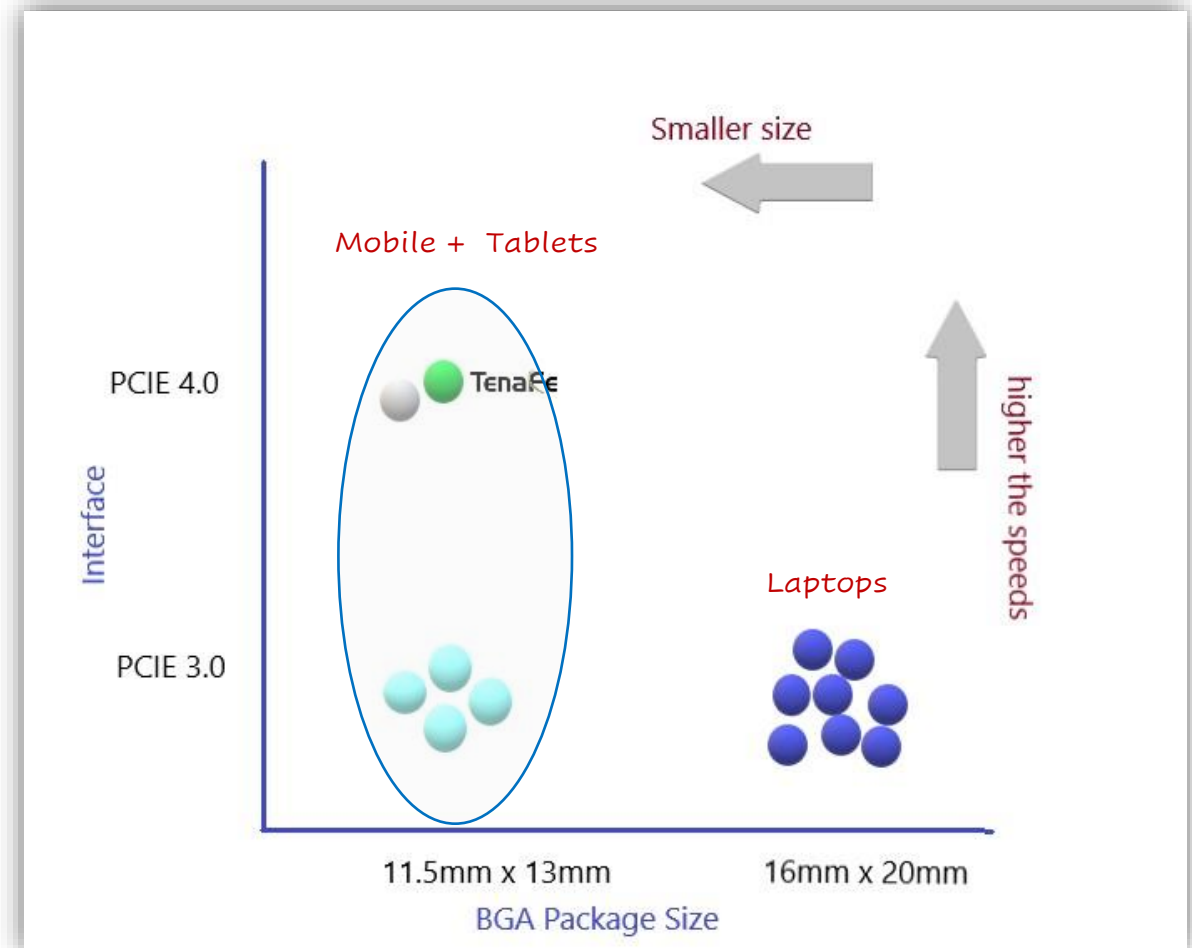
- DRAMless
- Small Form Factor
- Low Power



So, what is a BGA SSD?

BGA SSD Market Space

- **Majority of Available Products**
 - Gen3x2 speeds
 - 16mm x 20mm form factor
- **11.5mm x 13mm**
 - Needed for mobile segment
- **PCIe Gen4 BGA generation demands higher SerDes link speeds in smaller package size**
 - Challenges and opportunities to innovate



BGA SSD Form Factor

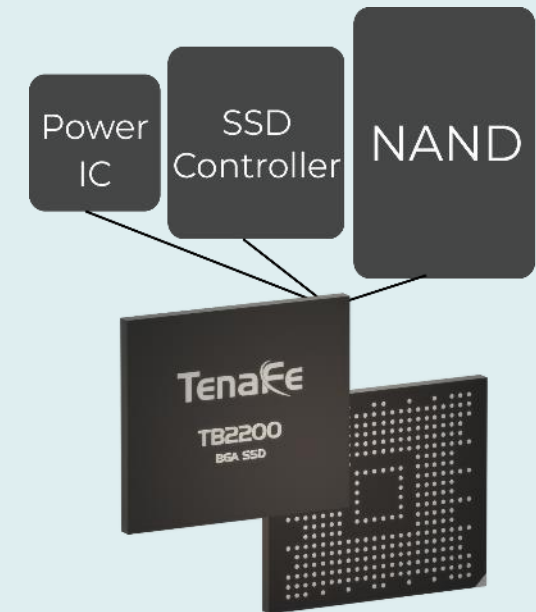


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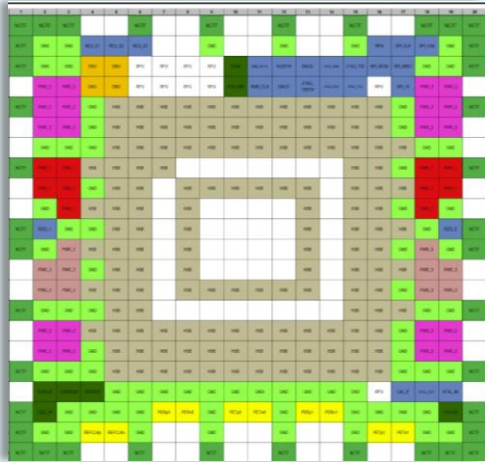
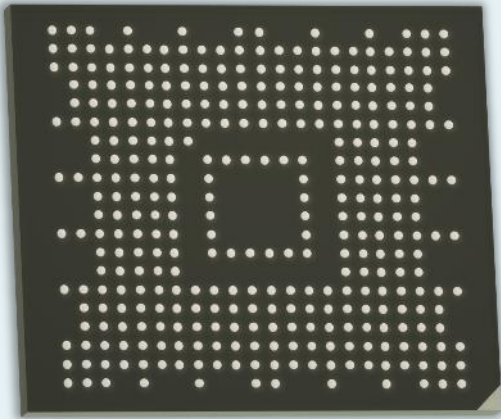
- **Targeted for Soldered Down Usage**
 - Type 1113, 1620, 2024, 2228 and 2828
- **Mobile and Tablets - Type 1113**
 - 11.5mm x 13mm
 - 60-70% Flash, 40% includes controller, routing and other components.
- **Z height is very sensitive in Mobile platforms**
 - 512GB and below ~ 1.3mm is okay, but for >1TB capacities cannot meet 1.3mm target.



BGA SSD Combines NAND Components, Controller, PMIC in One Small Package



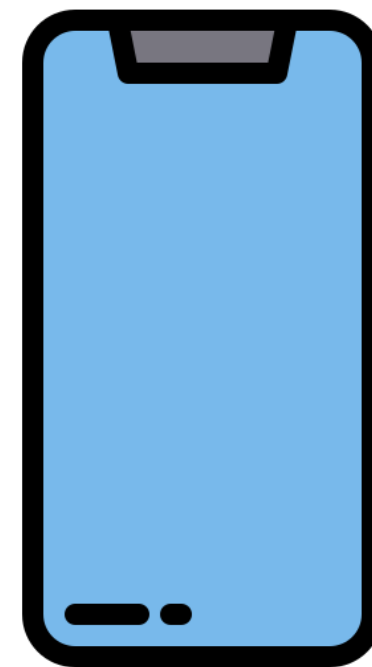
1113 FF Highlights



- **Ball Count of 345**
 - Predefined balls for PCIE (x2) , crystal, SMBUS and JTAG pins
 - 2 DIAG pins. Compared to 10 on typical SSDs.
- **Three Power Supply**
 - PWR_1(10pins): 3.3V or 2.5V supply
 - PWR_2(20 pins) : 1.8V or 1.2V supply
 - PWR_3(10 pins): 1.2V, 1.1V , 0.9V or 0.8V supply
- **Voltage Requirement Indication (V_ID)**
 - Controller voltage requirement to the host

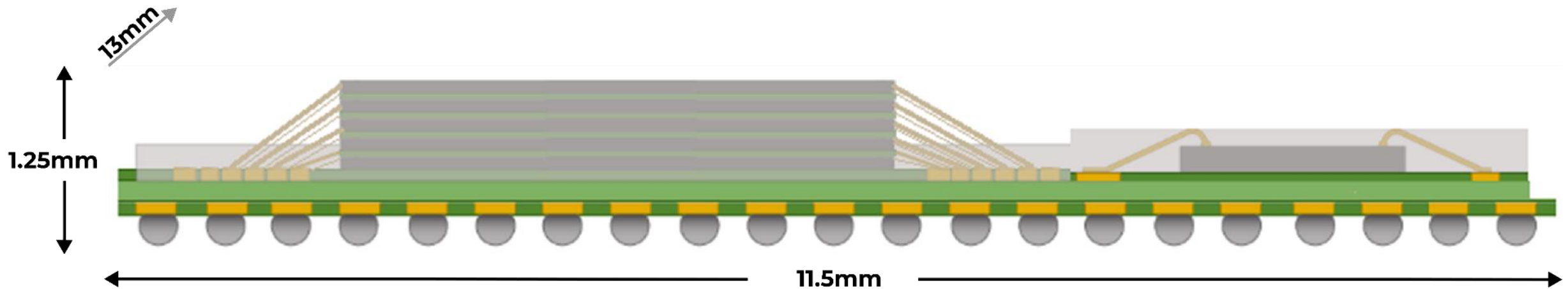
BGA SSD Product Requirement

- **Performance**
 - Determined by power budget and thermal consideration
 - No Airflow
- **Voltage Drop Detection**
 - Battery instability may cause large drops, SSD needs to handle it.
- **Supports HMB with Enhanced Reliability**
- **Advanced Memory Management**
- **Android System Sleep and Wakeup Support**



BGA SSD Stack

- Not enough room for linear component placement
- The Dies need to be stacked on top of each other.

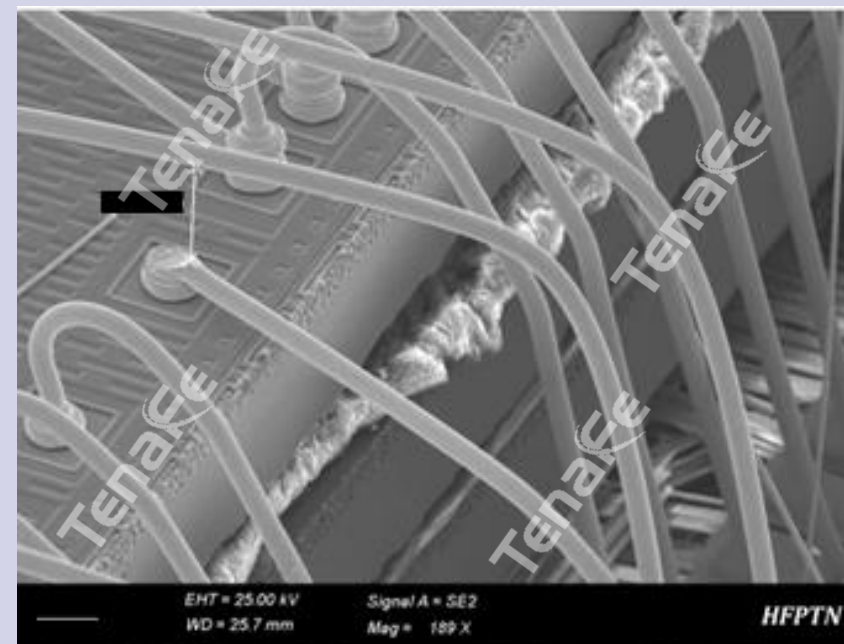


High Speed ONFI IO

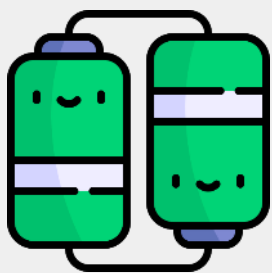


- Signal Integrity due to Cross Talk
- WireBond Placements
- Speeds , 1200MTs → 2400MTs → 3200MTs

Wirebond Spacing is key for good Signal Integrity

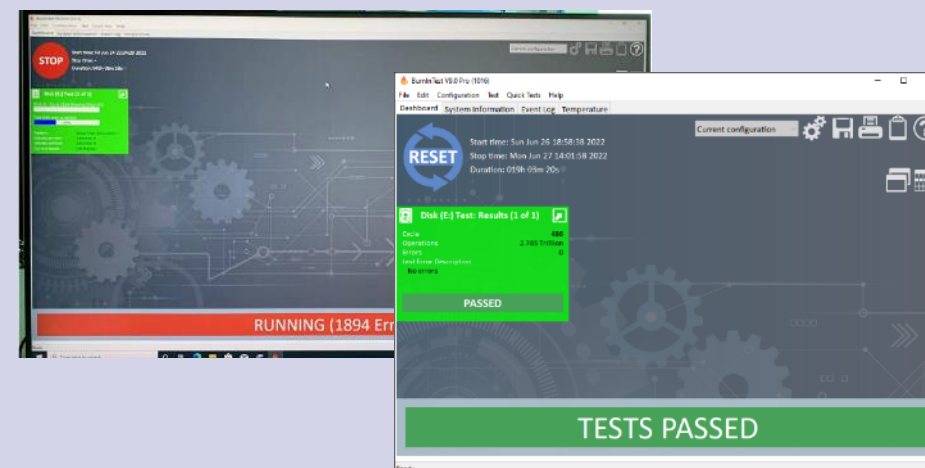


Power



- **Power Noise**
 - Voltage Drop
 - Signal Integrity
- **Capacitance**
- **Power Design and Simulations**

The ONFI IO power supply is sensitive to the choice of capacitance.



Power Design Fine Tuning necessary

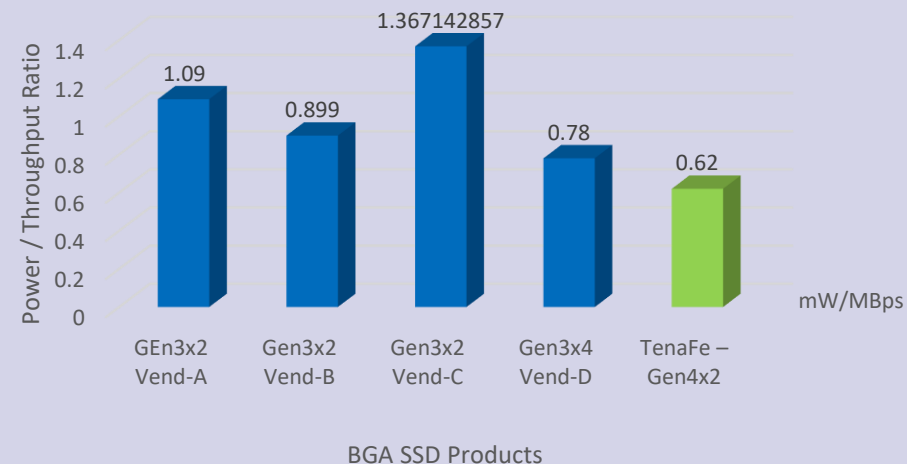


Thermal

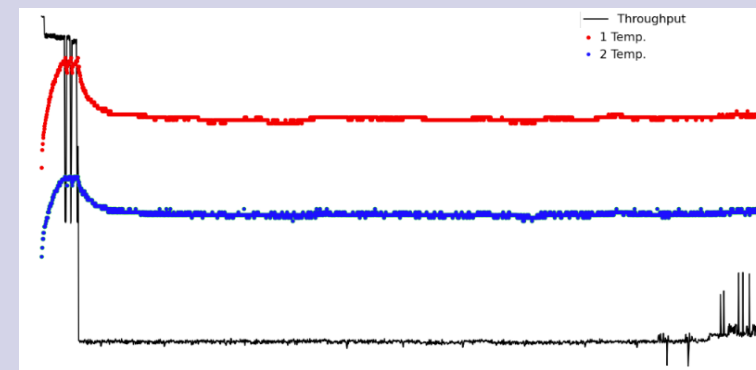


- No Air Flow
- BGA PCB provides 11x smaller heat dissipation Area than M.2-2280
- Improved Power/Performance Ratio is key to enable Gen4 on BGA SSD.
- Firmware and silicon thermal management enables consistent thermal profile

TenaFe's Low Power/Performance Footprint for Gen4 as compared to other Gen3 products



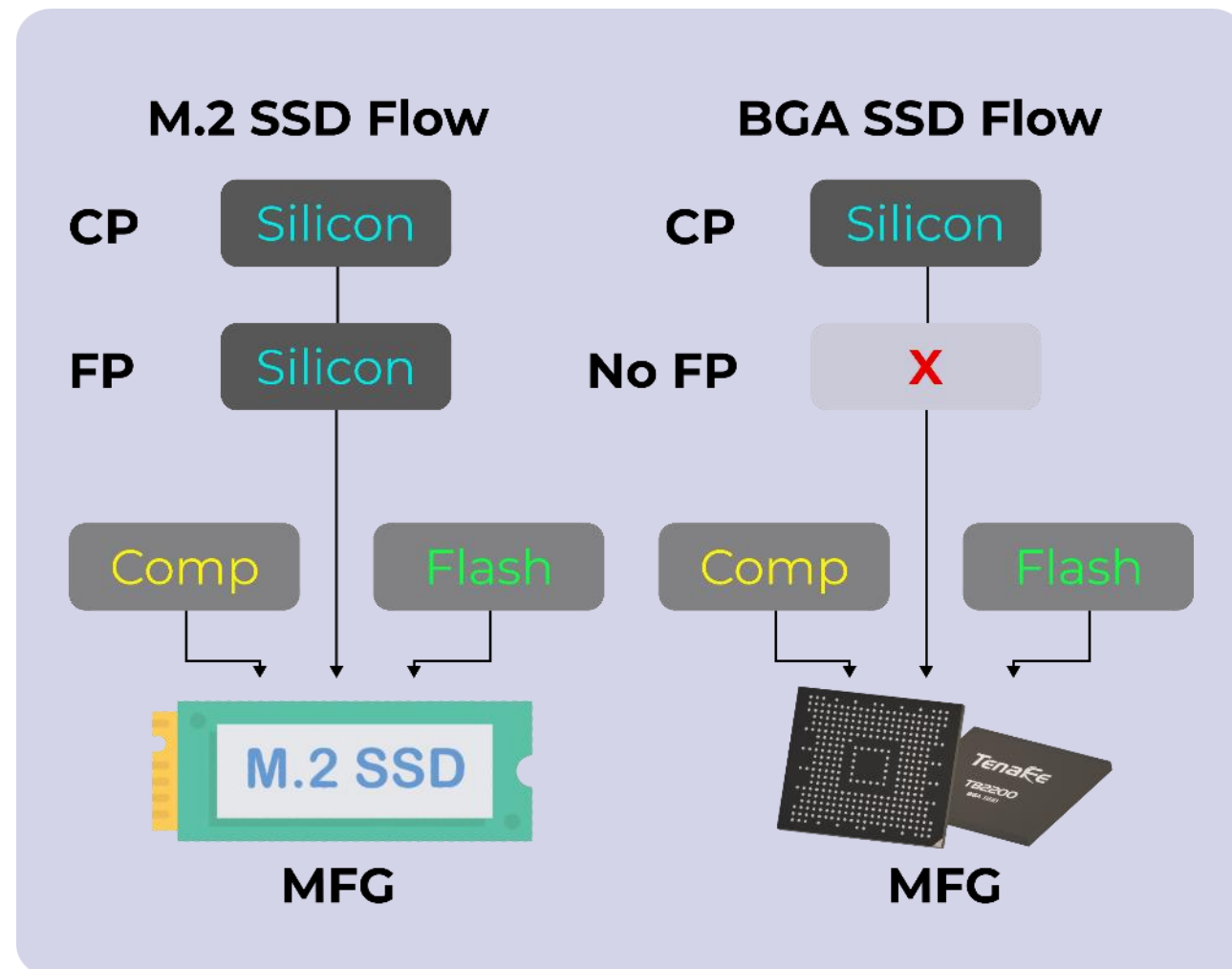
Consistent Temperature control with No HeatSink



Mass Production & Testing



- Only 2 Diagnostic pins on Package
- No Access to Silicon FP testing Pins
- Consider System level testing for coverage



Conclusion

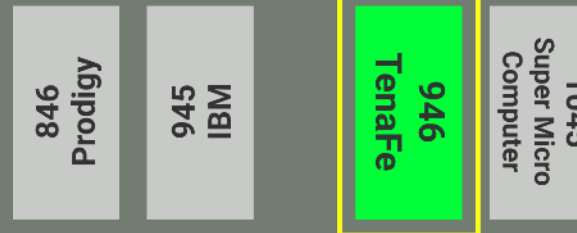
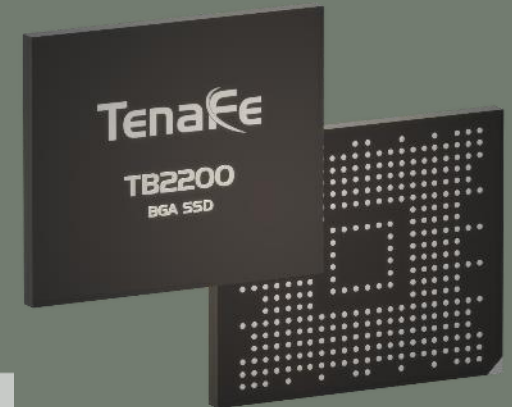


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- BGA SSDs are ideal NVMe storage solutions for embedded, industrial and automotive applications
- These tiny SSDs are expected to hold more data & perform reliably at high speeds, requiring different processes and technology to overcome those challenges

Visit TenaFe's booth at **#946** to check out the *TB2200 BGA SSD* and inquire details.

FMS Theatre
852



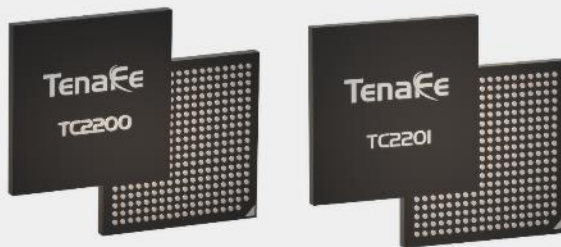
Overview of TenaFe

TenaFe was founded in 2019

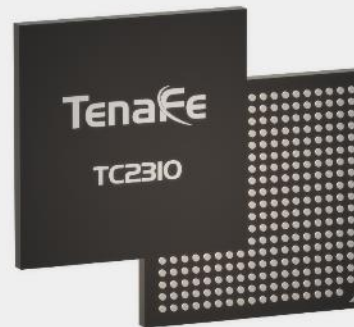
SSD Controller Solutions for **Client OEM**, **Data Centers**, and **Emerging Applications**

Leader in PCIe Gen4 DRAMless Technology, **OEM Qualified** and **MP** since **Q4' 2021**

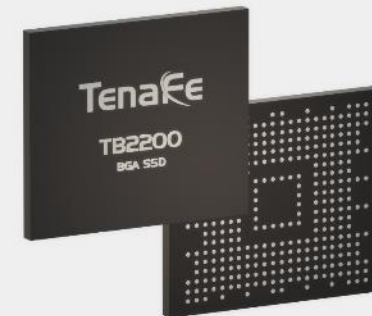
Client OEM
PCIe Gen 4
DRAMless Architecture



Data Center
PCIe Gen 5
IOPS/Watt Optimized



Emerging Technology
BGA SSD
Small Form Factor





Thank you!