# Embedded SSDs


## *When Less Really is More*

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# Typical Embedded Applications

# Embedded App Characteristics

- Often space-constrained
- Systems typically fan-less with <4W power budget

- Capacity “sweet-spot”: 2GB–16GB
- Data integrity and reliability higher priority than performance

# Embedded SSDs: Common Usage

## Booting (O/S or application)

- Typical O/S load is less than 4GB

## Data-logging

- Typically smaller (<1GB) files, 2-3 drive writes/day

## Fast backup

- Metadata file backup (~10GB) in system panic event

## Performance cache

- “Hot” data stored on SSD, “cold” data on HDD

# Embedded SSDs: The Right Fit

## Compared to “standard” SSDs, Embedded SSDs:


- Have a 50%+ smaller footprint
- Consume less power (and generate less heat)

| | 2.5” HDD | Embedded SSD | 2.5” SSD |
|---|---|---|---|
| Typical Power Consumption | 7W-10W+ | 2.5W-4W | 4.5W+ |

- Support lower capacities for lower acquisition cost (right-sized for the application)

# Embedded SSDs: No Compromises

Embedded SSDs include many of the same enterprise features as standard SSDs:


## Flash Management / Data Integrity


- Advanced ECC and data corruption mitigation


## Reliability

- Advanced power-fail and reset error handling


## Endurance


- Advanced wear-leveling, write-amplification reduction and read-disturb mitigation

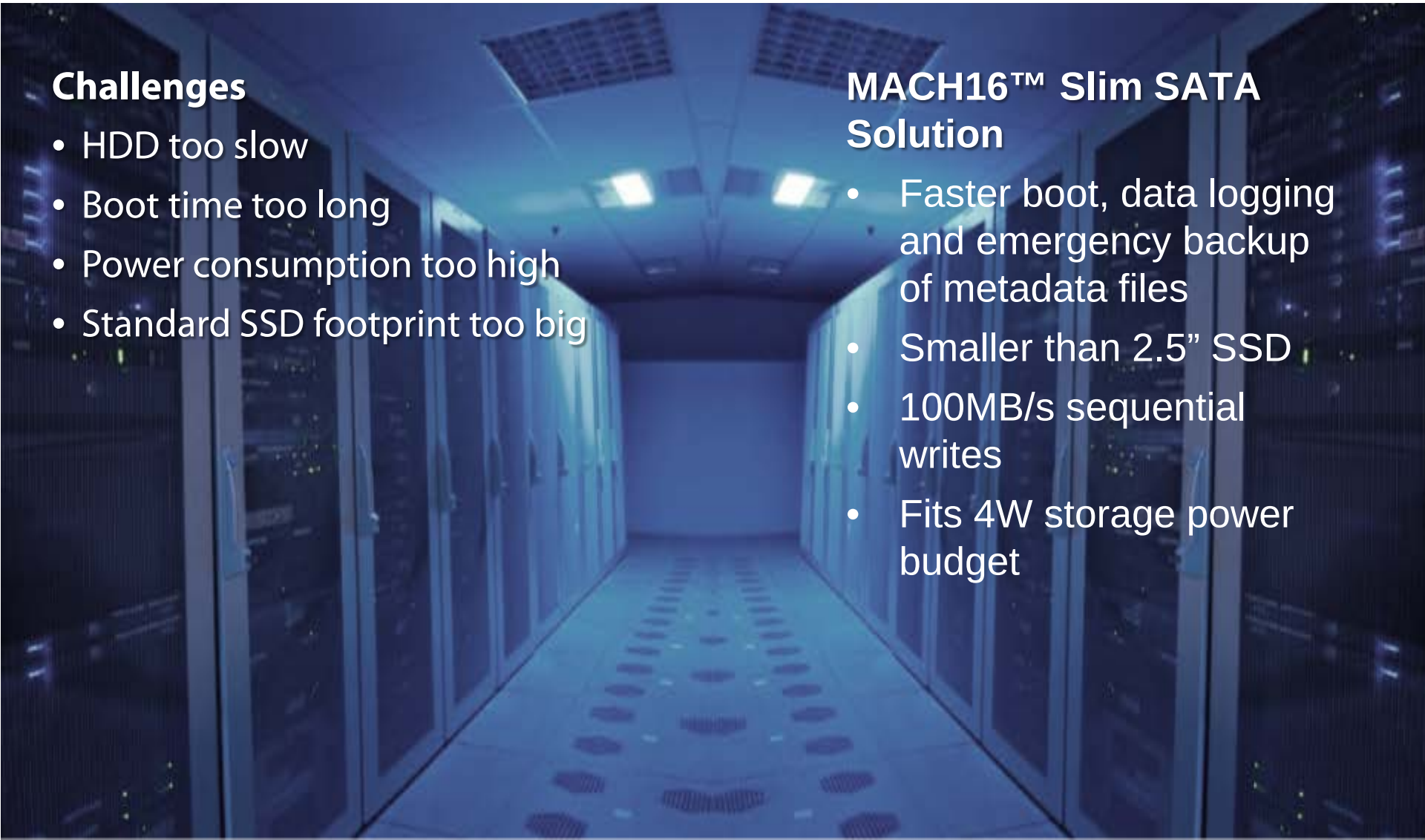
# Embedded SSDs: Reliable NAND

- Embedded SSDs use lower density flash (e.g. 8/16/32Gb)
- Lower density flash is mfg'd in larger die geometries (e.g. 4X/3Xnm vs. 2X/1Xnm)
- Consequence of smaller geometries is higher bit-errors and lower endurance
- Conclusion: Embedded SSDs are highly reliable

| | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| **Characteristics** | | | | | |
| *Monolithic Die Density* | 2Gb | 8Gb | 8Gb/16Gb | 16Gb/32Gb | 32Gb/64Gb |
| *Geometry (nm)* | 90 | 72 | 50 | 34 | 25 |
| *$t_{PROG}$ (µs TYP)* | ~300 | ~700 | ~300/~900 | ~300/~900 | ~300/~1300 |
| *Page Size (bytes)* | 2112 | 2112 | 4314 | 4320 | 8640 |
| *Number of Planes* | 1 | 2 | 2 | 2 | 2 |
| *Number of Pages (SLC/MLC)* | 64 | 128 | 64/128 | 128/256 | 128/256 |
| *Block Size (KB)* | 128 | 256 | 256/512 | 512/1024 | 1024/2048 |
| *$t_R$ (µs)* | 25 | 50 | 25/50 | 25/50 | 35/75 |
| *ECC Required/ Code Word* | 1/528 | 4/528 | 4/539, 8/539 | 4/540, 12/540 | **8/540, 24/1080** |
| *NOP (Number of Partial-Page Operations)* | 8 | 4 | 4/1 | 4/1 | 4/1 |
| *Endurance* | 100,000 | 10,000 | 100,000/ 10,000 | 100,000/ 5000 | **60,000/ 3000** |
| *Interface (MT/s)* | SDR 40 | SDR 50 | SDR 50 | DDR 166 | DDR 200 |
| *Packages* | TSOP | TSOP | TSOP | TSOP, LGA, BGA* | TSOP, LGA, BGA* |
| *Temperature Range* | C | C | C | C, I | C, I |

*Notes: Timeline years are approximate. Values specific to MLC devices are in bold. Shaded columns identify the NAND devices used for most of our comparisons. *Up to 8-die BGA packages offered.*

# Example: Enterprise Rack Server



**Challenges**

- HDD too slow
- Boot time too long
- Power consumption too high
- Standard SSD footprint too big

**MACH16™ Slim SATA Solution**

- Faster boot, data logging and emergency backup of metadata files
- Smaller than 2.5” SSD
- 100MB/s sequential writes
- Fits 4W storage power budget

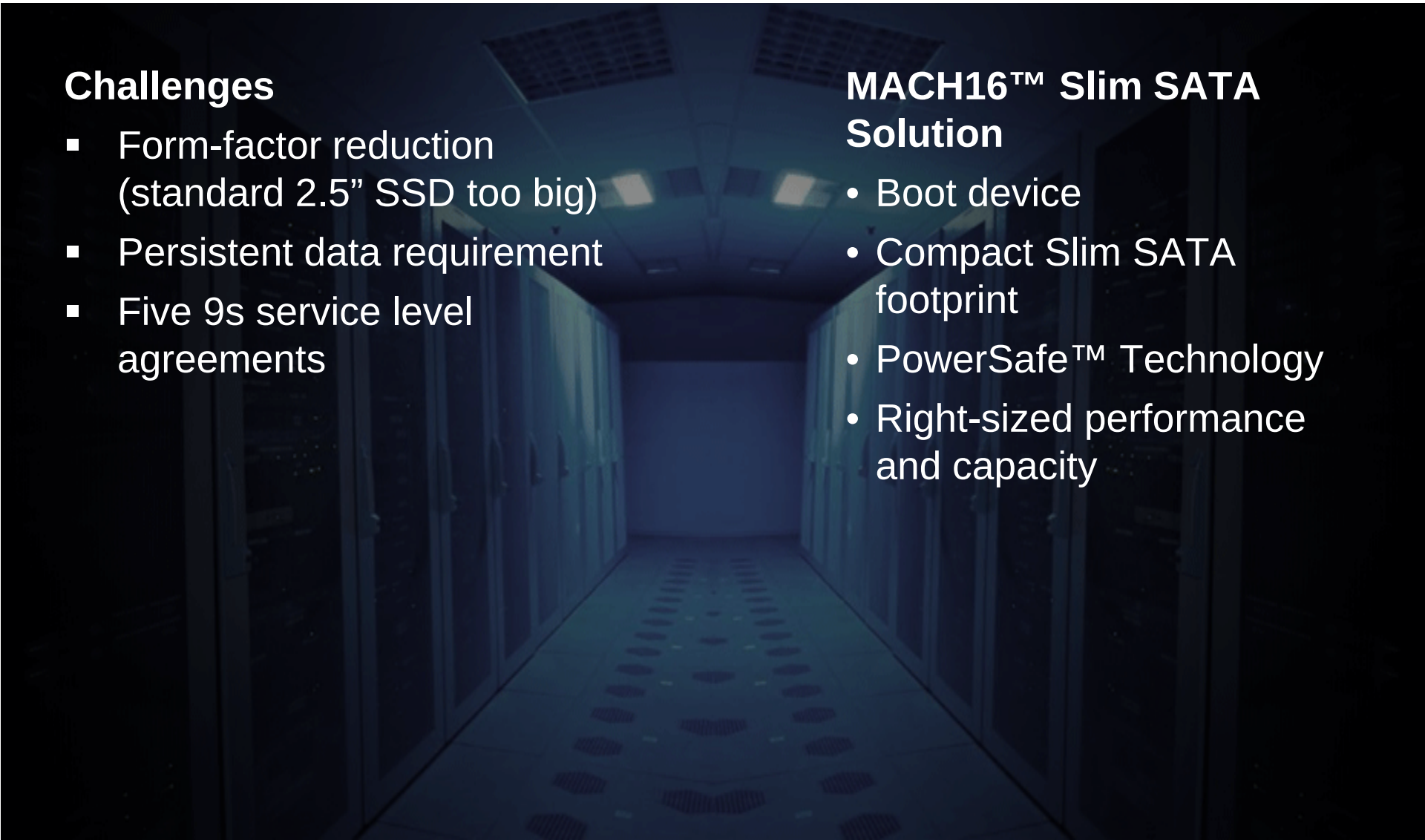
# Example: UMA Ground Control Unit

**Challenges**

- SWAP Design Requirements
  - Size—smaller than 2.5” SSD
  - Weight—lightweight, ruggedized
  - Power—battery-powered ; very low-power envelope
- Low-latency video recording
- Military requirements for rugged, long-lasting data reliability and integrity

**MACH16™ Slim SATA Solution**

- Low-latency solution for video capture
- Delivers on SWAP requirements (sub-4W design)
- Meets military specs for shock, vibration and temperature



# Example: High-End Network Router

**Challenges**

- Form-factor reduction (standard 2.5” SSD too big)
- Persistent data requirement
- Five 9s service level agreements

**MACH16™ Slim SATA Solution**

- Boot device
- Compact Slim SATA footprint
- PowerSafe™ Technology
- Right-sized performance and capacity


# Embedded SSD Benefits Summary

Embedded SSDs enable system designers to…

…build smaller, more compact and quieter designs (no cooling fans required)

…lower system TCO (lower acquisition and operating costs, smaller board designs)

…design for a variety of environmental conditions (e.g. temperature extremes, shock/vibration, etc.)

# THANK YOU!

Drop us a line at: EmbeddedSSD@stec-inc.com with any questions