



NOR Market Changes

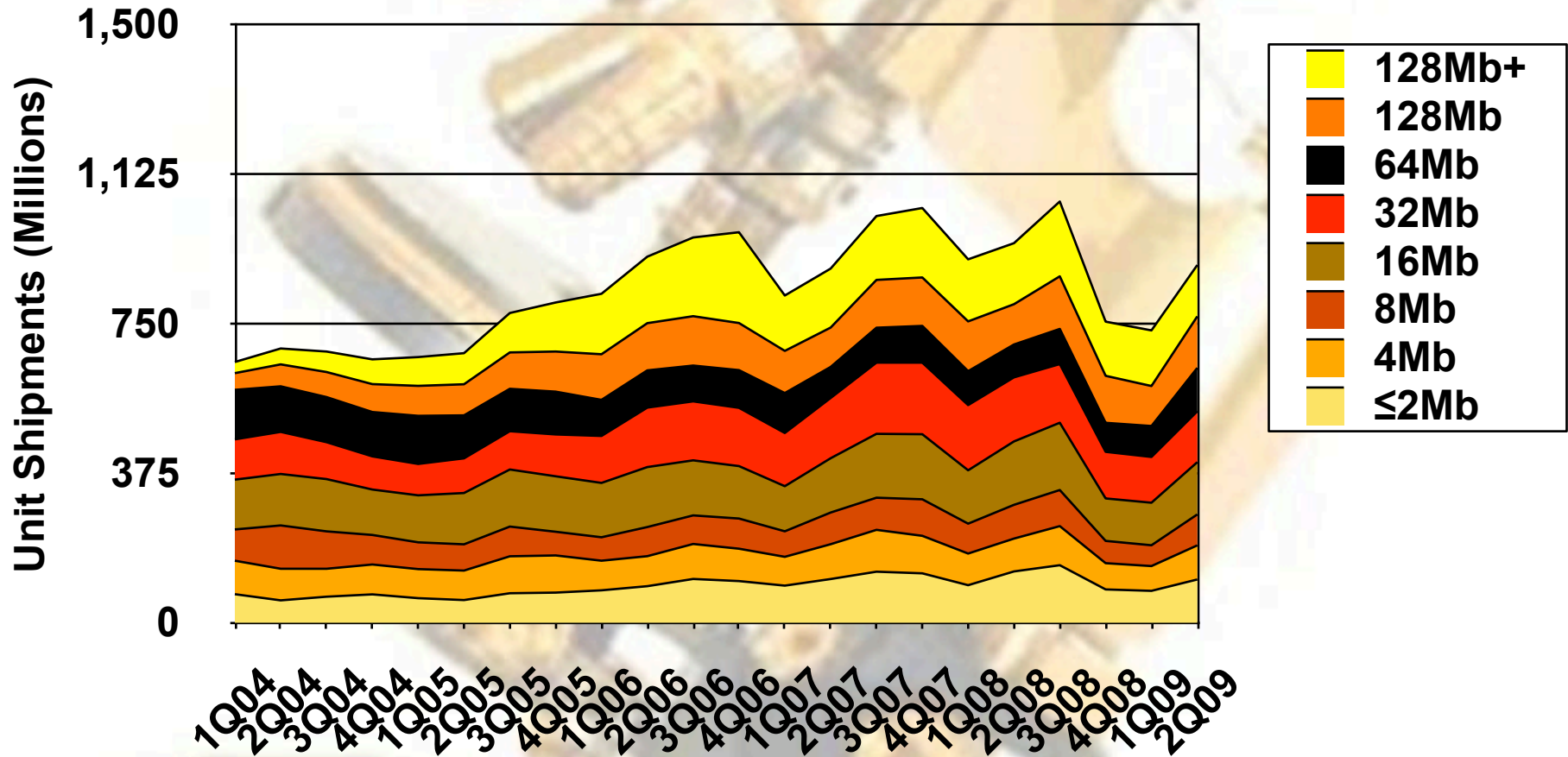
Jim Handy

**OBJECTIVE
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Is NOR Doomed?

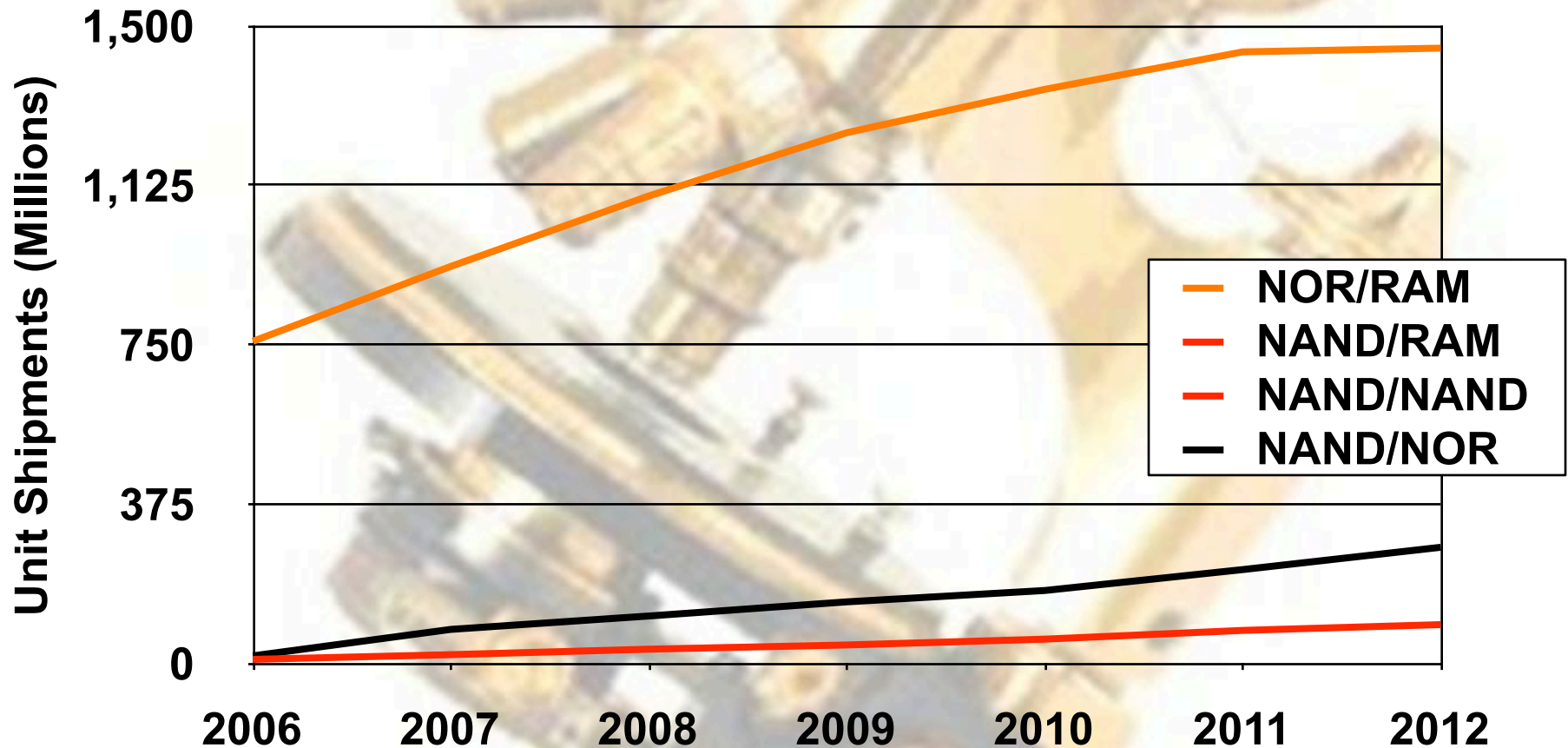
- NAND is penetrating cell phones
 - Some use no NOR
- NOR prices collapse in pace with NAND
- Limited supply base:
 - High Density: Spansion, Numonyx, Samsung
 - Low Density: Above plus SST, Macronix, Winbond, Sharp, Renesas, ISSI, A-Plus, Others

NOR Ships in Many Densities



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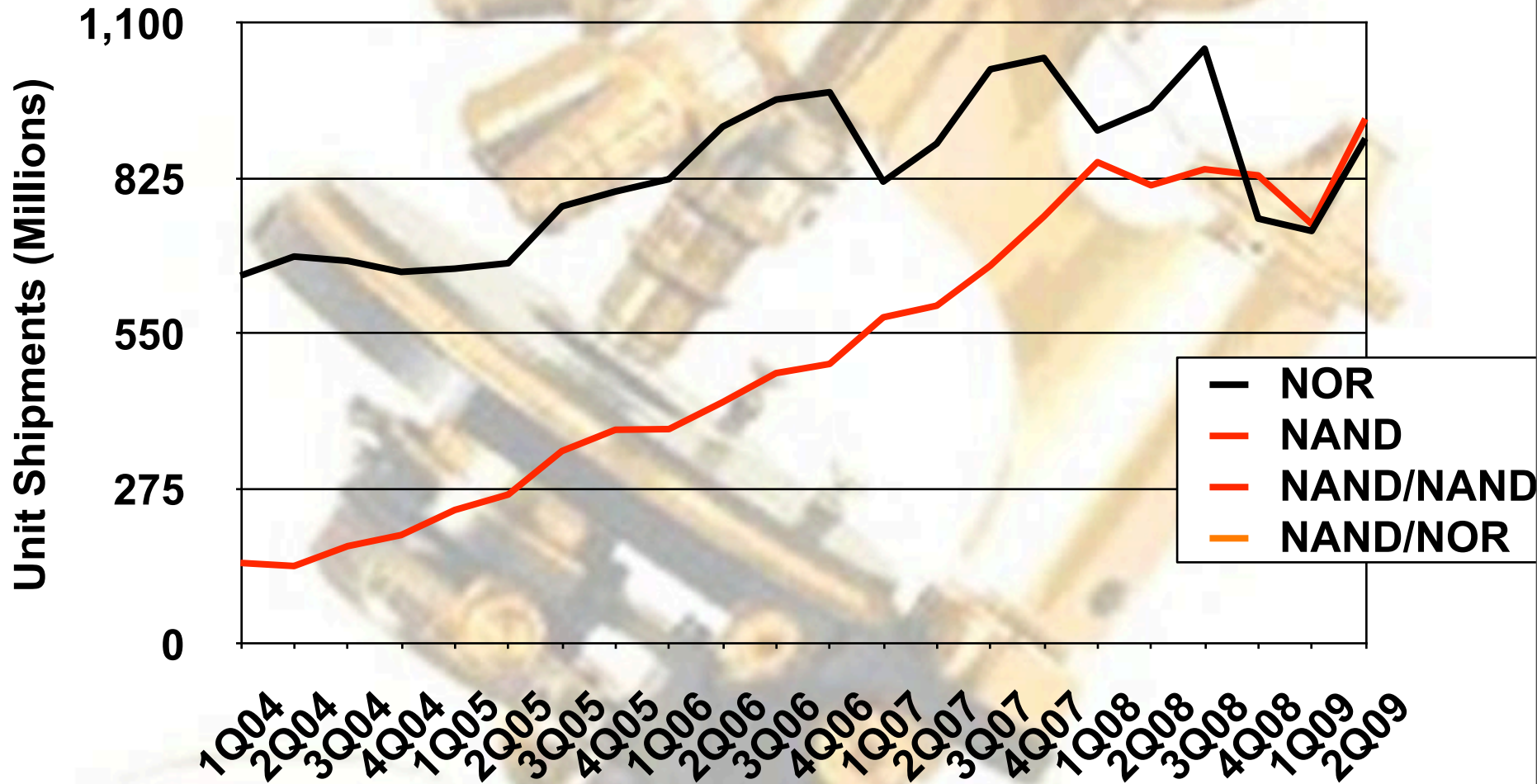
NOR Still Big in Cell Phone MCPs



From: *Flash Packaging: What Phone Makers Want & Why*

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NAND *Barely* Out-Pacing NOR



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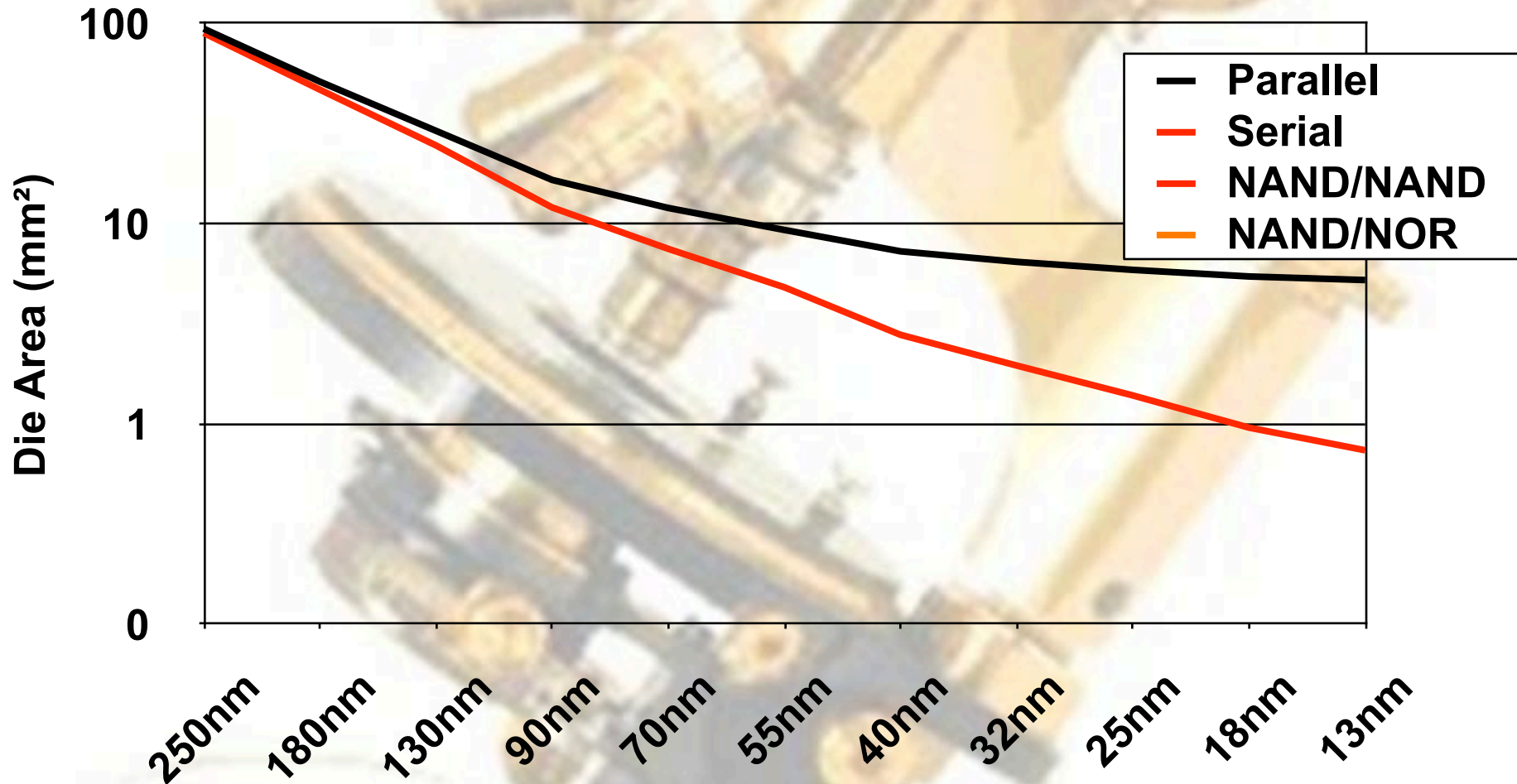
One Too Many Interfaces

- Three Big Interfaces in many systems
 - NOR: Parallel asynchronous
 - NAND: Serial asynchronous
 - DRAM: DDR, LP-DDR
- Each requires its own pins on the ASIC
 - Pins add significantly to costs
- Need to reduce ASIC pinouts
 - NOR with DRAM interface
 - Serial NOR

Process Shrinks Present New Challenges

- Die becomes pad limited
 - 8/16 I/Os
 - 24 Addresses
 - 5 Control
 - 8 Power
- New process fails to reduce costs

Serial vs. Parallel Die Shrinks



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Summary

- NOR market undergoing changes
 - Still prevalent
 - Lower densities will thrive
 - NAND will encroach at higher densities
- I/O needs to change
 - Standardize interface to reduce system costs
 - Serial flash will cut NOR chip costs