ELPIDA

FormFactor®
The MicroSpring® Company

Cost-Effective Fully Tested Die with High-Frequency and High-Throughput Wafer-Test Solution

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Southwest Test Workshop 2004

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Presentation Outline

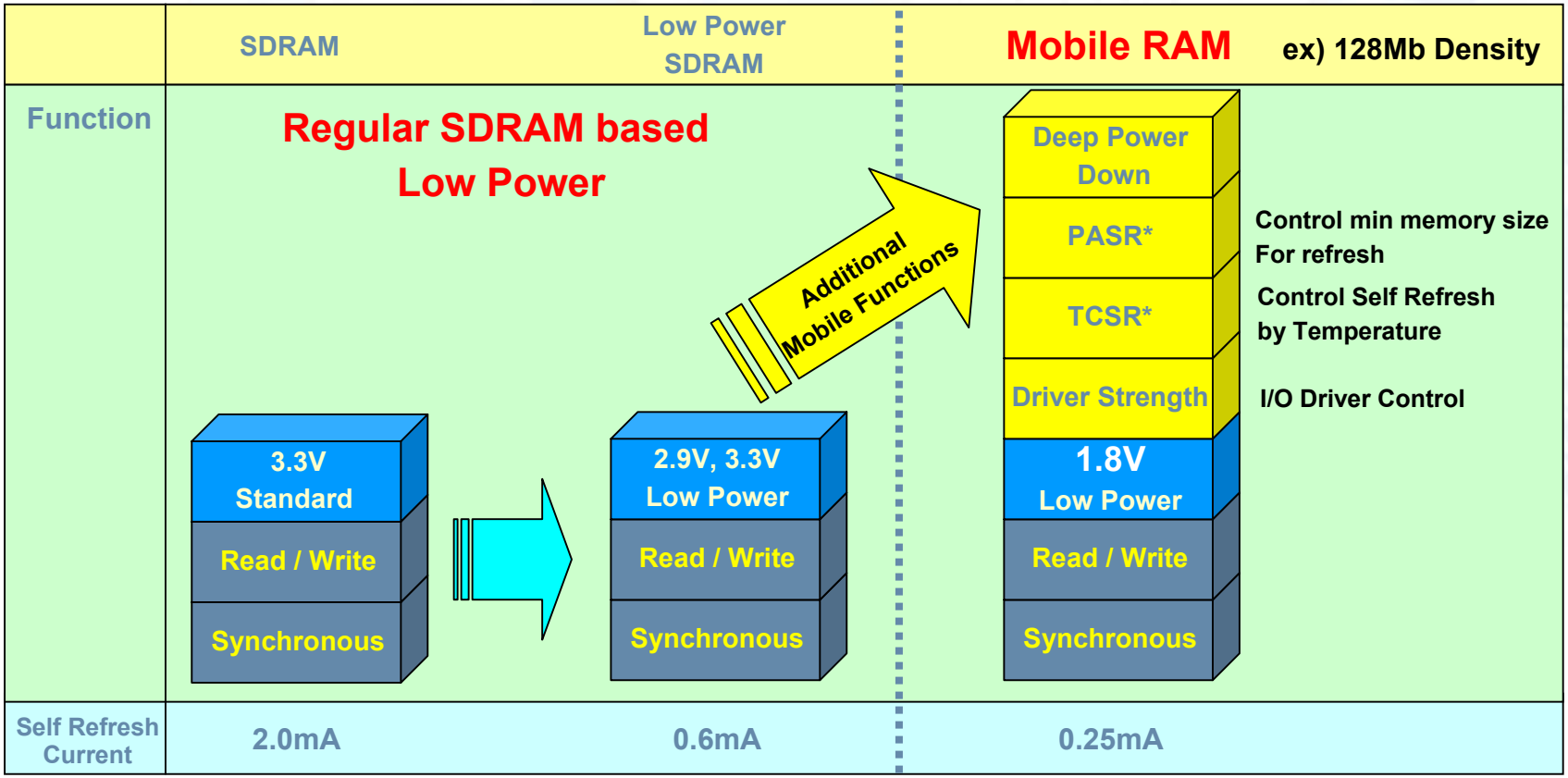
- Mobile RAM introduction
- Mobile RAM wafer-level-final-sort tests objectives and goals
- High performance probing technology solution
- New probing technology internal qualification
- Customer qualification
- Follow on work
- Summary and conclusion

Elpida DRAM Plant

300mm Fabrication in Japan

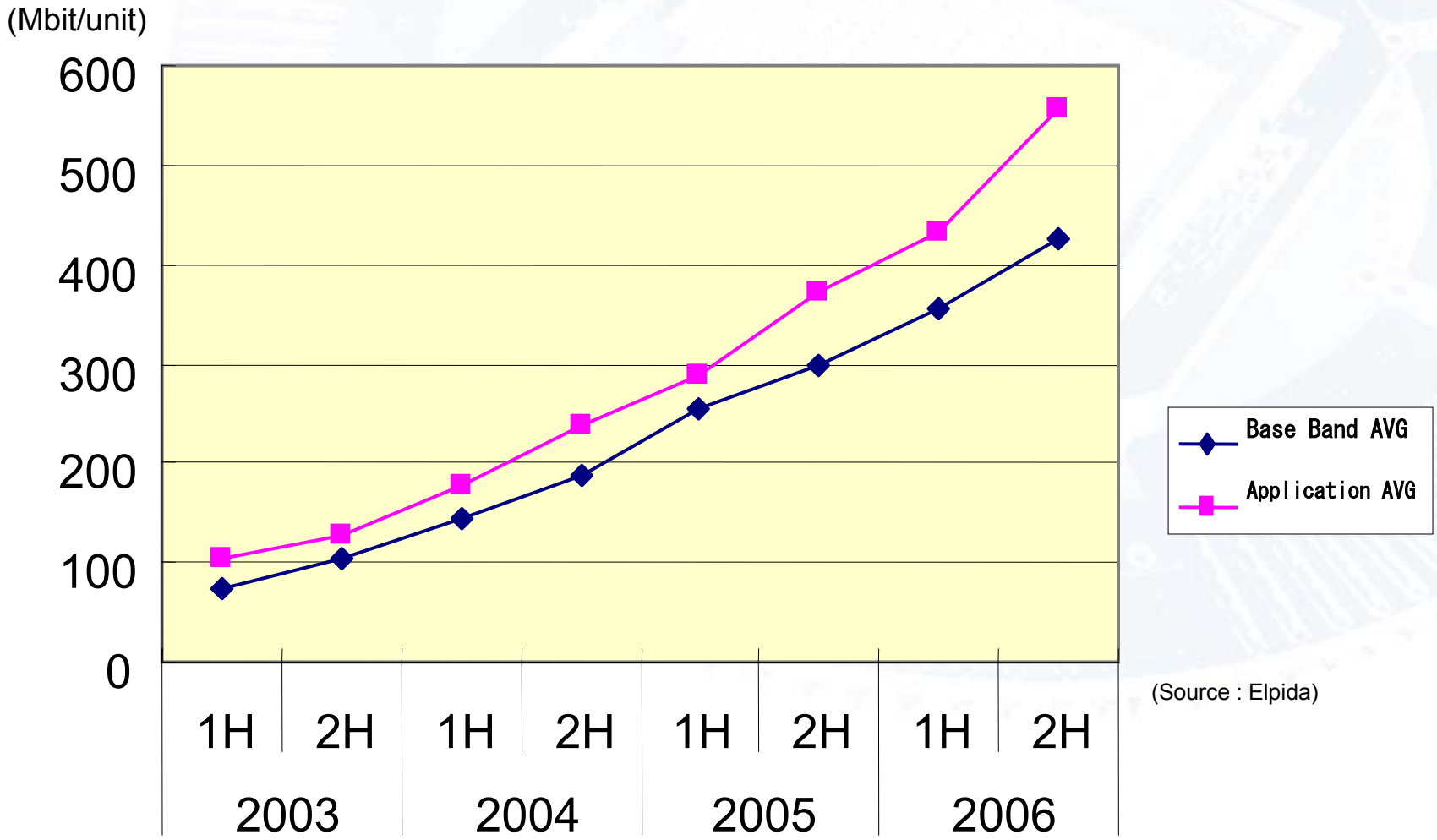
Mobile RAM Introduction

Lowest IDD6, Low Voltage (1.8V), and JEDEC Mobile Functions



* Low Power Mode
PASR: Partial Array Self Refresh
TCSR: Temperature Compensated Self Refresh

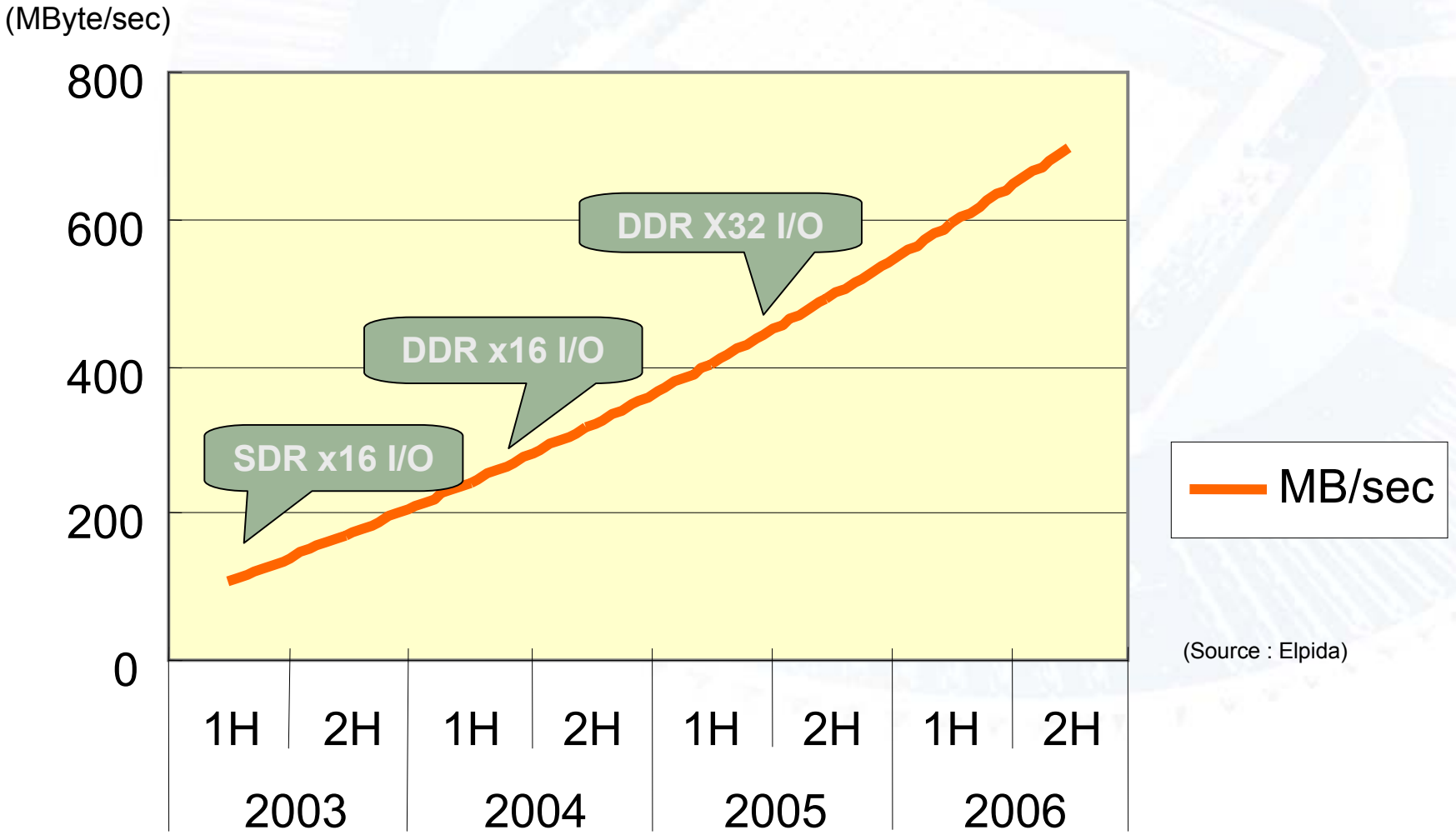
Required Density in Cellular Phone



(Source : Elpida)

Application memory is higher than Baseband memory.

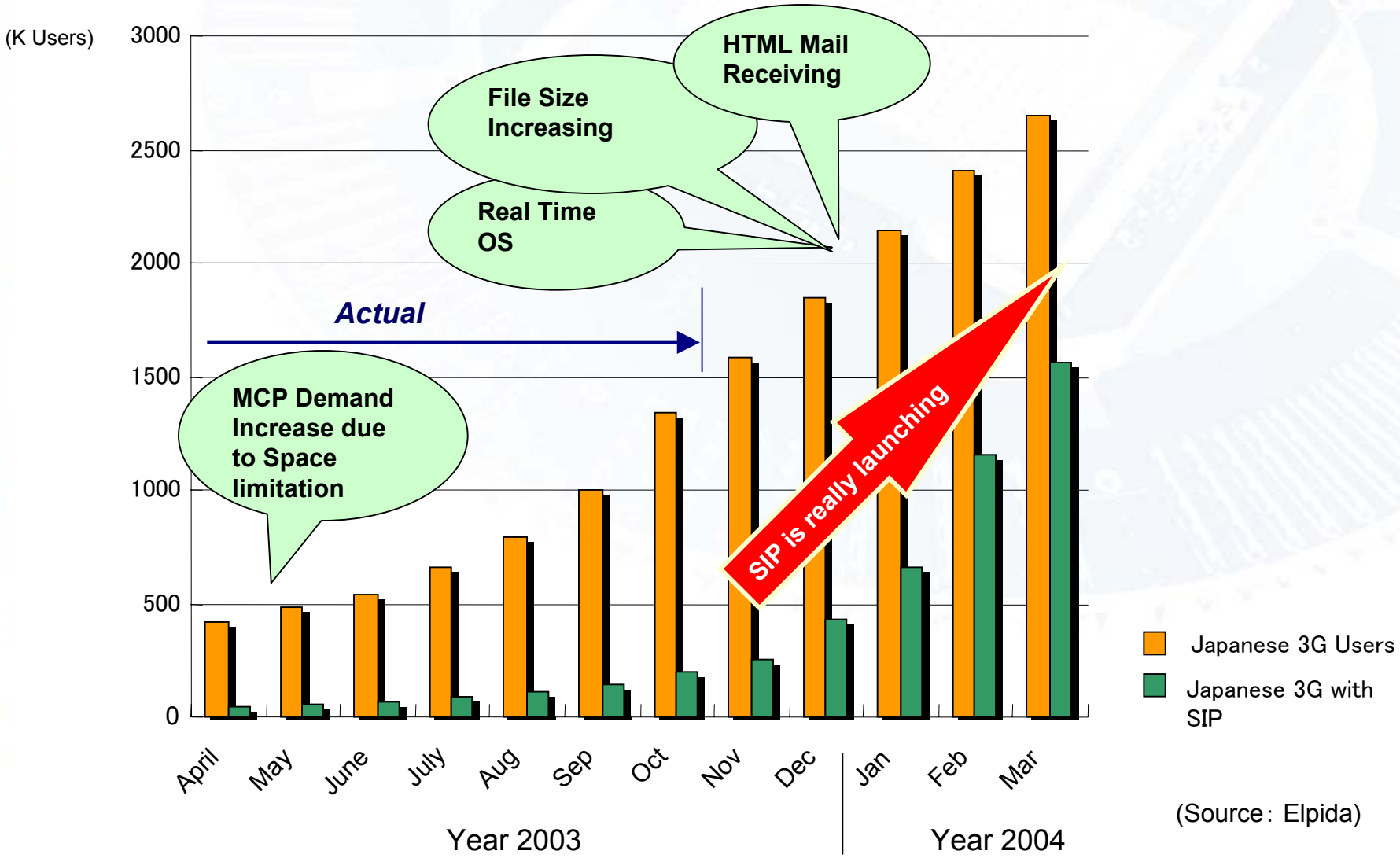
Bandwidth (Speed) for Cellular Phone



(Source : Elpida)

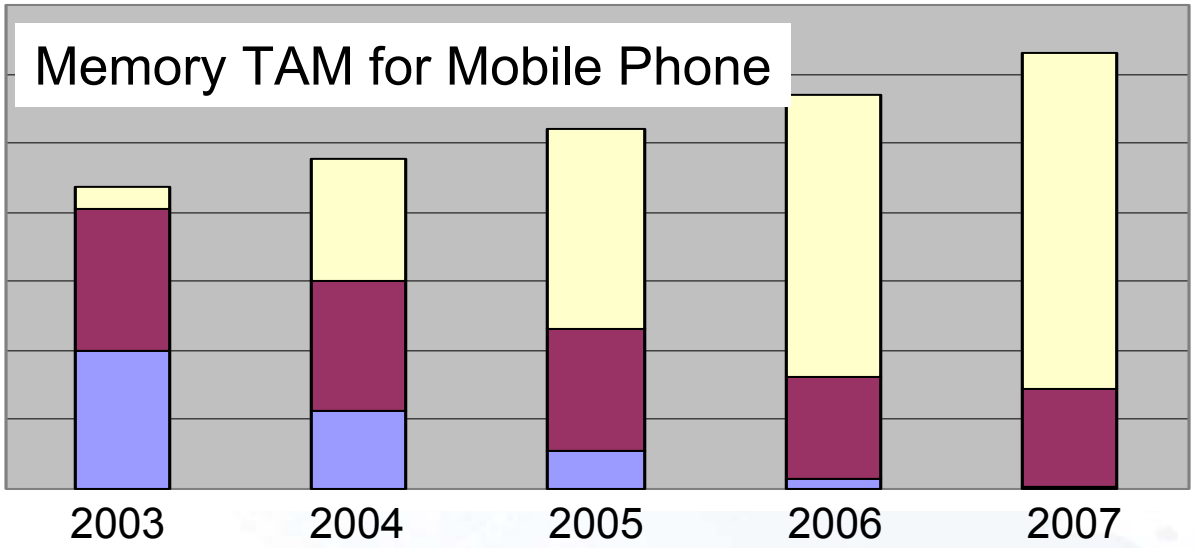
Due to advanced application, required bandwith is rapidly growing.

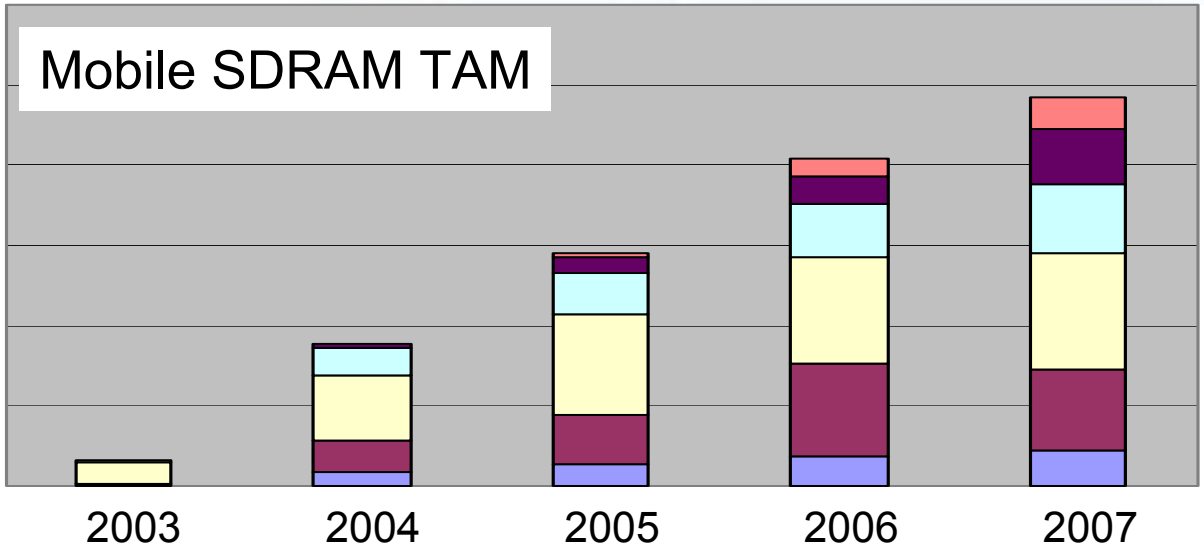
Japanese 3G Market Penetration Plan and SIP demand projection



(Source: Elpida)

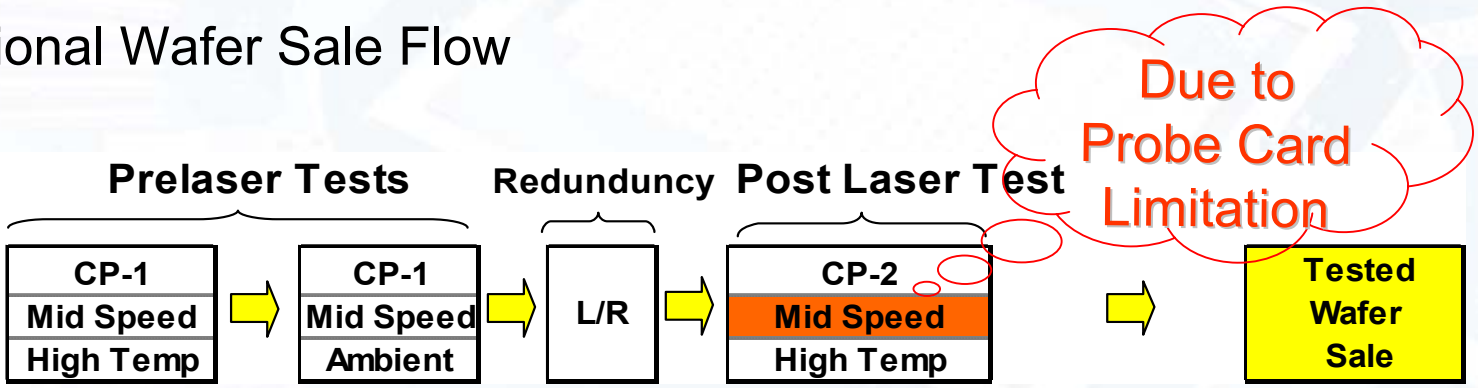
Mobile Memory TAM Trend



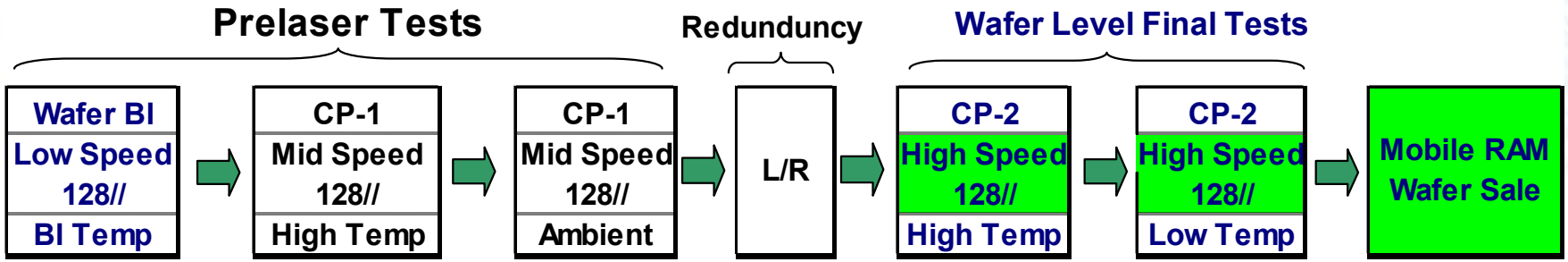


Advanced Mobile RAM KGD Flow

- Conventional Wafer Sale Flow



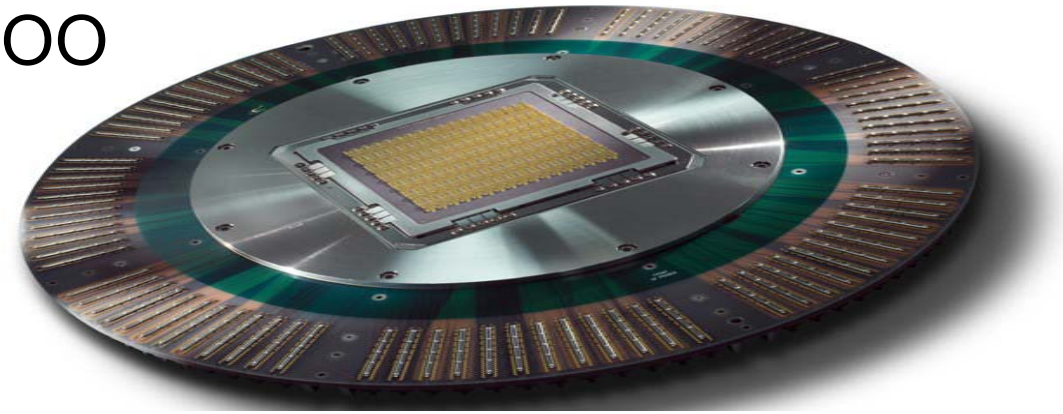
- Elpida Mobile RAM Wafer Sale Flow (Under Evaluation)



  - Wafer Level BI Test
  - High Speed and High Throughput Wafer Level Final Tests
  - High, Ambient, Cold Test Temperature Tests

Wafer-Level Final-Sort-at-Probe Objectives

- On-spec Mobile RAM testing
  - Low-voltage
  - High-frequency
  - Wide temperature
- Low TCOO



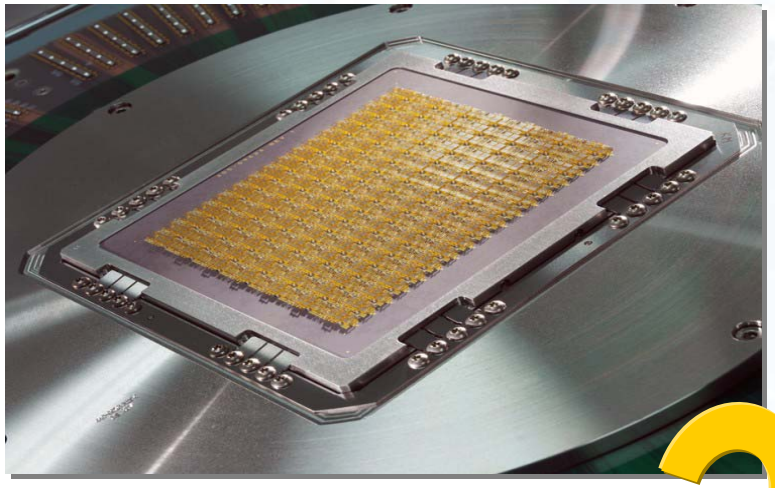
High Performance Probing Solution

High performance probing solution enables “Value-Added Mobile RAM Wafer-Sale Business”

High Performance Probing Solution

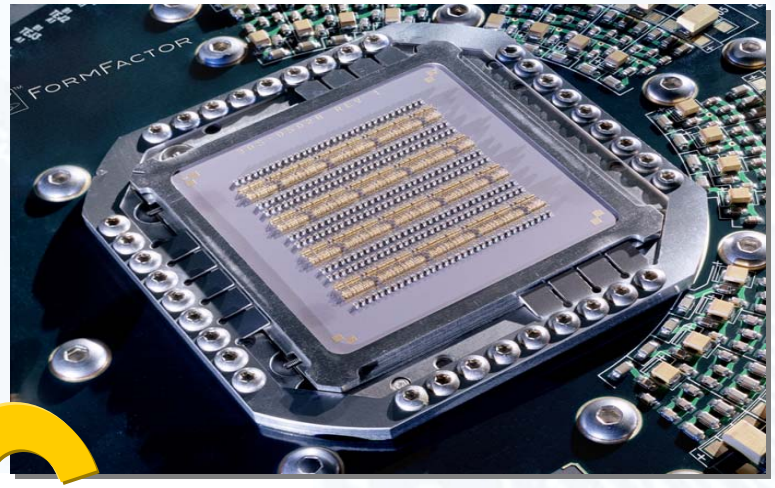
FFI S200™ probing technology

TRE™ probing technology

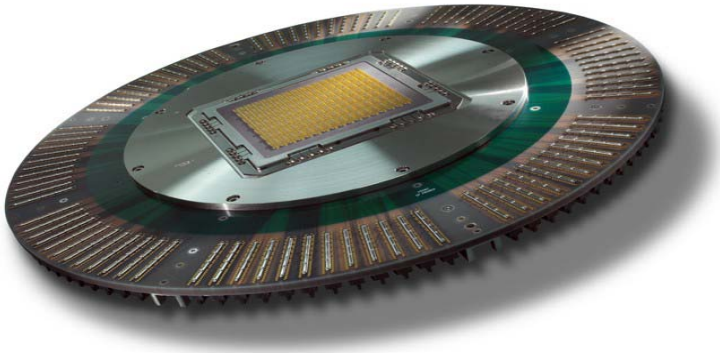


128 Multi DUT testing, 66MHz

HFTAP™ probing technology



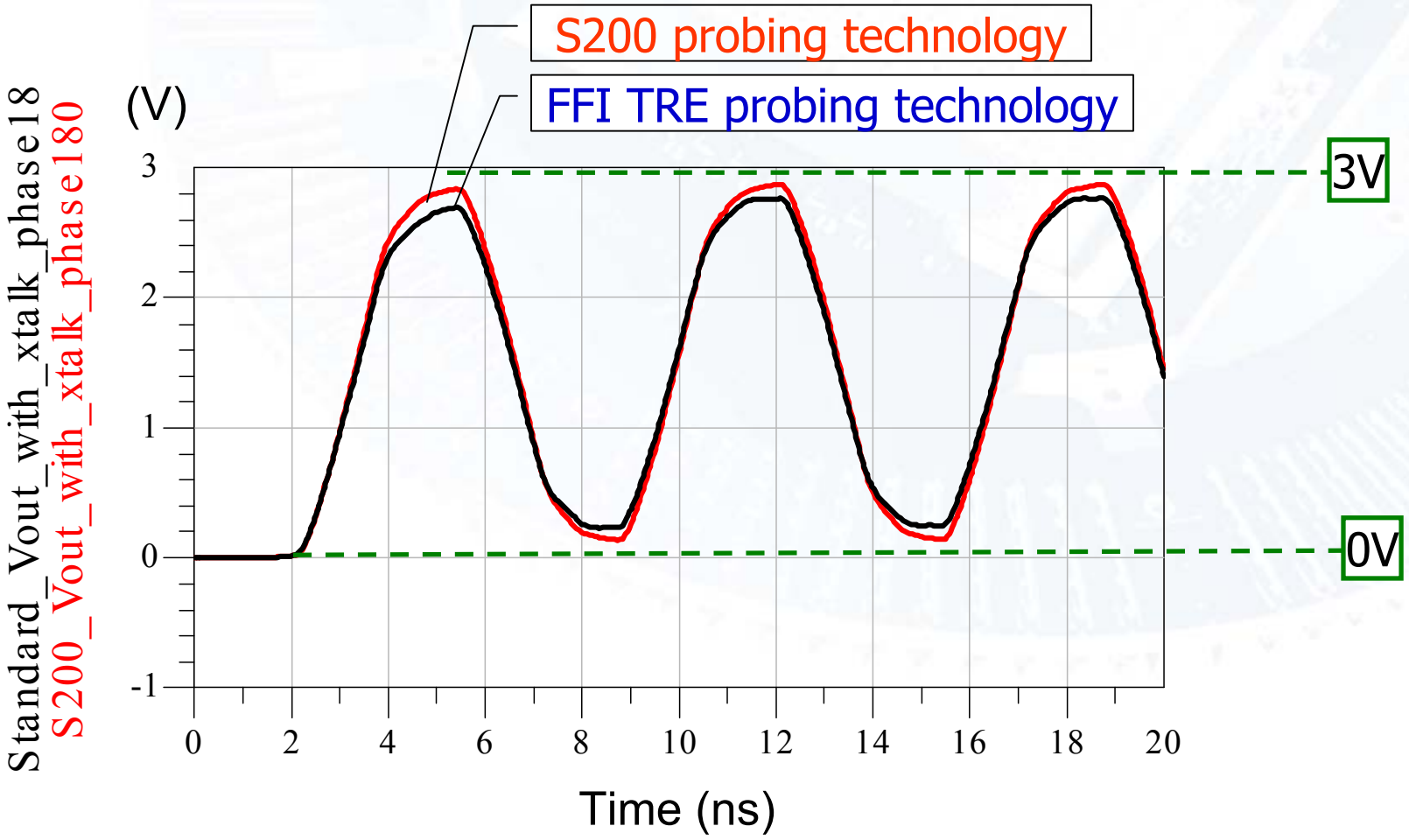
500MHz, High signal integrity



200MHz High signal integrity 128 Multi DUT

FFI Internal Qualification

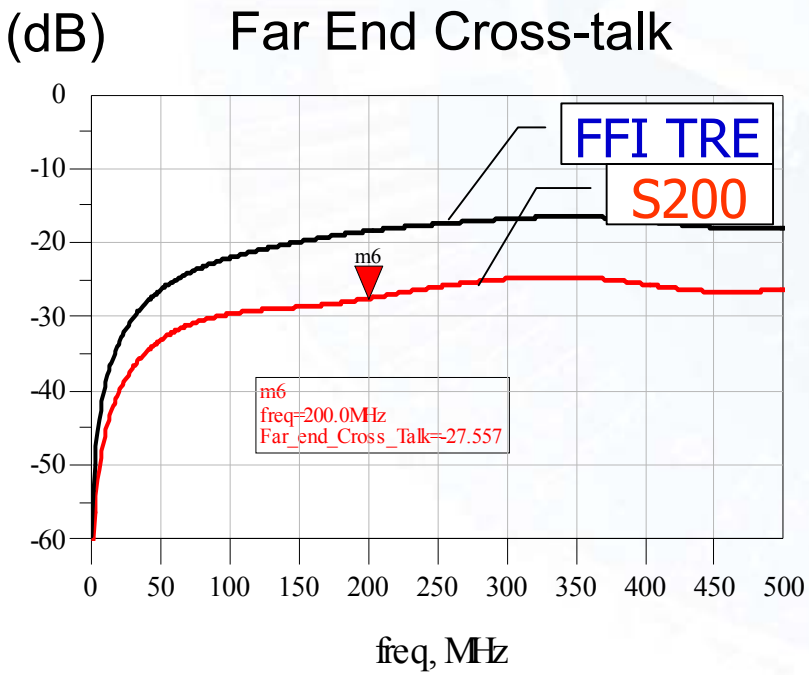
Signal Integrity: Cross-talk simulation*

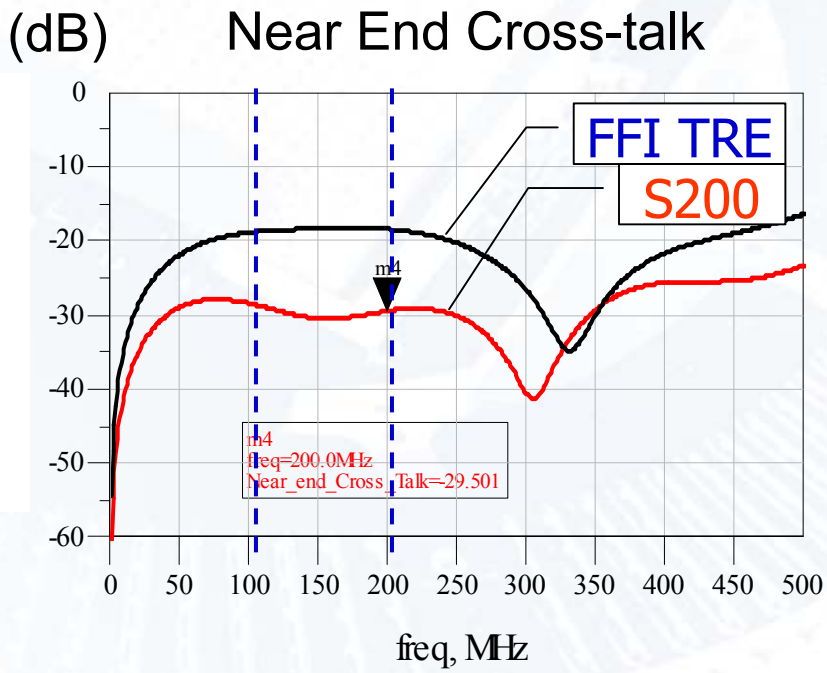


*180° out-of-phase cross-talk effects super-imposed

FFI Internal Qualification

Signal Integrity: cross-talk simulation





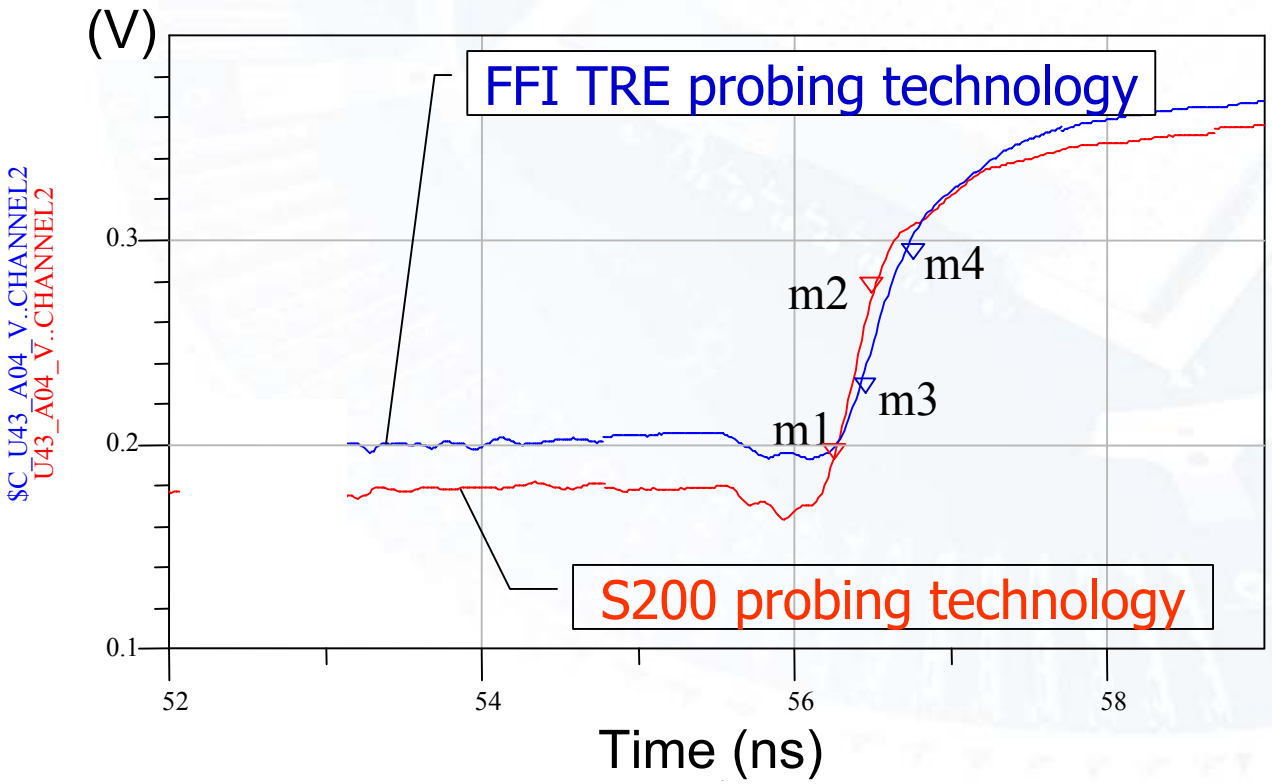
$$NEXT(dB) = 20\log_{10}\left(\frac{V1}{V2}\right)$$

V1: Measured Power in volts

V2: Reference Power in volts

$$-20dB = 20\log_{10}\left(\frac{0.1}{1}\right) \therefore 10\% \ , \ -30dB = 20\log_{10}\left(\frac{0.032}{1}\right) \therefore 3.2\%$$

FFI Internal Qualification
Signal Integrity: Tr/Tf Measurement



FFI TRE Probing Technology	S200 Probing Technology
t m3-m4 = 0.45ns	t m1-m2 = 0.35ns

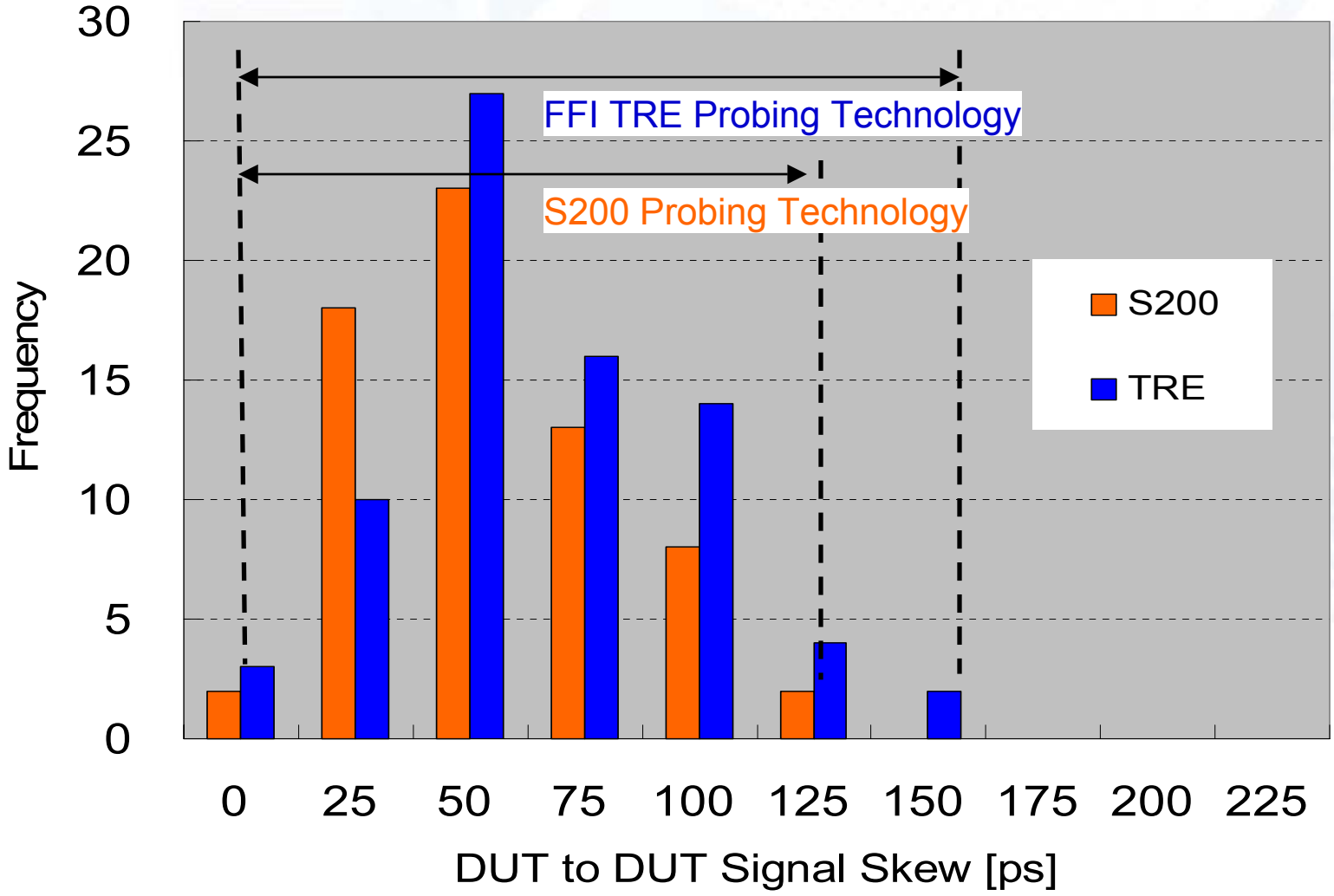
S200 Internal Qualification Results

Internal Qualification		S200 Results
Attenuation	-1 dB Bandwidth	225MHz
	-3 dB Bandwidth	850MHz
Rise/Fall Time	20%-80% Tr/Tfl	350 pS
Skew	Channel to Channel	+/- 70 pS
Temperature	Operation Range	-40 to 125℃
Parallelism	Driver Sharing Level	x2
	// per Station	128//

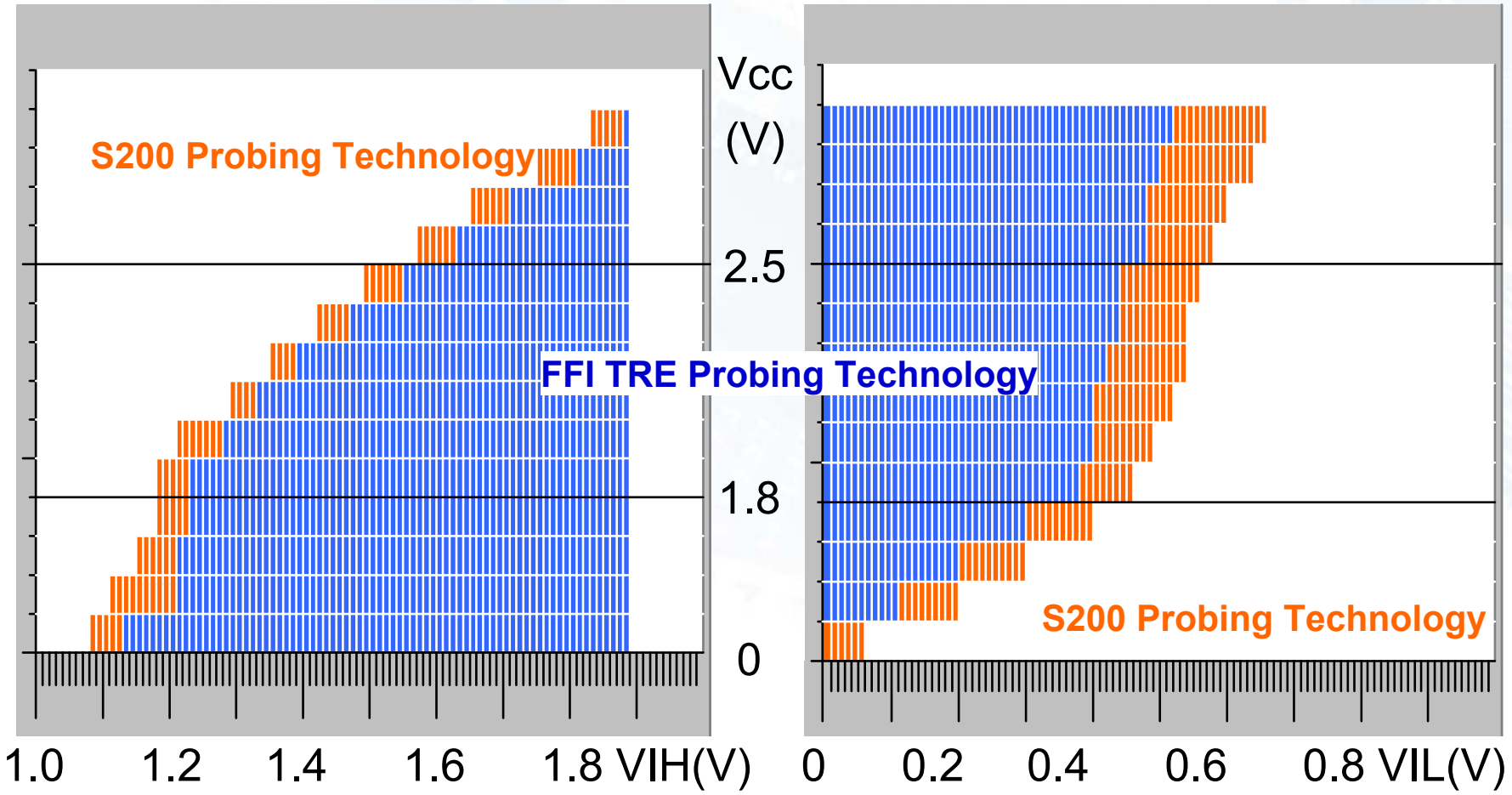
Wafer-Level Final-Sort Test Customer Qualification

- 143MHz tester + 100MHz Mobile RAM
  - Output pin waveform
  - DQ signal skew
  - Input and output voltage margins
  - Vcc margin
  - Timing margin
  - Wafer-to-wafer high-speed binning correlation

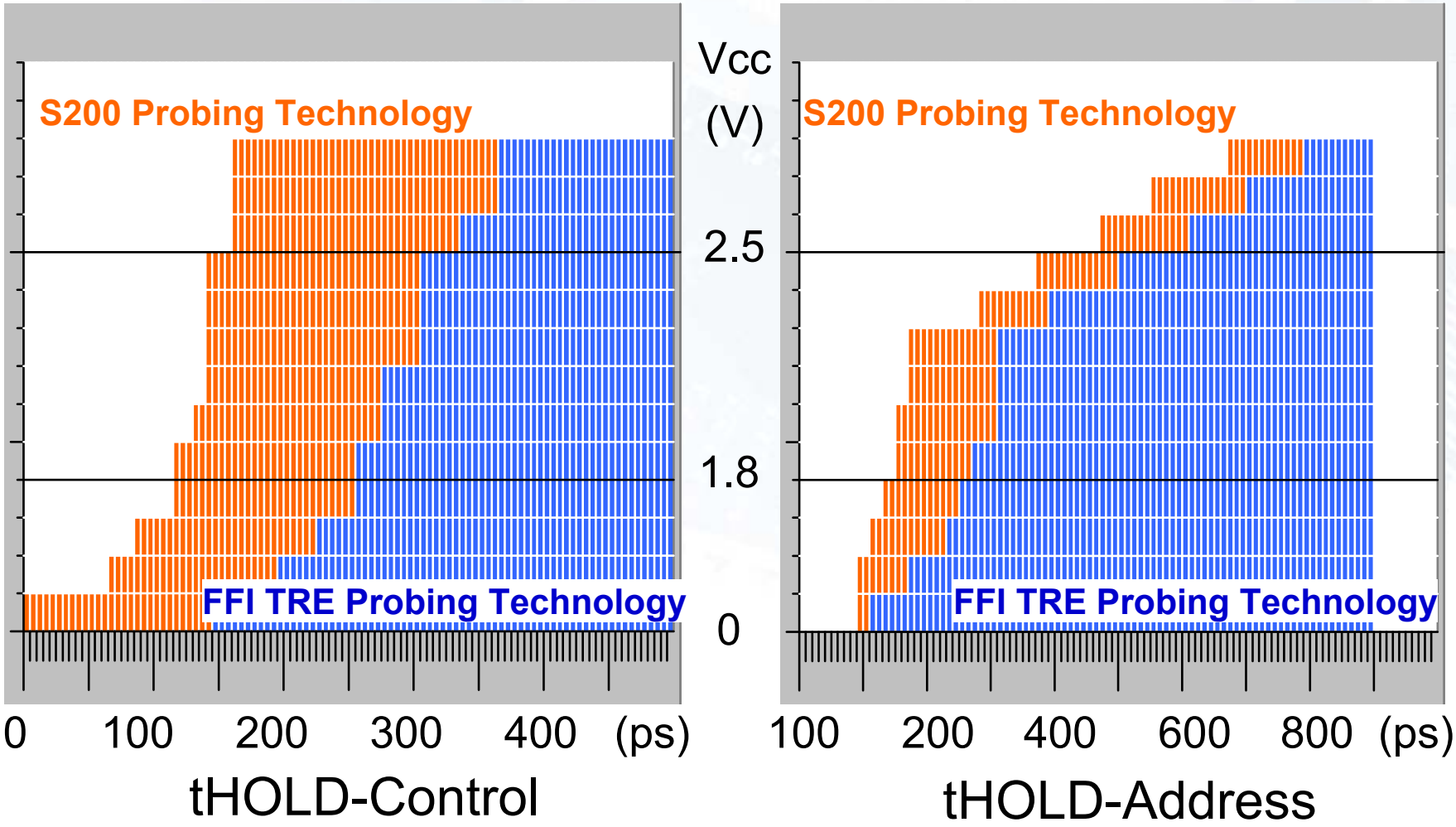
Customer qualification: DUT to DUT Skew



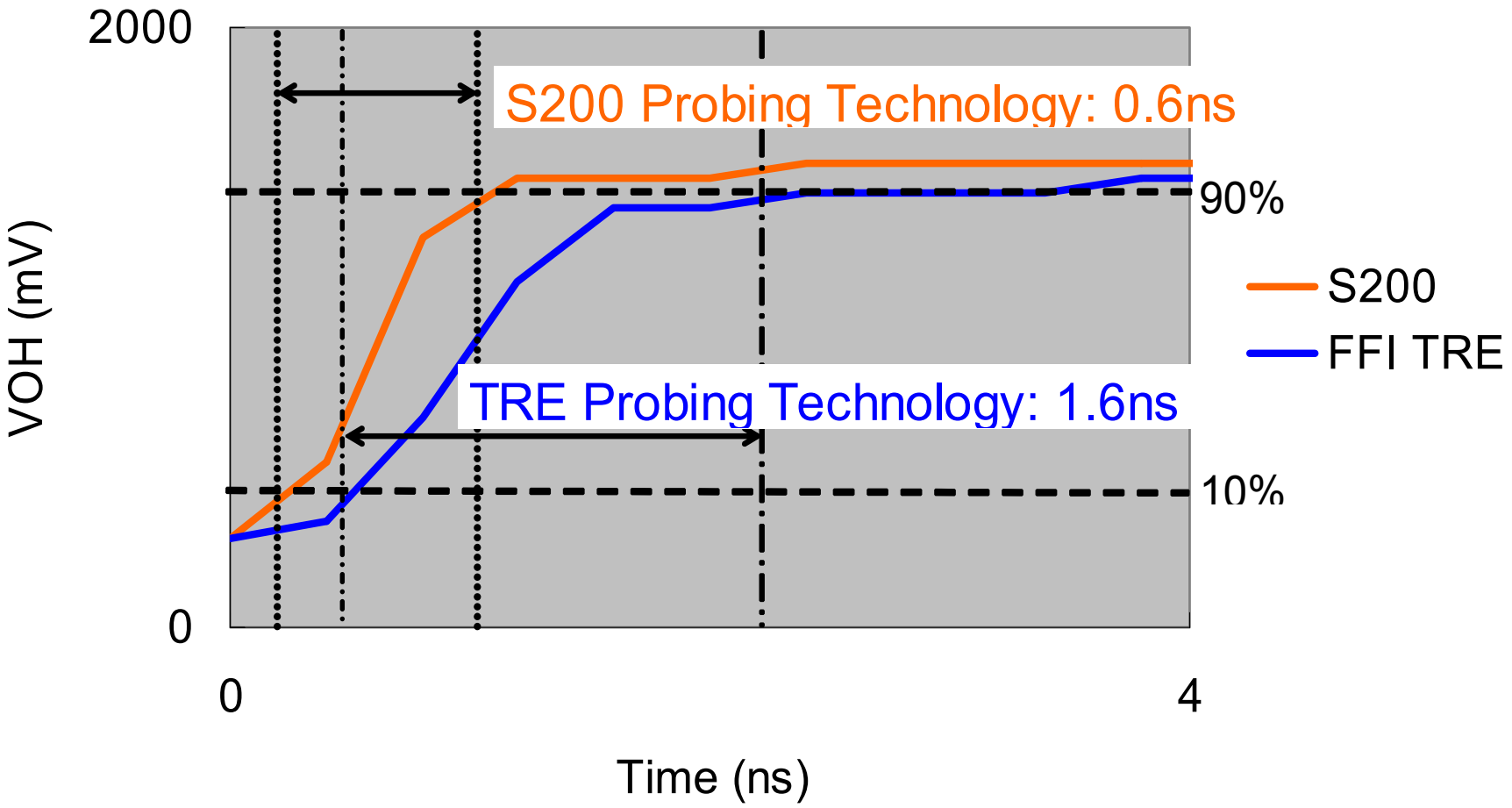
Customer qualification: VIH/VIL Margin Shmoo



Customer qualification: tHOLD-Control / tHOLD-Address Margin Shmoo



Customer Qualification: DQ SMHOO Plot



Summary and Conclusion

Objectives	Results
High-frequency testing	100MHz beta evaluation
Low TCOO	128 parallel per station
	1.5x throughput compared with non-TRE probing
	1.1x throughput compared with low-frequency testing
Wide temperature	Low-to-high temperature testing throughout the test process
On-spec testing	To be applied to133MHz Mobile RAM at device speed testing

Follow-on Work

- Elpida Memory Inc.
  - 100MHz Mobile RAM production using S200
  - Evaluation of 133MHz Mobile RAM at-device-speed testing with S200
- FormFactor, Inc.
  - Customer qualification for 133MHz and beyond
  - Beta site evaluation of multi-bit FLASH memory 100MHz and beyond

Project Members

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