

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

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

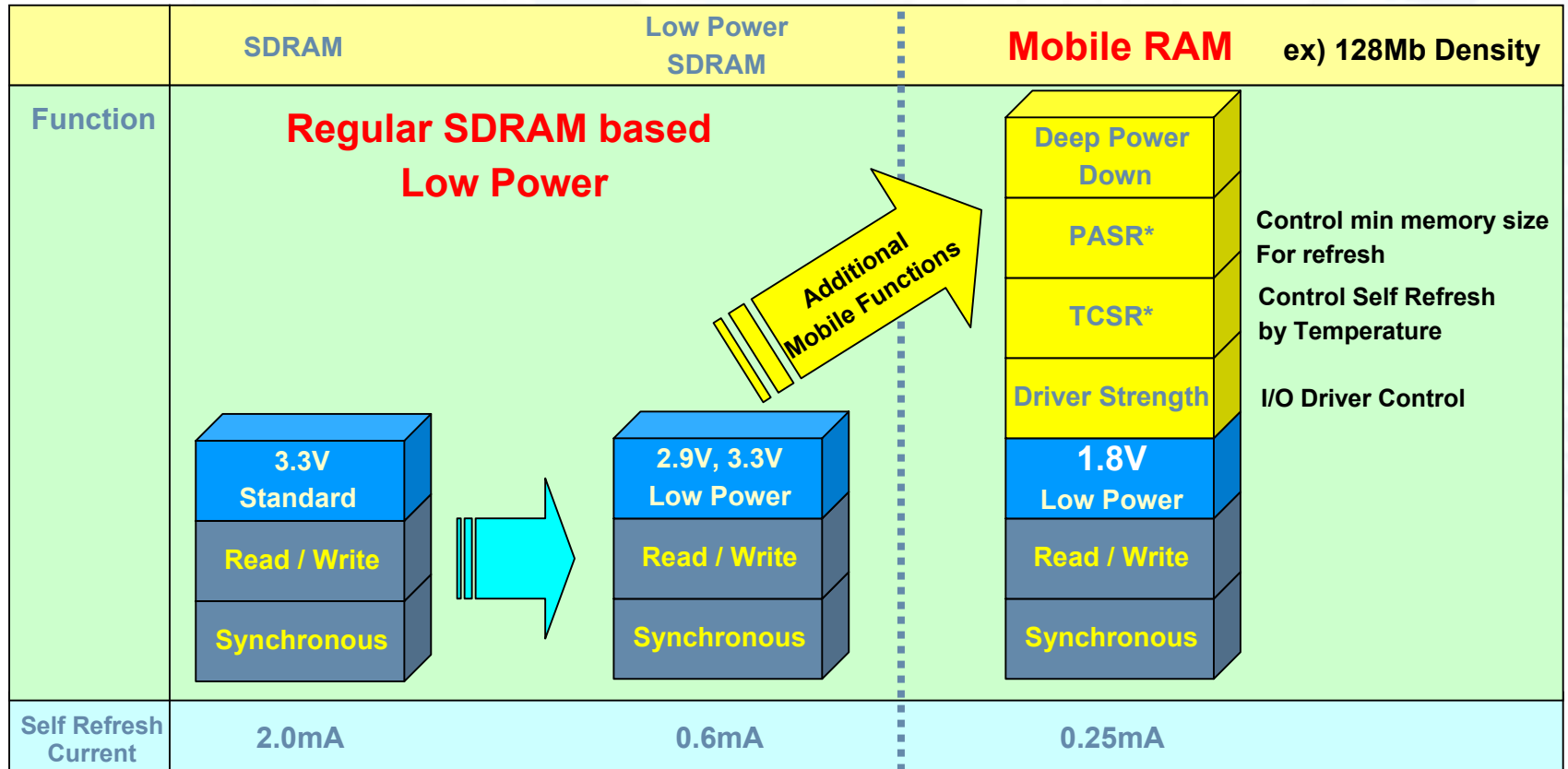
Elpida DRAM Plant

300mm Fabrication in Japan



Mobile RAM Introduction

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

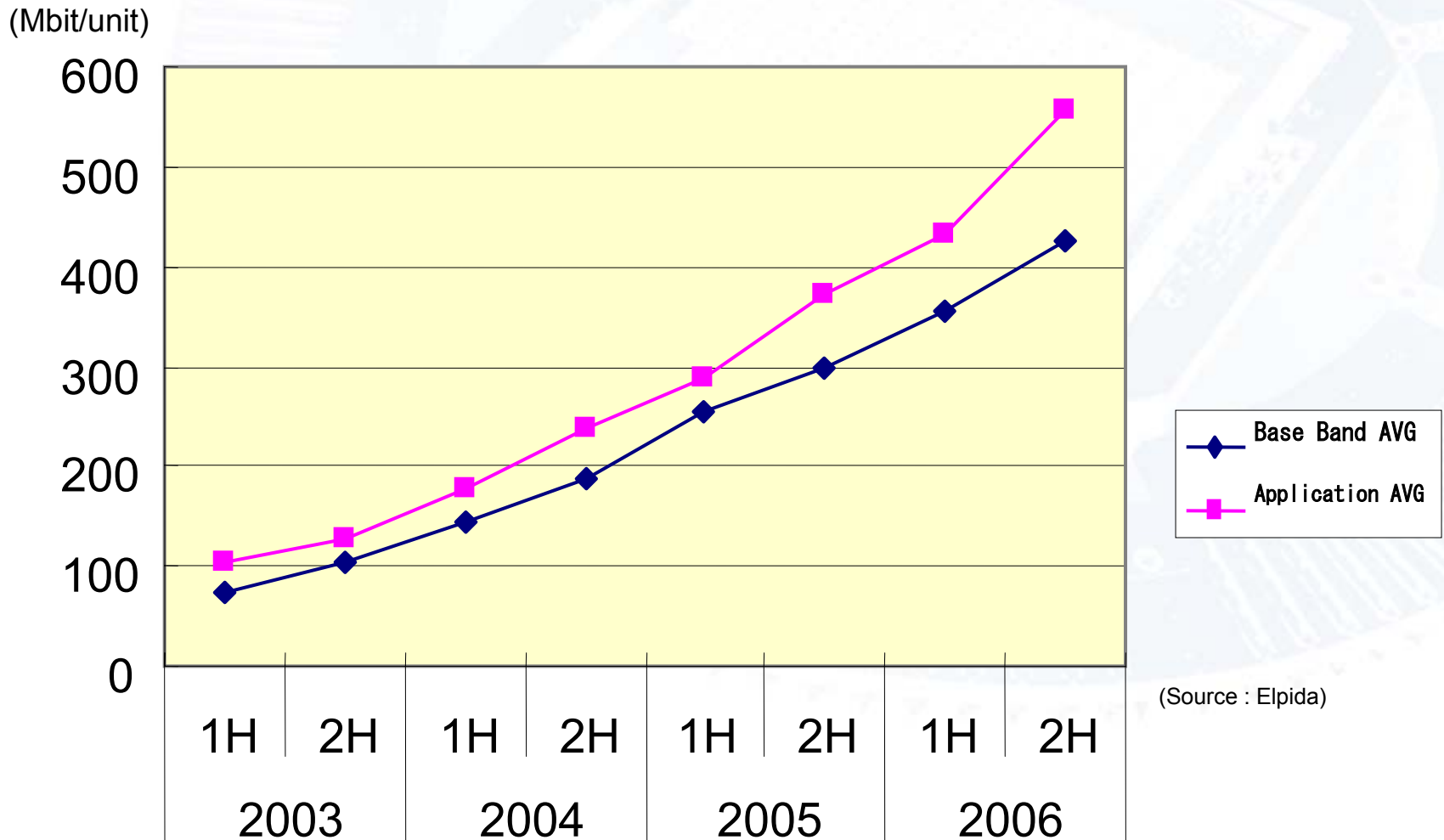


* Low Power Mode

PASR: Partial Array Self Refresh

TCSR: Temperature Compensated Self Refresh

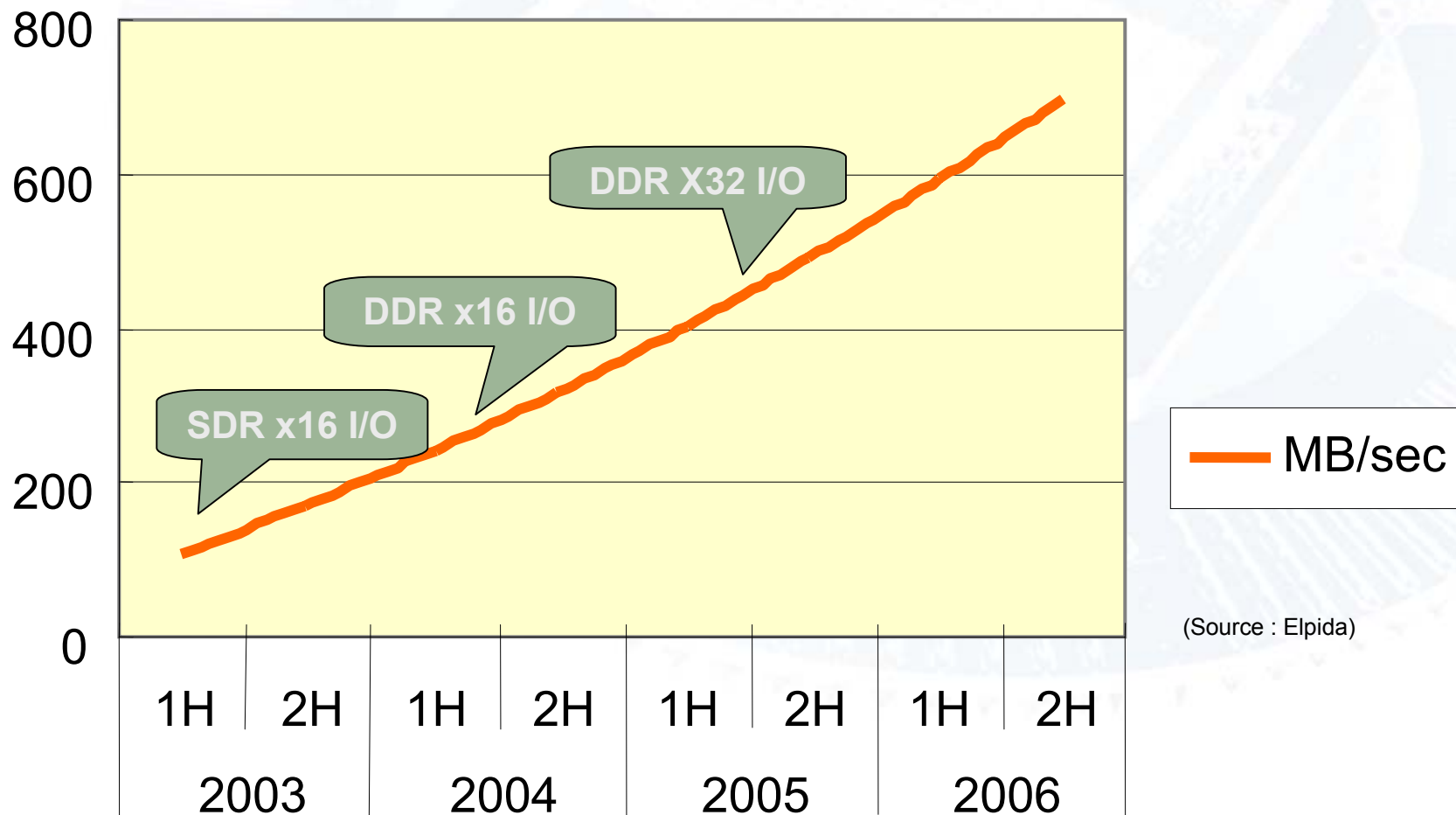
Required Density in Cellular Phone



Application memory is higher than Baseband memory.

Bandwidth (Speed) for Cellular Phone

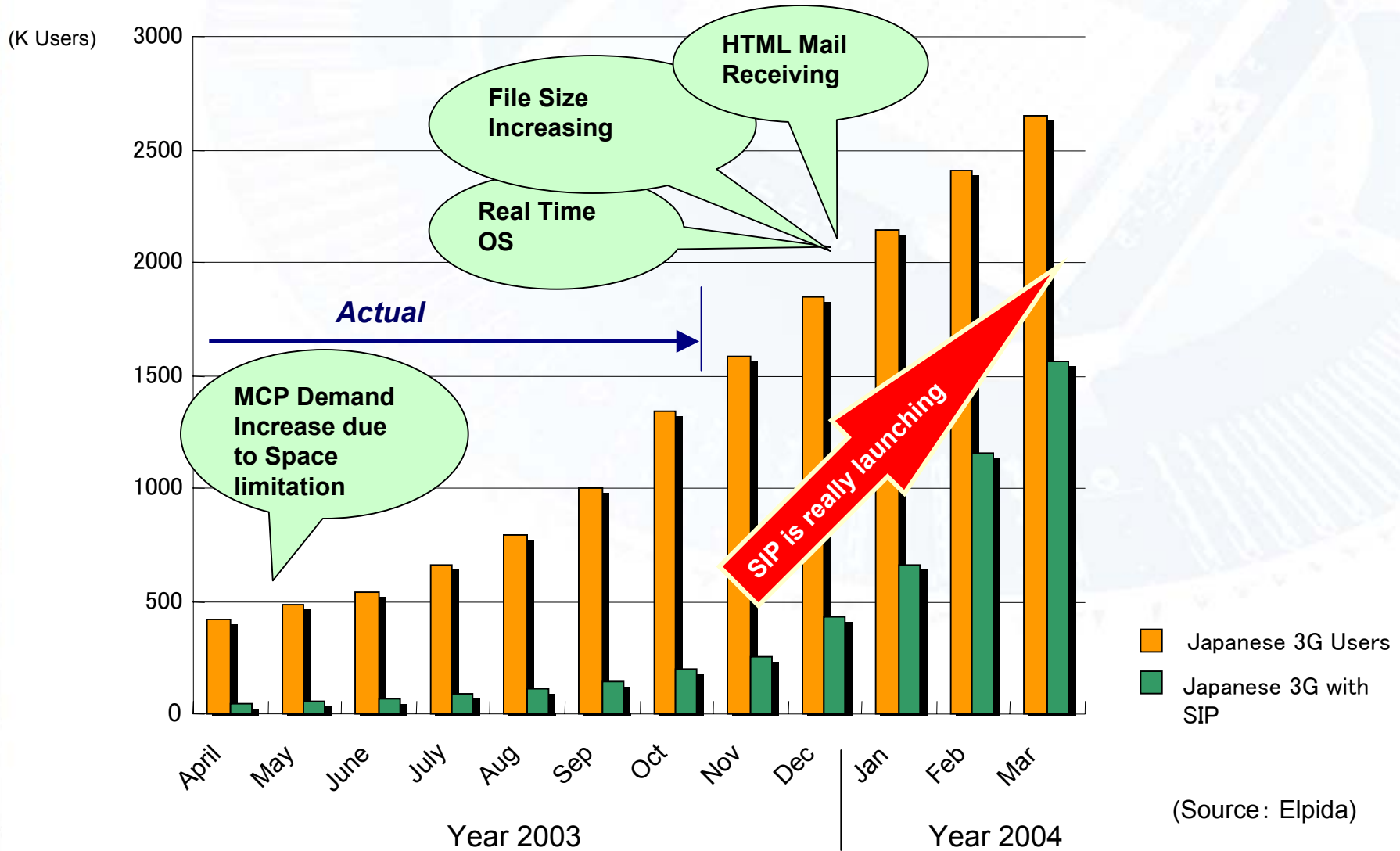
(MByte/sec)



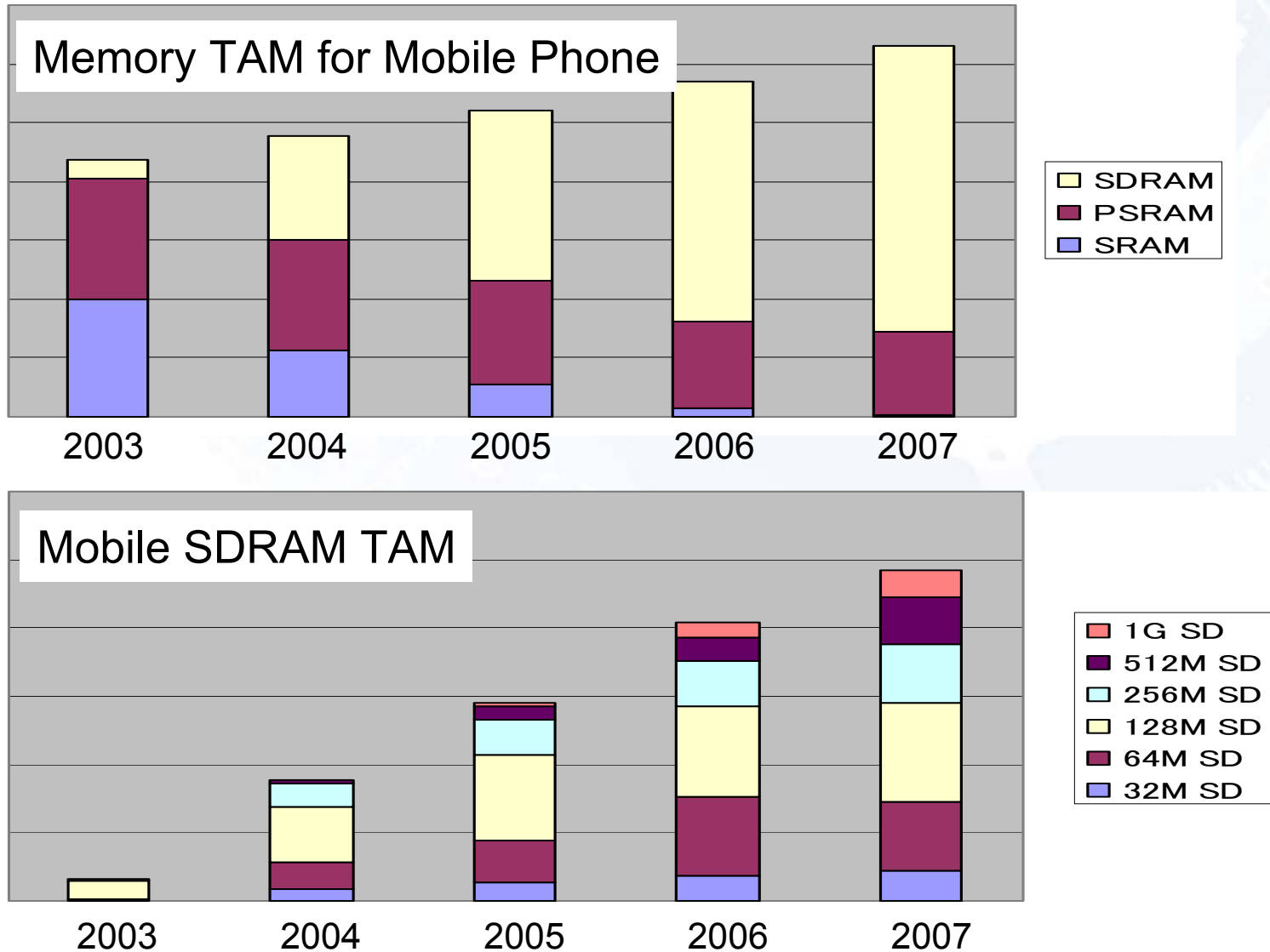
(Source : Elpida)

Due to advanced application, required bandwidth is rapidly growing.

Japanese 3G Market Penetration Plan and SIP demand projection

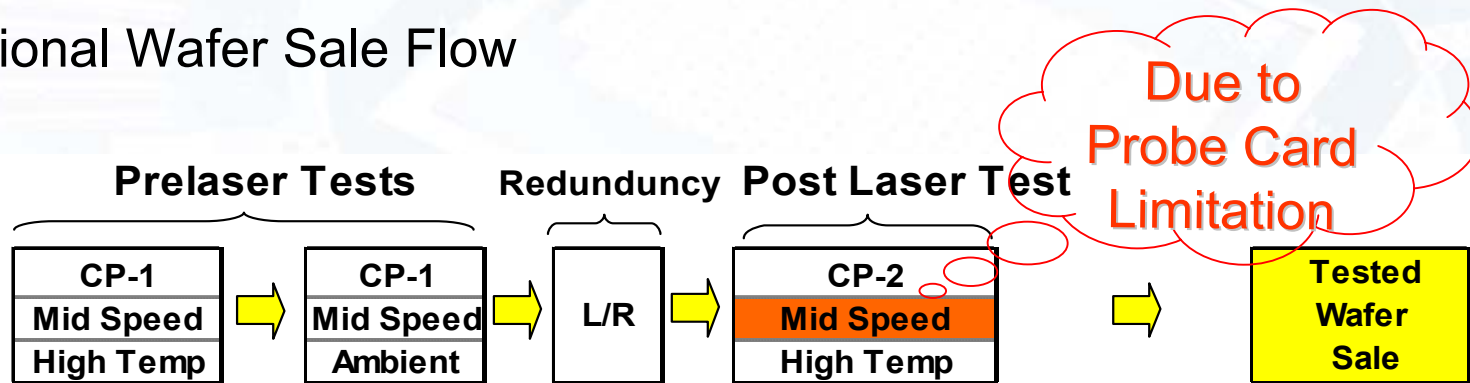


Mobile Memory TAM Trend

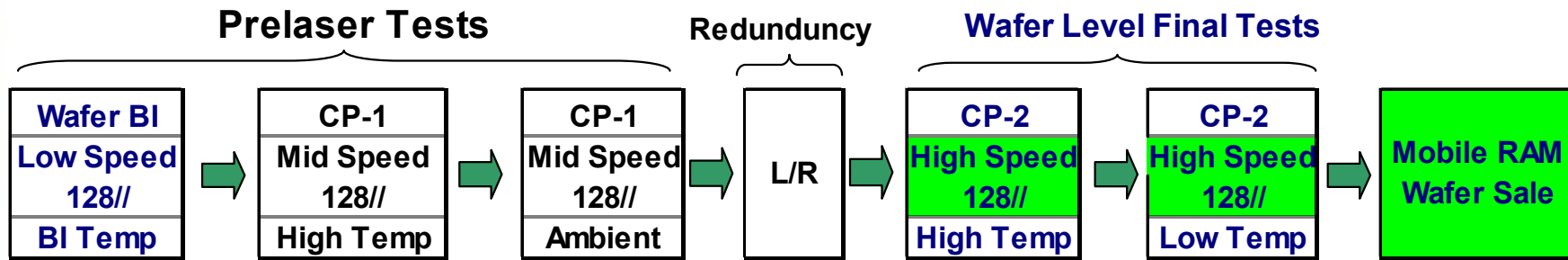


Advanced Mobile RAM KGD Flow

- Conventional Wafer Sale Flow



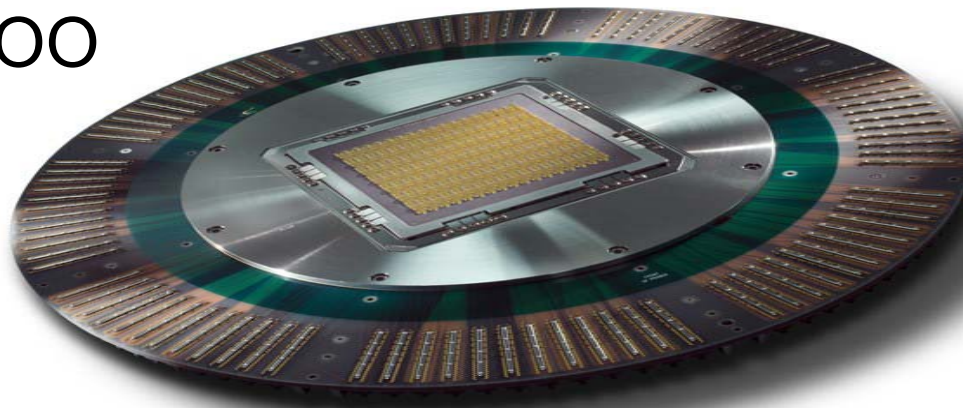
- Elpida Mobile RAM Wafer Sale Flow (Under Evaluation)



- 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

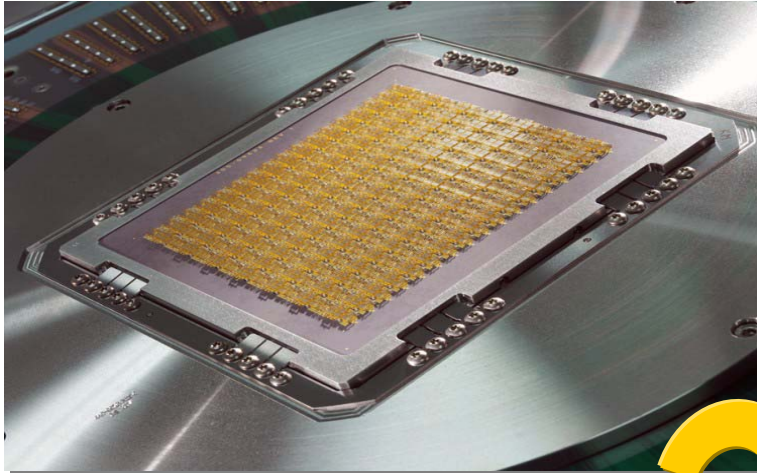
High performance probing solution enables “Value-Added Mobile RAM Wafer-Sale Business”

High Performance Probing Solution

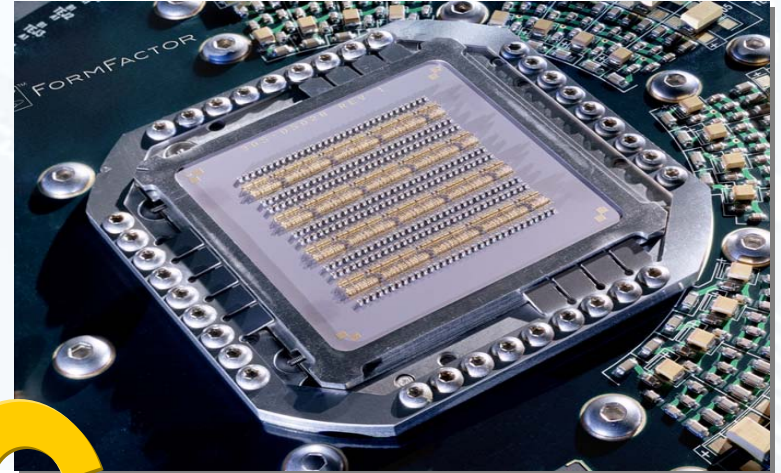
FFI S200™ probing technology

TRE™ probing technology

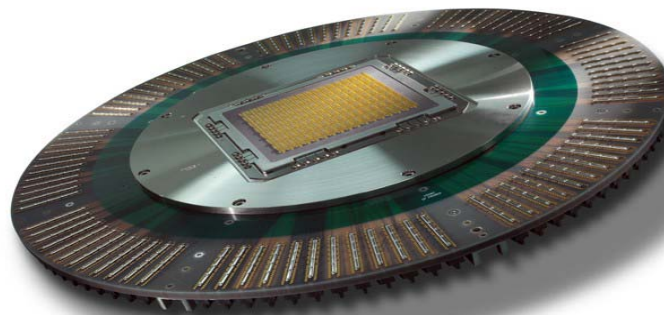
HFTAP™ probing technology



128 Multi DUT testing, 66MHz



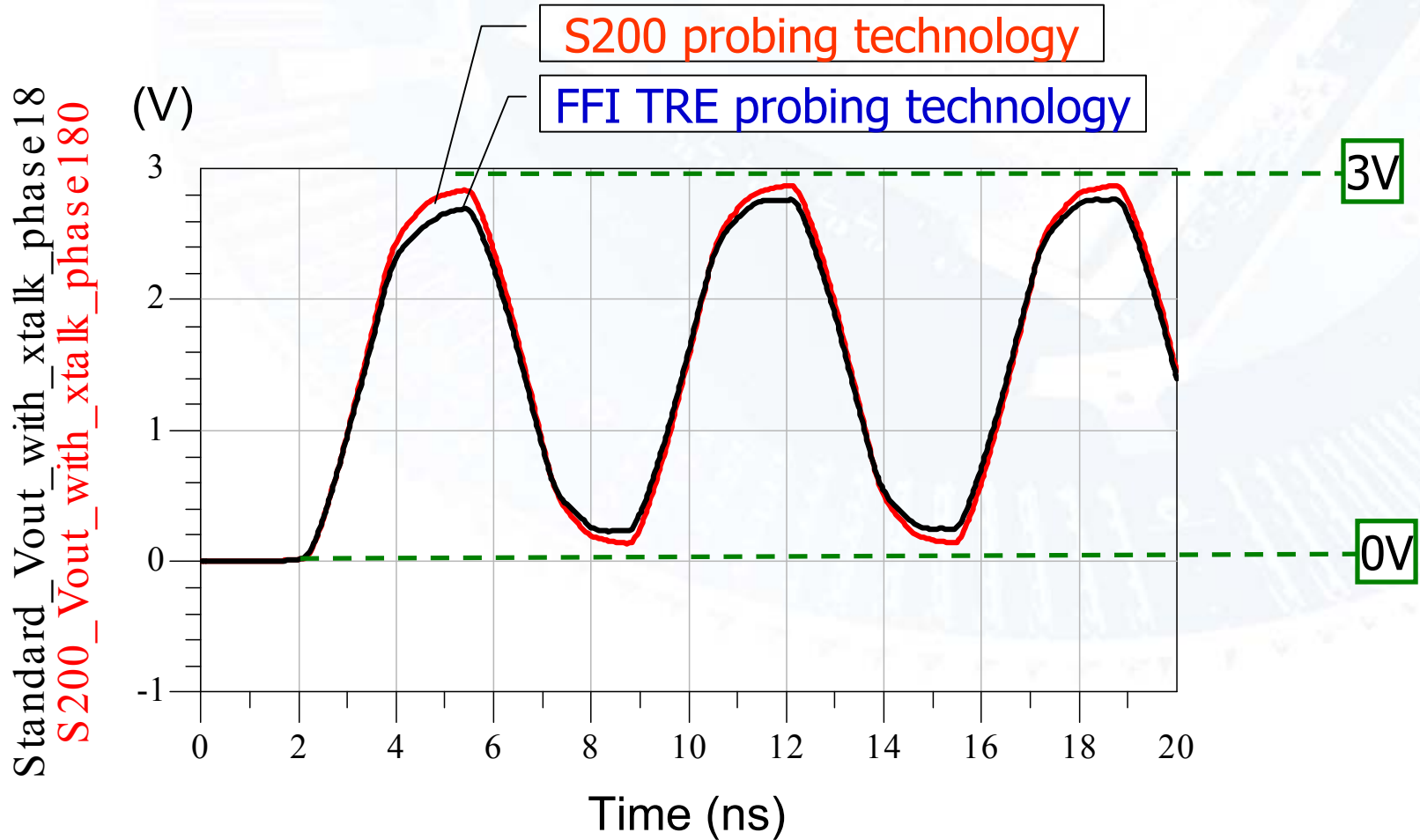
500MHz, High signal integrity



200MHz High signal integrity 128 Multi DUT

FFI Internal Qualification

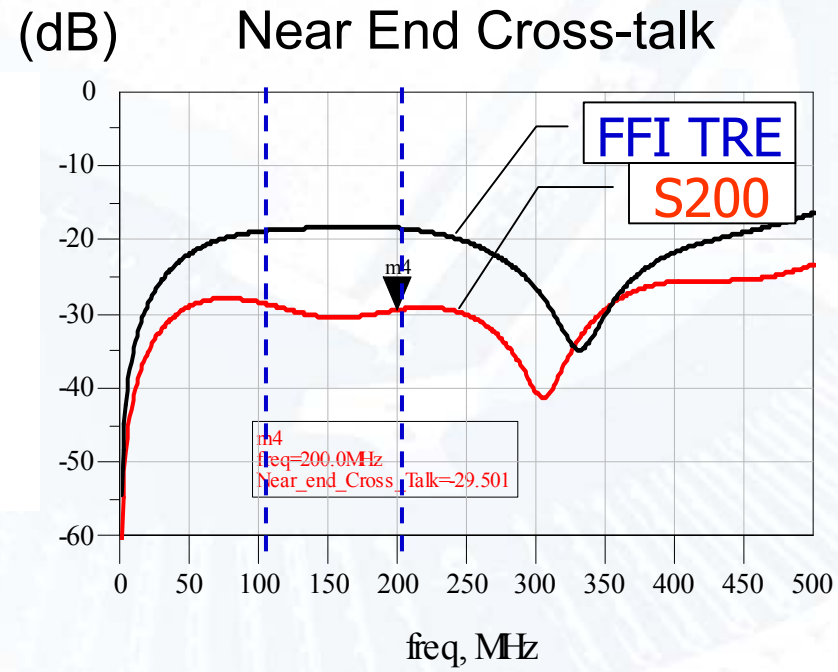
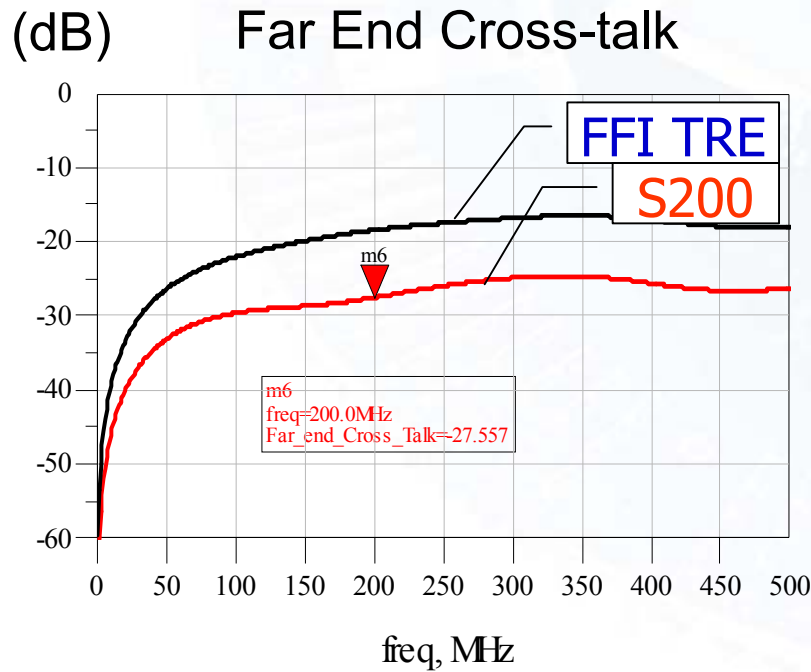
Signal Integrity: Cross-talk simulation*



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

FFI Internal Qualification

Signal Integrity: cross-talk simulation



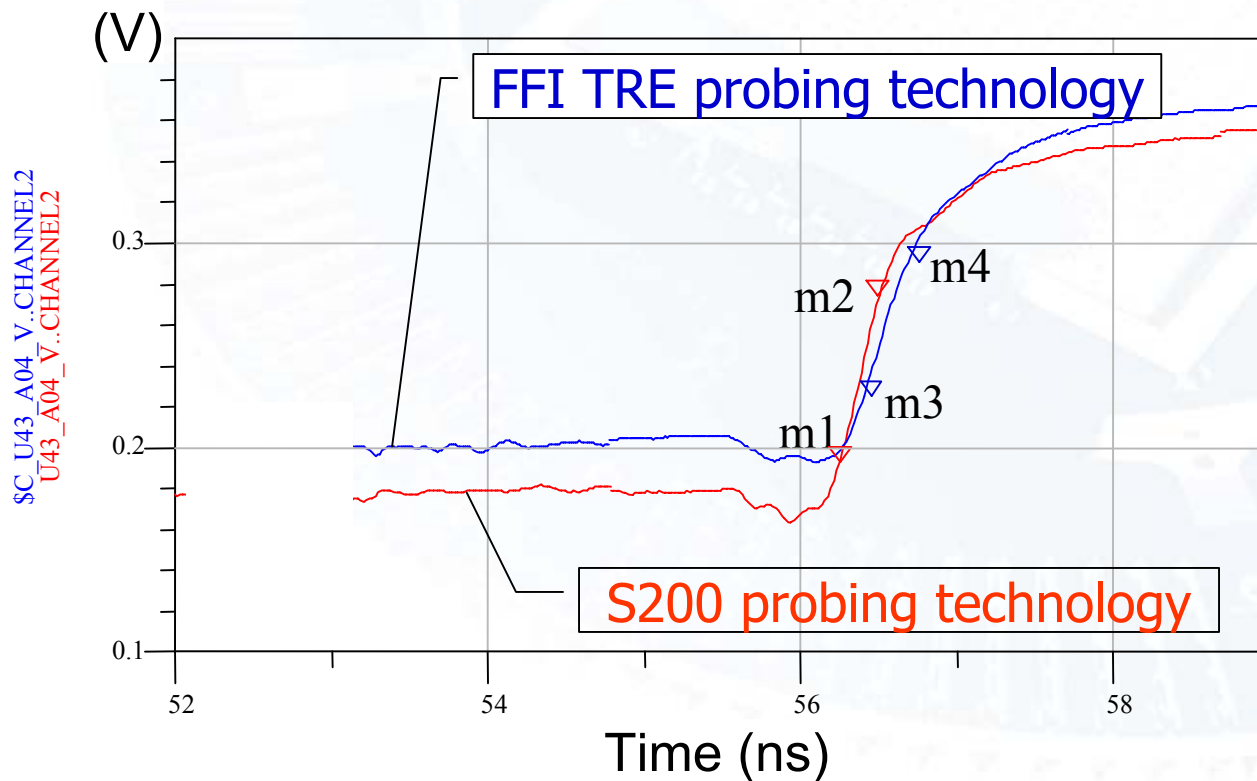
$$NEXT(dB) = 20 \log_{10} \left(\frac{V1}{V2} \right)$$

V1: Measured Power in volts
V2: Reference Power in volts

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

FFI Internal Qualification

Signal Integrity: Tr/Tf Measurement



FFI TRE Probing Technology	S200 Probing Technology
$t_{m3-m4} = 0.45\text{ns}$	$t_{m1-m2} = 0.35\text{ns}$

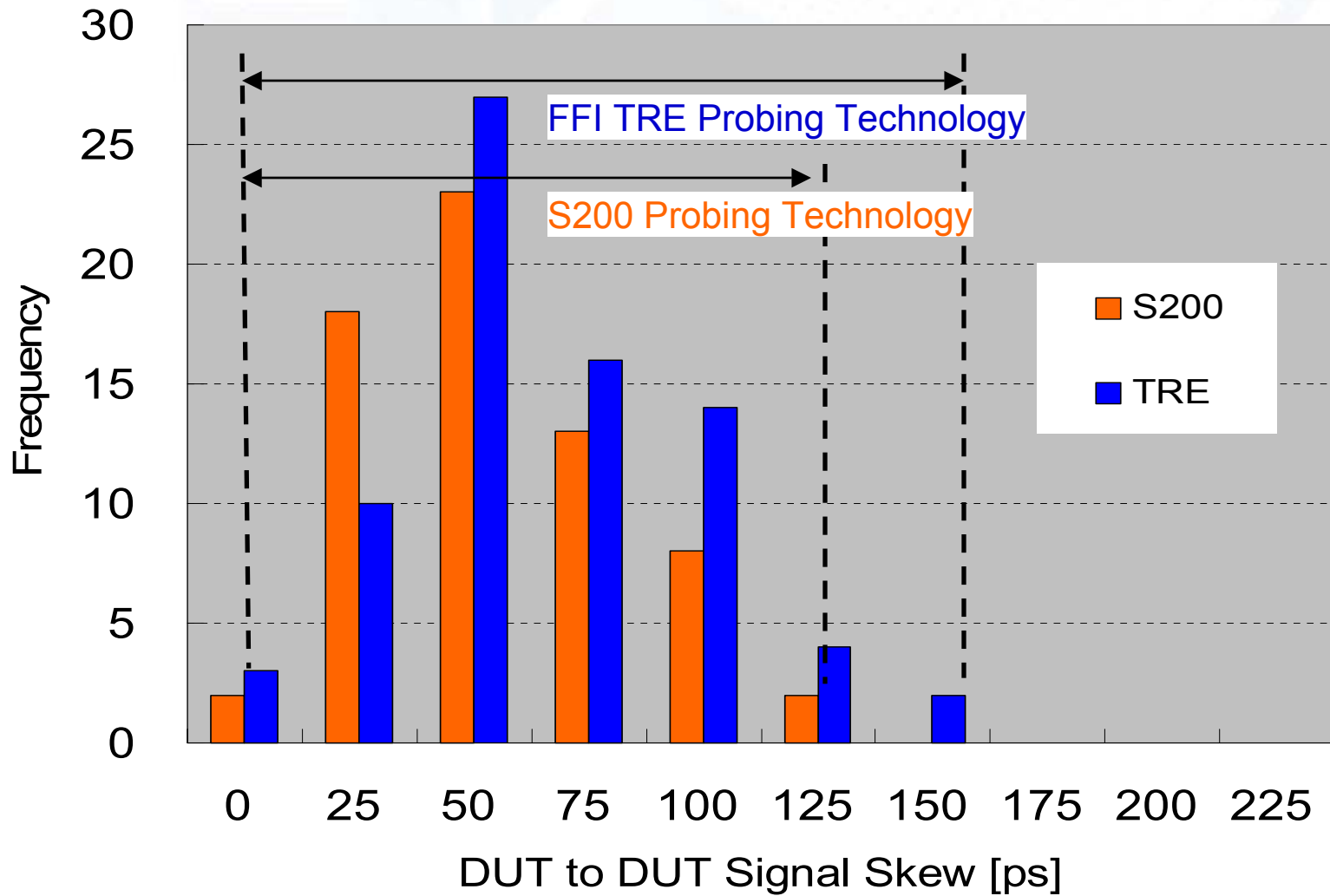
S200 Internal Qualification Results

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°C
Parallelism	Driver Sharing Level	x2
	// per Station	128//

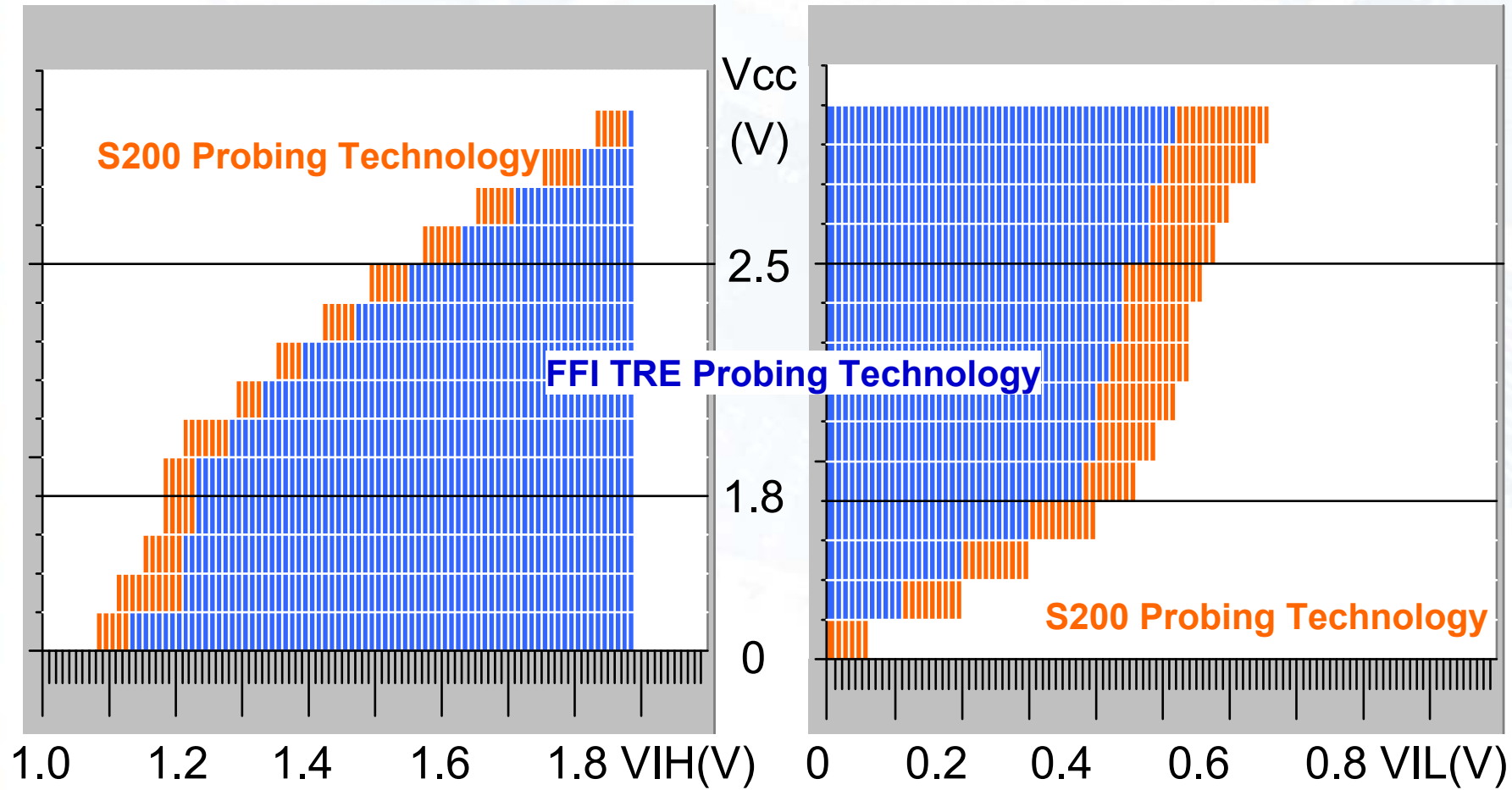
Wafer-Level Final-Sort Test Customer Qualification

- 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

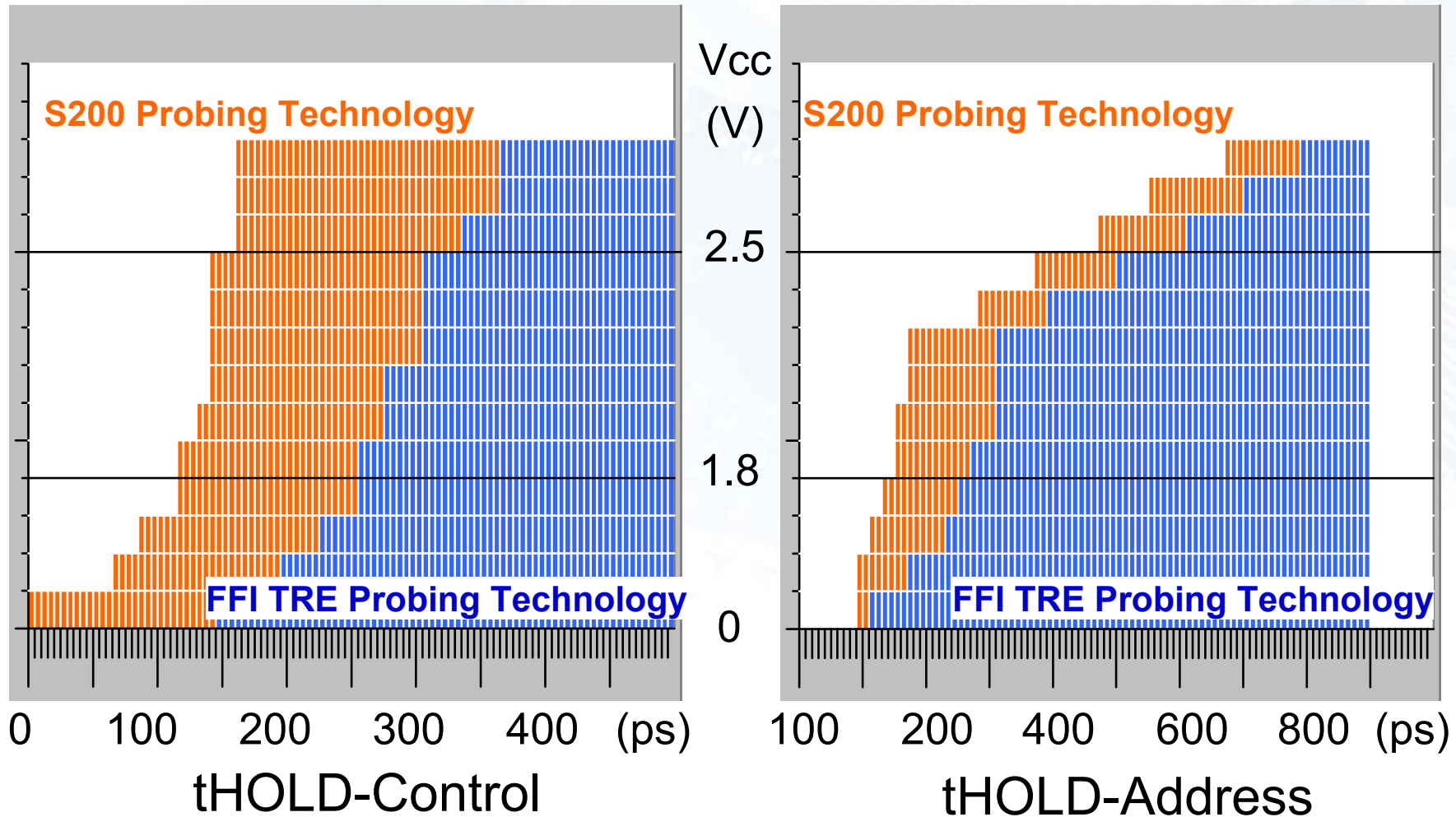
Customer qualification: DUT to DUT Skew



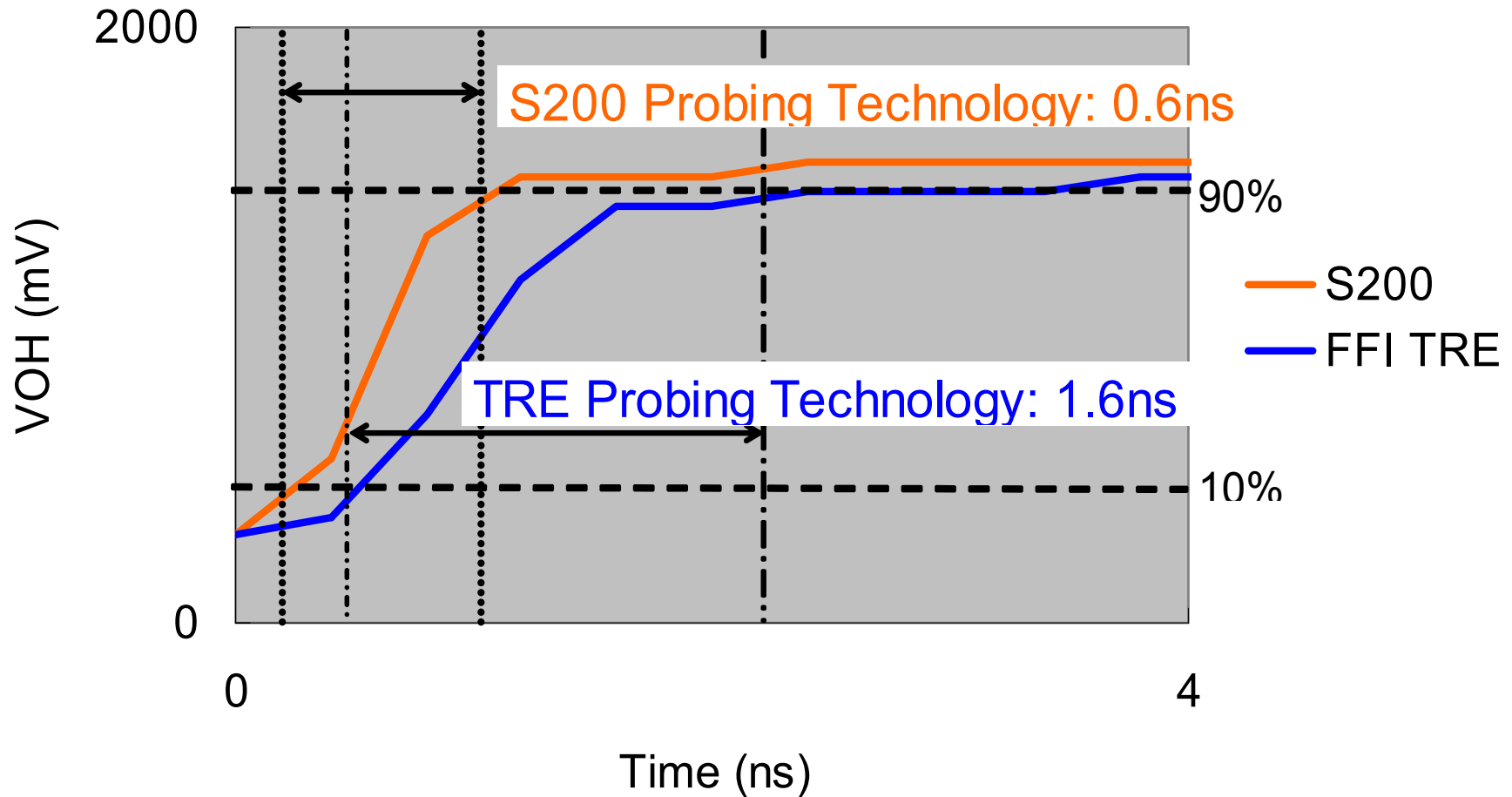
Customer qualification: VIH/VIL Margin Shmoo



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 to 133MHz 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

- Elpida
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 - Yosuke Kawamata
 - Hajime Sasamoto
 - Satoshi Gomi
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