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A Memory Lapse  
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For a product with the rather quaint moniker of memory, DRAM chips don't appear to benefit much from history when it comes to determining demand, supply and pricing.

The demand-supply imbalance with which DRAM suppliers and purchasers perennially wrestle is compounded today by a raft of new technologies and vendor business strategies that are set to hit the market over the next year.

Following the giant, 52 percent hike in DRAM revenues last year, producers and analysts have differing predictions for 2005. Semico Research Corp. (Phoenix) pegs DRAM industry revenues at \$25 billion, for a 4.4 percent year-over-year decline; iSuppli Corp. (El Segundo, Calif.) expects a \$27 billion tally, for a 3.4 percent gain. Bit growth is expected to jump between 45 and 50 percent this year, a figure that most observers think will slightly exceed demand. That should lead to an oversupply, ranging in severity from modest to significant, depending on the forecaster.

Based on how DRAM supply shapes up, the average selling price (ASP) is expected to fall 30 to 35 percent, according to iSuppli. That would follow a 9 percent ASP rise in 2004.

But that is not the full story. Industry executives said DRAM supply and pricing in 2005 will be affected by a number of factors, including:

- how fast manufacturers transition to the next-generation DDR2 memory;
- how fast vendors can ramp up 90-nanometer production processing, and what yields they get;
- how quickly DRAM production starts at new and expanded 300-mm fabs; and
- how suppliers change the production mix of DRAMs, flash memory and other semiconductor types made on the same lines.

Clearly uncertain

No one has an accurate crystal ball to predict how all these forces will play out in the market. "I foresee pockets of oversupply for some DRAM densities and types," said Terry Lee, Micron Technology Inc.'s executive director of advanced technology and strategic marketing. "At the same time, there are pockets of shortages of other types. And this could keep changing through the year."

It is going to be very complicated as DRAM makers try to manage their lines to achieve the most efficient product mix, according to Bernd Lienhard, Infineon Technologies North America's vice president of memory products.

The high number of technology transitions this year means that the industry could experience oversupply in some areas and undersupply in others. That is the reality of the market, said Dan Donabedian, president of Elpida Memory USA (Santa Clara, Calif.).

The supply chain got a preview last year of what can happen when DRAM manufacturers juggle production lines. DRAMeXchange, a Taiwan-based market intelligence service, pointed out that the

falling prices and shrinking profit margins for DRAMs in 2003 caused some memory companies last year to shift a portion of production capacity into higher-profit, 1-Mbit NAND flash memory. That tightened DRAM supply and boosted prices, but it caused an oversupply and price declines in 1-Mbit NAND.

This year, DRAMeXchange predicts chip makers will shift more DRAM capacity into NAND flash, for a 73 percent DRAM/27 percent NAND mix, compared with a 79 percent DRAM/21 percent NAND mix in 2004.

Supply conditions will also be affected by how quickly DDR2 ramps up in the market, possibly taking a greater share of capacity from DDR1. Ken Hurley, president of Nanya Technology Corp. USA (San Jose, Calif.), is typical of DRAM executives who predict accelerating growth this year for DDR2 after a slow start in 2004. "We should see the crossover of DDR2 in units over DDR1 in the second half," Hurley said.

Nanya itself plans to allocate half of its DRAM capacity to DDR2 by the end of the second quarter. Lee of Micron, meanwhile, said the company expects customer demand to raise its DDR2 production to 30 percent of all DRAM output this spring. And Samsung is projecting DDR2 will reach 40 percent of its DRAM output by the third quarter and exceed 50 percent by the first half of 2006.

DDR2 was expected to pick up dramatically in notebooks, after Intel Corp. early this year introduced its chip set, code-named Alviso, to supply dual-channel DDR2 memory for mobile PCs. The power savings resulting from DDR2's new lower-voltage, 1.8-volt operation is a big incentive for system builders to jump on the DDR2 bandwagon.

#### Technology transition

The DRAM market will also be governed by how well producers make the transition from 110-nm processing to the next-generation, 90-nm node. DRAMeXchange cautioned that many vendors initially will have trouble ramping up 90-nm production lines because of the new materials and chemicals required, along with some lithography tool changes.

Rickie Yang, an analyst with DRAMeXchange, believes 90-nm processing will proceed slowly, accounting for only 8 percent of all DRAM unit output in the fourth quarter of this year.

Hurley of Nanya predicted the move to 90 nm "will be as challenging as the transition to 110 nm. But Nanya is comfortable with 90 nm, and we will make the transition well."

Jim Elliott, associate DRAM marketing director of Samsung Semiconductor Inc. (San Jose), said Samsung expects to have 90 percent of its total DRAM production in 90-nm processing sometime in 2006.

Tier-one DRAM producers are all jockeying for greater market share in 2005. Samsung Electronics Co. will remain the uncontested global leader, having grabbed 28.6 percent of the market last year with \$7.53 billion in revenue.

But Nam Hyung Kim, iSuppli principal analyst, believes the next three ranking suppliers are so close in revenue that any one of them could trade positions this year. Revenue at Hynix Semiconductor Inc. last year jumped 68.3 percent, to \$4.29 billion, putting the company in second place, with a 16.3 percent market share. Micron was third, with \$4.21 billion in revenue and 16 percent share. Infineon was fourth, with a 14 percent share, or \$3.68 billion in revenue.

The fastest-growing DRAM vendors last year were sixth-ranked supplier Powerchip Semiconductor Corp. (with a 185 percent growth spurt in revenue, to \$1.23 billion, for a 5 percent market share) and fifth-ranked Elpida Memory Inc. (with revenue of \$1.81 billion, up 141 percent over 2003, for a 6.9 percent share).

## More machines

DRAM makers are expected to spend lavishly this year on capital investment as they joust for market position. Morgan Stanley Research (New York) estimates Samsung Semiconductor's 2005 capital expenditures at \$5.1 billion, of which approximately half would be allocated for memory chips.

Infineon's capital expenditure this year is estimated at \$1.4 billion, Micron's at \$1.3 billion and Powerchip's at \$1.2 billion (a 50 percent increase.) Hynix Semiconductor is expected to spend \$1 billion, as is Inotera, the joint venture of Infineon and Nanya. Elpida's capex is put at \$909 million.

Much of the capex is slated to complete 300-mm wafer DRAM fabs. As they ramp in 2005, the new facilities will pour far more memory chips into the market.

Sherry Garber, senior vice president of Semico Research, lists nine 300-mm DRAM fabs that are ramping up now and a 10th expected by the third quarter. "So much 300-mm capacity in DRAMs is coming online that a major oversupply will happen in the second half of the year," Garber projected.

That could be good news for OEMs, which could reap the benefits of lower prices driven down by a memory chip glut. Garber also believes the DRAM oversupply would be propelled by higher yields in 90-nm processing as suppliers ultimately move up the learning curve in the next-generation technology.

DRAM foundry partnerships have allowed many DRAM producers to gain extra capacity without having to make a costly investment in their own facilities. Infineon looks to its partners now for half of its DRAM needs, which come from the Inotera joint venture with Nanya and from foundry agreements with Semiconductor Manufacturing International Corp. of China and Winbond Electronics of Taiwan. Elpida gets a little less than one-third of its DRAM output from foundries. Hynix early this year transferred 90-nm process technology to ProMOS Technologies Inc. as part of an alliance to get DRAMs from the Taiwanese company.

This year, DRAM chip makers are counting on two growing markets-high-end handheld devices and consumer electronics products-to accelerate demand.

Mueez Deen, Samsung Semiconductor's director of DRAM graphics and mobile memory products, said handset builders initially used single-data-rate SDRAM to support increasingly sophisticated data requirements. "We now see new handset designs starting to use DDR1, and products should be on the market by the end of the year," he said.

The handheld market accounts for about 10 percent of Samsung's total DRAM output, the company said.

Elpida sees a similar progression to higher-performance DRAMs in the consumer electronics market. Originally, legacy DRAMs in the 16-Mbit to 64-Mbit densities dominated this sector, but Elpida's Donabedian said his company is increasingly selling workhorse 256-Mbit SDRAMs, with DDR1 coming into play.

"I expect that we will see some high-end consumer electronics using DDR2 by late 2005," he said.

A new Rambus Inc. memory design, XDR DRAM, will also be courting the consumer electronics sector. Scott Beekman, communication device business development manager at Toshiba America Electronic Components, said digital TV, graphics, supercomputers and other digital consumer products are target markets for XDR DRAM.

PCs, servers and other computer products still account for 70 percent of total DRAM revenue, according to iSuppli. As a result, this segment will determine the fortunes of the DRAM market in

2005, the research firm said. With a slowdown in PC growth forecast for this year, analysts and chip makers are expecting a much more somber DRAM market.

"It's a difficult year to predict," Infineon's Lienhard said.

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