

5 Thoughts on China Memory Progress, December Edition

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Recent headlines highlight ChangXin Memory (CXMT) plans to ramp manufacturing and also referenced YMTC plans in NAND. Lets "fact check" the status and announcements.

Chinese and all memory companies make optimistic claims stating 10's of Billions have been spent. They show cartoons of factories that don't exist yet or are empty. These claims are easy to challenge as companies track shipments to China and China reports equipment delivered by area. So it is very easy to verify the actual amount of capex and model where it is going. Lots of money is going into Chinese owned memory companies but it is no where close to \$30B yet and there are not significant shipments yet.

- 1) Report: CXMT is running 19nm DRAM in production at 20K wafer per month and will ramp to 60K by end of 2020. Production was started in September
 - a. Facts: We know based on shipping reports that CXMT is spending \$200-250M per month on tools. We know that this is roughly on pace to tool out 1/3 of a large fab. CXMT will have tools to run 20K wafer per month soon and is on pace to ramp those tools to a 40K per month pace at least. The hype over the last 2 years is becoming a reality... it's a real fab with real tools now!

- 2) Report: YMTC is running 10-20K wafer per month of NAND and will quadruple output in 2020.
 - a. Facts: YMTC/Tsinghua is among the leaders in hype and delayed results. They were supposed to have technologies shipping for the past two years and have shipped little so far.
 - b. Facts: YMTC is also taking tool shipments at a high pace. 2018 showed tool deliveries of ~\$1B dropping dramatically at the end before resuming in June 2019 at a \$200M/month pace. We will revisit the plans to quadruple output by end of 2020 but it is possible with current spending level if it continues through 2020

- 3) Report CXMT has production 19nm technology being used for LPDDR4.
 - a. Facts: CXMT has made a number of public statement so we don't need to guess. The technology is based on Qimonda, they hired former Qimonda people as well as people with DRAM experience from Samsung, Micron, and Hynix presumably. So they have a technology and some expertise
 - b. Rumor (or Alternative Facts!): A recent report online stated that the yields on this technology are <20%. When checking sources recently, input was "we have a technology, it just doesn't work". Last year I was told that they didn't have an approved process flow so there is progress ... but more work to be done.
 - c. Prediction: We have not seen samples from CXMT or even die photos, cross sections, etc. That plus the timing plus my historical experience on process learning while ramping indicates that they have a technology but it is low yielding and still being developed. Based

on this I would expect "Maturity" around the beginning of 2021 if they execute well. Until then we can expect samples and focused low volume shipments

- 4) Report: YMTC Technology is 64L Xstacking and will ramp to 128L in 2020.
 - a. Facts: We know they are installing equipment and sources state that have low volume and they are sampling some 64L. I showed previously that this is not a cost effective process but, if they get shipments out and supply local customers, then profits don't matter at this time.
 - b. Alternative Facts: Based on fab volume and timing, and the complexity of Xstacking, they should be able to get units out at low yield for certain applications in 2020. The ability to ramp 3x to 4x wafers and improve the process in 2020 is highly unlikely. But they will have fab capacity.

- 5) SUMMARY PREDICTION (Facts, Alternative Facts, Rumors):
 - a. CXMT and YMTC have their initial fab line set up and are ramping. They plan to ramp to 60K+ wafers per month by end of 2020. Both are running technologies that are not mature and are probably 1 year plus from maturity. We also have no public samples of either technology (despite my attempts to buy them!).
 - b. I would expect us to see samples and low volume shipments in 2020 only in China. If the process technology does not improve in next 3-4 months, I would expect to see a delay in the fab ramp with a statement of "we are going to focus on the next generation (17nm or 128L) and will not be ramping the current generation"
 - c. Improving yields at a fast pace requires expertise and teamwork. Ramping wafer starts 3x or more is a huge challenge on its own (getting tools to match is a full time job).
 - d. CXMT will be less than 2% of the bits shipped end of 2020 and YMTC will be less than 3% of the NAND bits shipped at end of 2020. Both have a strong possibility of being less than 1% of the bits shipped
 - e. CXMT and YMTC will spend money to become 5% of the DRAM and NAND market by 2025.

Additional thoughts:

Chinese owned memory companies are shipping both DRAM and NAND manufactured by other companies under a supply agreement (essentially rebranding). This is not widely reported but is significant and could expand as a way to deal with trade issues and provide local supplies. This is good for both China and for the memory companies