eMemory Q4 2022 Results – Earnings Call Q&A

February 10th, 2022

1. **What impact does the increase in foundry pricing have on the company? How much revenue was affected by the rise in foundry prices last year? How much is expected this year?**

   >> Last year our average foundry wafer price increased by 4.9% YoY. We believe the main reason is the increase in 12-in, especially the shipment of 28nm (from 7.4%-15.5%). Because the largest foundry only started to raise its wafer prices in Q4 of last year, and our main customers' wafer prices in the tier-two foundries will also increase this year, we expect the effect of the foundry wafer price increase this year to be more apparent than last year.

2. **What is the difference between eMemory's root-of-trust and those provided by other companies in the market? Is there really a need for PUF?**

   >> Root-of-trust is mainly to provide the trust foundation for the secure operation of chips and devices and to certify the originality of the operating system and software.

   The general practice is to write and store the key for security authentication in eFuse, which doesn't have any protection against attacks. This key is used to perform secure operations within a crypto algorithm.

   Customers will encounter two key problems when using it:

   1. Without safe storage and protection, the key will be easily stolen and the root-of-trust can be easily breeched.
   2. Customers need to design their own true random number generator (tRNG) to match the crypto operation. Qualified tRNG requires the entropy of analog design. Generally, customers do not have enough professional R&D and know-how to develop the design. Without PUF, the key, which is the basis of trust can be cracked and stolen.

   Our PUFrt utilizes PUF to provide immutable inborn secret required by the root-of-trust. The unique identity (chip fingerprint) of PUF can be used as the basis of trust for secure boot, key protection and software authentication.

PUFrt hard macro also provides an entropy source with each chip's own unique chip fingerprint to generate true random numbers. That is, each chip has a tRNG with its own unique chip fingerprint, which will not be easily cracked and improves operational security. In addition, all the security operations in PUFrt are enclave with Anti-tampering by using PUF itself to defend all kinds of attacks.

3. The TSMC earnings call mentioned their plans of developing 28nm embedded memory. Is this a threat to the company?

>> The “embedded memory” that TSMC is referring to is mainly the fact that there will be problems when traditional embedded flash migrates to 28nm and below, so this part of the market have no proven commercial technologies yet. Currently, two emerging memory technologies, MRAM and ReRAM, are competing to replace embedded flash beyond 28nm. At present, we are cooperating with foundry partners and memory cell companies to develop both technologies in foundry processes. Our role is to incorporate circuitry design with memory cell to become a complete IP and in return, we will receive design license fees and royalties after wafer production.

TSMC’s strategy is to develop its own memory cell in ReRAM and MRAM instead of license third party memory cell like embedded flash. We can provide design service if TSMC opens for design service. In addition, we believe our own memory technology, NeoFlash, can provide better quality and reliability than the others, and are proposing to foundries for 28nm and below processes.

This is different from our OTP market. We already developed our OTP and PUF in embedded flash and ReRAM processes, creating what is known as “secure flash” to protect the data stored in embedded memory.

4. eMemory has always mentioned the advantages of eMemory IP over eFuse. Why hasn’t the penetration rate increased significantly yet?

>> In advanced processes, OTP is mainly used to store keys in security applications. In the past, the requirements for security were not high and everyone used eFuse. However, with the increase of cloud applications, cloud application providers and edge computing customers have increased the level of their security, which will lead to the use of eFuse for key storage to eventually upgrade to NeoFuse-level OTP and NeoPUF-level secure OTP.

We have observed this trend in the last year and many customers who used eFuse have switched to OTP and secure OTP.

5. eMemory recently announced its cooperation with Intel's foundry. Will this affect your collaboration with TSMC?

>> Our collaboration with Intel is mainly focused on digital product applications below 16nm, such as AI, SoC, CPU, DPU, GPU, OEM customers that require security. Advanced process customers in TSMC also have the same security requirements. Our cooperation with TSMC will continue to strengthen as we move forward to more advanced processes.

6. Is eMemory worried about the oversupply of 8-in mature processes?

>> Our 8-in design activities are still very strong, indicating that although some products are migrating to 12-in, there are still new product applications being developed in 8-in. In addition, there are no new 8-in factories built and many applications are more suitable to manufacture in 8-in. For example, power management chips for electric vehicles have little chance of moving to 12-in since it's not economical.

Moreover, due to the very tight wafer production, many new applications are lack of capacity for production. More capacity will help new customers and new products have enough production capacity, which is not a bad thing.

As our 12-in NeoFuse enters a period of rapid growth, its proportion has exceeded the contributions of 8-in and is progressing below 16nm, which contains much higher royalty per wafer, also for higher royalties from new technologies, such as security and MTP-related IPs. So, we think there is enough driving force beside 8-in.

7. Are Chinese IP competitors a threat to eMemory?

>> For quite a long time, one or two small companies in China have been providing similar technologies in the legacy node but with very limited customers.

The technology we developed is the most fundamental semiconductor transistor, needs to be patented, requires time to be verified in each foundry process, needs to accumulate production records before widely adoption, need to have process availability in worldwide foundries, and have capability to migrating into more leading edge.

These are not available to the Chinese companies which have limited resources to access to foundries outside China, nor technical capabilities. This is evident from the substantial growth in our licensing fees from China in the past.

8. **DDI and PMIC account for a considerable proportion of the company's revenue. After the rapid growth in the last two years, there may be oversupply and inventory correction. Will this affect eMemory?**

   >> The substantial growth in revenue of chip companies in the past two years is largely due to the increase in chip prices as a result of chip shortages in the market. Shipment growth is nowhere near that of revenue and we don't think that there is a serious inventory problem.

   Our growth in major applications is mainly due to the increase in market share. Taking DDI for example, the growth is driven by our market share gain of largest Korea OLED chip maker. We believe this segment will continue to grow this year as higher foundry wafer price and more OLED contribution. Similar to the situation of PMIC.

9. **What will be eMemory's business model if you co-work with a big shark like Arm in security applications? Do we still charge the same 1-2% of wafer cost as royalty?**

   >> In our business model for important CPU manufacturers, in addition to providing our OTP for security storage, we also provide PUFrt and other security IPs to strengthen security protection, so as to offer the best security solutions to customers. Furthermore, other than our OTP royalties, we will also collect security IP-related licensing fees and royalties which will contribute to our revenue.

10. **Historically, it would take up to three years to collect royalty after licensing. Does eMemory expect a more rapid adoption in the future?**

    >> As our IP is adopted in more and more applications and technologies nodes, there will be more off-the-shelf IPs for customers to choose from. This facilitates customer's progress towards mass production, so we do expect the period before collecting royalties to shorten.

11. **What is the progress in advanced node since TSMC focused its expansion on advance nodes under 7nm.**

    >> We already qualified our OTP and verified PUF IP in N7 and N6 nodes. There are several design wins including FPGA, AI, ADAS, HPC, memory controller and other applications. In N5, our OTP IP was verified and is going to the qualification stage soon. As to N3 and N4, we are discussing OTP IP spec with customers and they are under planning now.

12. **Regarding the partnership with Arm, Arm has its own trust zone architecture, how is it different from PUFsecurity's PUFrt? In addition, OTP technologies have been around for a long time, what are the barriers from OTP to developing OTP-PUF?**

    >> In Arm's trust zone, highly sensitive applications is operated and separated from general applications in terms of the program or data used. In the new Armv9 confidential computing architecture, PUFrt, the hardware root-of-trust, will provide keys and random numbers required when trust zone operates. That is, PUFrt enables confidential computing and is the most important function in chip security.

    PUF is derived from our OTP technology which use two OTP cells to generate "0" and "1" by comparing the quantum tunneling current of these two cells. Since our OTP have been developed in worldwide major foundries, many processes, including advanced processes, so our PUF is also ready in those platforms.

    Deriving PUF cells from OTP requires brand new invention so that the PUF design can magnify manufacturing variation to generate random numbers. Our NeoPUF is exactly this type of fundamental patent.

13. **Will the partnership with Intel Foundry Service extend to Intel's own product lines? How are the chances of Intel partnering with eMemory in terms of products that are out-sourced in other foundries? In addition, these foundries are competent in SRAM technologies, why don't they use SRAM to implement PUF?**

>> Intel is already one of our end customers.

It is true that all foundries have SRAM technology. However, using SRAM for PUF cell is very unstable. The volatility of the external environment may change SRAM PUF from "0' to "1" or "1" to "0", or the PUF value will change during power on/off. No one wants to use an unstable PUF which is why we started promoting our PUF as the solution to this problem. Since most design companies who have used SRAM PUF complain about its difficulties, the stability of our PUF is the reason why our progress keeps improving. That is also why our PUF is a very important element in hardware security.

Furthermore, eMemory PUF is derived from our OTP cells. For all the platforms that already have OTP, it is easy to develop PUF because our OTP platform is already established in foundries worldwide. On top of that, with our PUF is reliable and easy to use. Therefore, we are very confident that our PUF is irreplaceable and so we have a leading global position in our PUF-based hardware security IP and root-of-trust.

14. **Last year, most of the first-tier/second-tier IC design companies and wafer foundries demonstrated a high-growth performance in Q4 revenue. In theory, the performance of eMemory's revenue in January 2022 should've been quite high. However, the announced results are only close to low-single-digit growth. This is not only very different from the overall market conditions, but also shows a huge gap in performance compared to last year. Can you analyze the reasons in detail? Or should investors assume that the company's revenue is stuck in a stagnant transition period of revenue growth?**

>> Our revenue in January was record high. The drag down of growth rate was from the licensing part which dropped 41.5% compared to last January, which had one big license from MRAM. Royalty of January (reflecting foundry's wafer shipment in the last Q4) increased by 14.6% QoQ, and increased by 17.5% YoY (in terms of USD, the increase was 20%). We expect the February revenue and beyond to see a clear pick up on growth momentum due to the continued strength of our business as mentioned in the conference call.

15. **Last year, we saw the 5/6nm production in Q3, but there was no announcement of the 5nm verification on the official website. TSMC's N6 was announced in September of last year and passed the verification but why has 5nm not? Can you estimate when the verification of 5nm will be completed? When will the royalties of 5/6nm start to contribute to your revenue?**

>> The N6 OTP has passed reliability qualification and has been adopted by several customers. The N5 OTP has passed the function verification and is ready to enter the qualification stage. Reliability qualification will be completed this year and several customers are already discussing specifications. We expect there will be more N6/N5 related royalty next year and further.

16. **Without considering the price increase from fab as a factor, what is the growth prospect for 7nm compared to last year?**

>> As we reported earlier, our NTO number in N7/N6 tripled last year compared to the year before, and we also started to receive royalties in Q4 of last year. This year, we expect more adoption from new and existing customers. The number of N7/N6 NTOs and royalty will certainly grow this year.

17. **Will 28nm make the largest contribution to revenue this year? In terms of revenue growth, which process node will see the largest growth? UMC has reported to have ordered OLED ISP and new driver IC from a Korean company, both of which are in 28nm. However, based on eMemory's Technology Development table last year, Process Type OLED was under 55/65nm and 80/90nm, is there an upgrade plan for this?**

>> We expect 28nm to be the node with the highest growth rate this year. However, it is not the node with the largest contribution since we still have a large and stable production in mature processes. In addition, since the new capacity for the 28nm will only be available next year, we expect the contribution to be much higher with the new capacity ramping up.

In terms of OLED DDI, we have the market share gain of largest Korea OLED maker for its 28nm OLED, which is already in production now. Our existing OLED customers are also moving into 28nm for production from 40/55 nm.

As foundries are building more capacity for 28nm OLED process, we expect that the growth from this segment will be quite significant in the future.

18. Will the popular 2.5D/3D packaging, in-memory computing, etc. affect the promotion of eMemory IPs? Will this be a positive or negative impact?

>> For the current popular 2.5D/3D packaging, because multiple ICs need to be stacked, there will be higher requirements for the yield of each IC in order to maintain a certain yield after packaging. Our NVM IP can be used to adjust and repair IC functions after production, which will help customers improve the yield of each IC. Thus, it will have a positive impact for our IPs.

19. Not long ago, Quantinuum from Honeywell International launched an encryption key created by quantum computers. Do you know the price of the product, the user experience, and whether or not our OTP/PUF will win if compared to this product? If so, why?

>> Quantinuum uses a quantum computer to generate the key using software. They sell this key to customers, who will then inject it into their chips. This approach requires a quantum computer, and the method is not as secure as generating the keys inside the chip itself. Using a quantum computer is only slightly better than using ordinary computers to generate keys via software. By doing this, both the key injection and cryptographic operations must be done externally, which we know is very insecure. Our PUF uses the natural random numbers generated on the chip as the basis for the key, not through software. As a result, this method is simpler, cheaper, and much more secure.

20. On Feb 7, you announced the next-generation PUF-based hardware root-of-trust IP for future computing. How is this different from the current one? Can you explain further?

>> The current root-of-trust practice is to store secret keys directly in an unsecured eFuse or Flash. Our cooperation with Arm is to use PUF technology, which allows the generation and storage of keys to be completed inside the chip. Our quantum-tunneling PUF uses the DNA of each chip (the quantum wells characteristics, including the numbers and locations of the wells in the transistor gate oxide layers are different.) The fingerprints generated inside the chip are highly random and unique, resulting in a high security level. This is why Arm chose our PUFrt as the root-of-trust for their Confidential Computing Architecture.

21. The application of display technology has developed towards MiniLED and MicroLED. Apple products have also begun to use MiniLED. Is our IP applied to MiniLED?

>> Currently, MiniLED is mainly used as a backlight source or with DDI module. Similar to regular DDI, MiniLED also needs trimming and configuration settings, which will require OTP and MTP. However, the current design of each company is different, so it is not as standardized as DDI. We already have customers using MiniLED and we expect to generate more NTOs in the future.

22. Will the subsidiary, PUFsecurity have a chance to balance the profit and losses this year? When does the company expect to start profiting?

>> Increasing attention is directed towards hardware security for chips and more and more customers are engaging with us to use PUF-based Hardware Security solutions.

Our goal is to balance our profit and losses. Judging by the current market demand, we have an opportunity to achieve that goal this year.

23. What are the differences and competitiveness of NeoFlash vs. traditional eFlash?

>> NeoFlash only needs two to three more extra mask layers than logic process, whereas, traditional embedded Flash needs at least 10 to 15 additional mask layers than logic process. Therefore, NeoFlash is low cost, high yield, and has a faster cycle time than traditional embedded Flash.

24. What is the nature of your partnership with Verisilicon in China?

>> VeriSilicon works as a design service company like GUC, or Faraday Taiwan. We treat them as one of our design licensing partner.