16 Future and Conclusion

1. Predicting the unpredictable

Will the semiconductor industry run out of process technology soon? The international technology roadmap for semiconductors sets industry technology targets and milestones for the next 15 years [Itrs]. This prospective is probably one of the most referenced document in micro-electronics. The roadmap predicts transistor-gate lengths in microprocessors shrinking to 25 nanometers (0.025 micron) by 2008, five years earlier than earlier editions

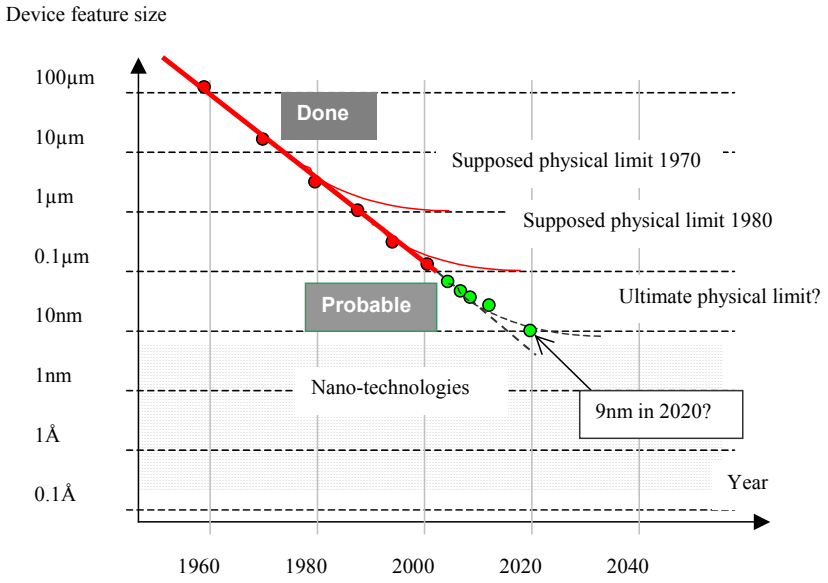

Figure 16-1. The art of predicting the future of micro-electronics

The technology scale down beyond 90nm

The 90nm CMOS technology was introduced in 2004 for system-on-chip fabrication. The next technological steps are presented in figure 16-2: 65nm, 35nm, 25nm, 15nm and 9nm. By 2007, processors with 1 billion transistors are expected to be developed, running at 10GHz.

The power consumptions of these processors could rise to around 100 Watts per square centimeters on the die, which could represent the second limiting factor in CMOS design, after the cost of the foundry and the masks.

By 2016, the ITRS roadmap projects the minimum physical gate length of transistors to be close to 9 nm (0.009 micron), which is considered by most researchers to be the physical limit of silicon. Will the transistor-gate length scaling continue below 9nm? This prospect is now causing the industry to consider post-CMOS technologies.

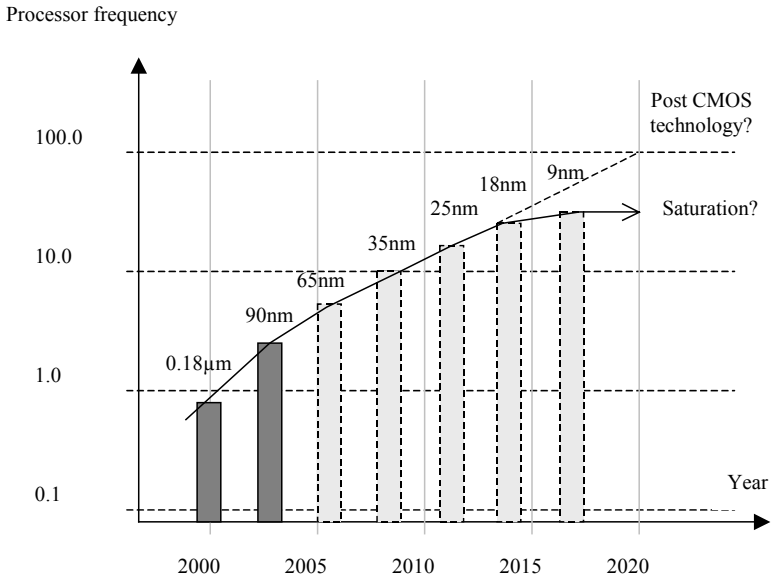

Figure 16-2. CMOS technologies forecast until 2020

2. As a conclusion

This book has described several aspects of the CMOS circuit design, using the Microwind tool as an illustration. A very important gap exists between the educational PC-based tool and the professional tools used in industry for real-case designs. However we hope that the readers have caught the essential parts of MOS devices, logic circuits, memories, analog cells and interfacing, through the illustrations and numerous examples.

No book, no teaching can replace the practical experience. Although the simulations should never be trusted, the access to microelectronic technology tends to be more and more costly, which justifies the relevance of such simple tools.

The authors have dedicated around two years to build the technical contents of this book, and tried their best to improve the Microwind and Dsch tools, trying to make attractive and simple something which tends to be more and more complicated. Still, some bugs needs to be corrected, the user's interface should be improved, and important new features should be included. As the tools are in constant evolution thanks to user's feedback and comments, we encourage the reader to download the updated version of Microwind and Dsch from their web page, as detailed in the companion CD-ROM introduction. The tools have benefit from the real-case experiments conducted in 0.35, 0.25 and 0.18µm CMOS technologies in partnership with ST-Microelectronics and Motorola.

We hope that the reader will find the contents of this book and the companion tools useful. It is our hope that the reader will design logic and analog circuits by himself, understand by a practical approach the principles of deep submicron VLSI design, and later contribute to innovative designs to support the electronic systems of the future.

References

[Irts] Tech. Roadmap <web>