Intel's Process Technology

- 65nm: IEDM'04
- 45nm: IEDM'07, VLSI Symposium'08
- 32nm: IEDM'09
- 22nm: IEDM'12
- 14nm: IEDM'14

Intel's Process Technology

- I_D characteristics

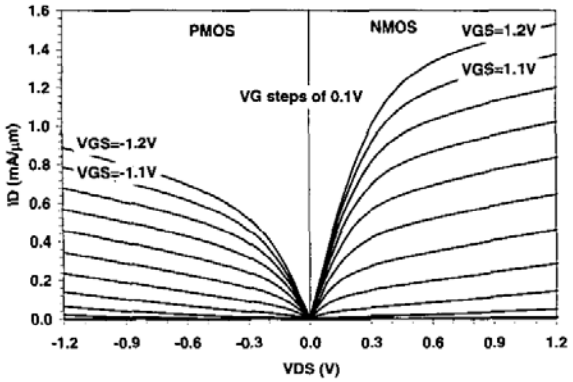
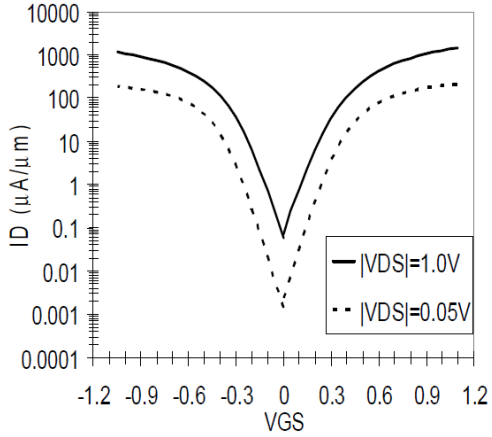


Figure 5: Transistor I-V curves



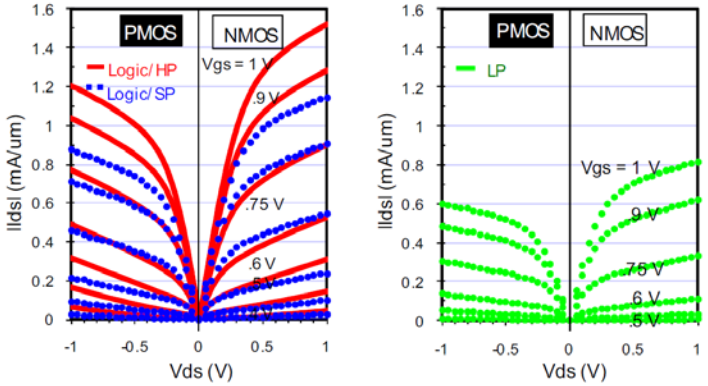
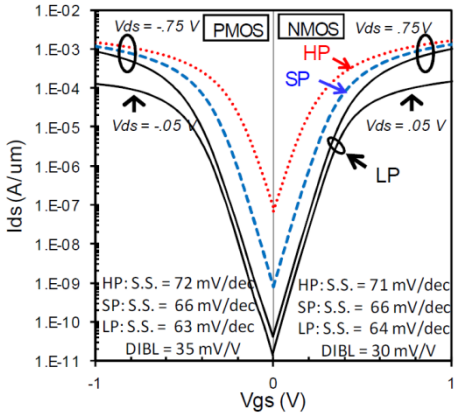


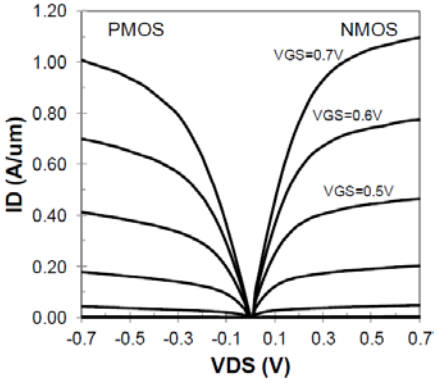
Fig. 4 Typical Id-Vds of logic and low power transistors

65nm



22nm

45nm



14nm

32nm

WASHINGTON STATE UNIVERSITY

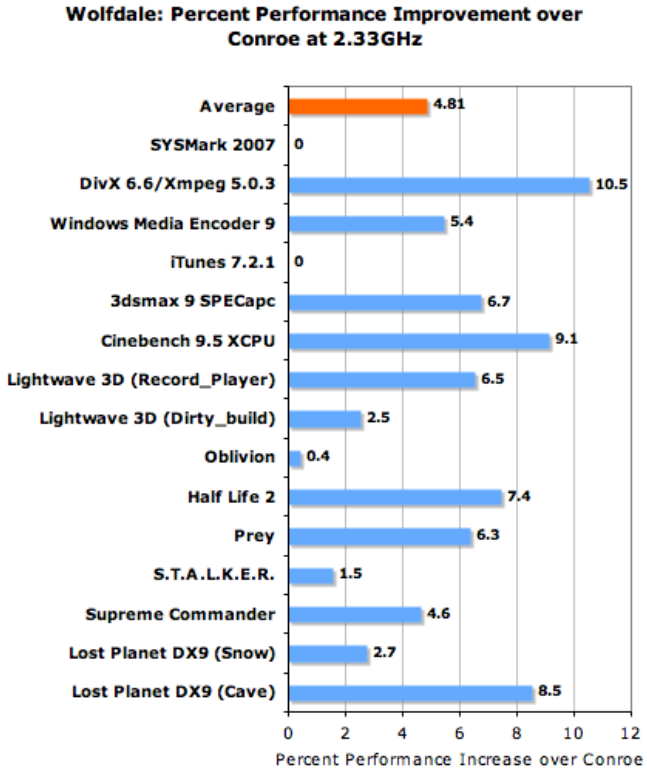
Intel's Process Technology

- I_D characteristics (uA/um)

Process	V_{DD}	NMOS	PMOS
65nm	1.1V	1320	760
45nm	1.0V	1000	1000
32nm	0.9V	1250	1000
22nm	0.75V	1000	1000
14nm	0.7V	1100	1000

Performance Improvement Between Two Adjacent Process Technologies

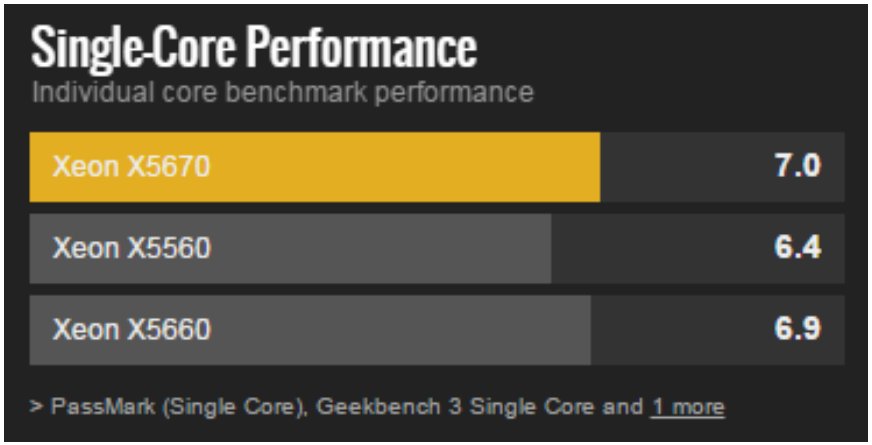
- Core microarchitecture
  - Merom (65nm) vs. Penryn (45nm)
  - ~5% performance improvement (on average)



Source: http://www.anandtech.com/show/2306/3

Performance Improvement Between Two Adjacent Process Technologies

- Nehalem microarchitecture
  - Nehalem (45nm) vs. Westmere (32nm)
  - ~4.4% performance improvement (on average)
    - 7.0 / 6.4 * (2.8GHz / 2.933GHz)
    - X5560: 2.8GHz, X5670: 2.933GHz



Source: http://cpuboss.com/cpus/Intel-Xeon-X5670-vs-Intel-Xeon-X5560

Performance Improvement Between Two Adjacent Process Technologies

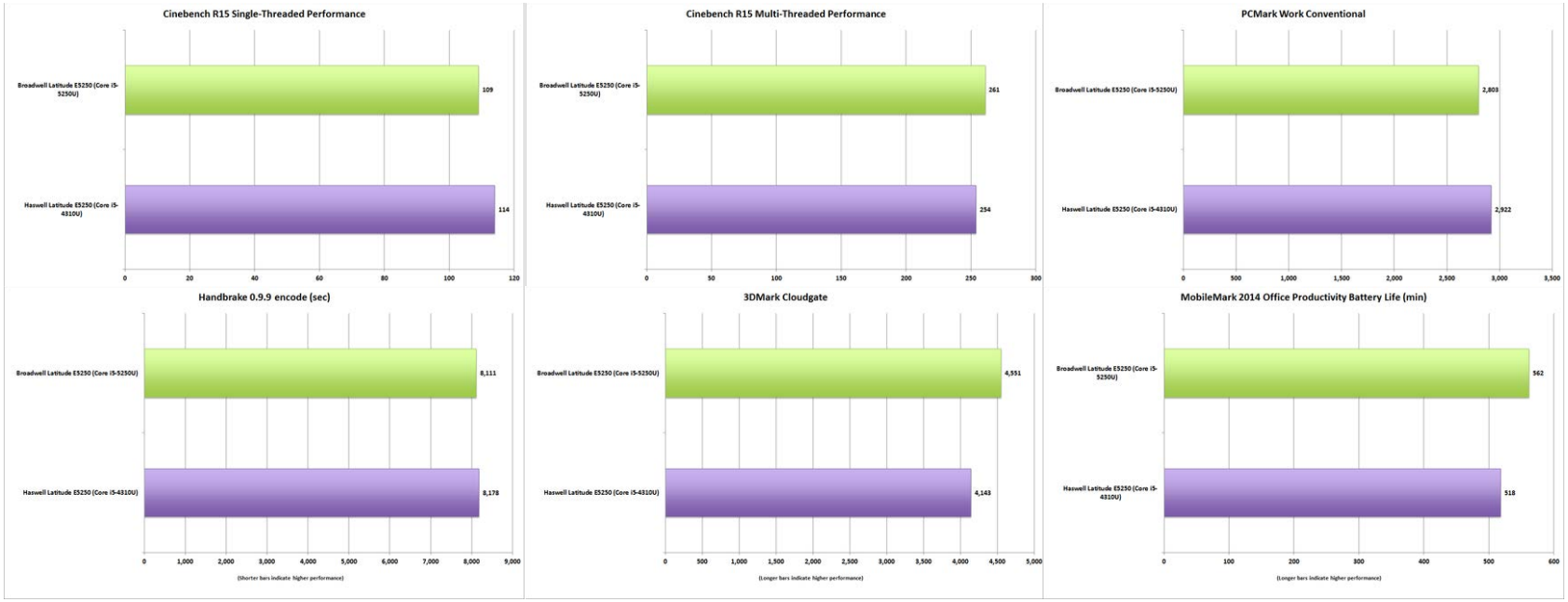
- Sandy Bridge microarchitecture
  - Sandy Bridge (32nm) vs. Ivy Bridge (22nm)
  - ~5% performance improvement (on average)

> **4. Ivy Bridge is faster—but just a little.** Performance generally improves more between "ticks" and "tocks" than between "tocks" and "ticks," and you can see this in the relationship between Sandy Bridge and Ivy Bridge. In our testing, for example, an **Intel Core i7-3770K** Ivy Bridge processor earned in our CineBench R11.5 multicore rendering test a score of 1.65, compared with a **Core i7-2700K** (the fastest Sandy Bridge chip) in the same system earning 1.58. The chips' scores in **PCMark 7** (3,679 versus 3,867) and times in **Adobe Photoshop CS5** (2 minutes 47 seconds versus 2:50) and Handbrake 0.9.6 (32 seconds versus 31 seconds) also bear this out. So you will see speed bumps, but they'll be small this time around. Chances are, however, that next year's "tock" will boost the speeds of new processors considerably more.

Source: http://www.pcmag.com/article2/0,2817,2405317,00.asp

Performance Improvement Between Two Adjacent Process Technologies

- Haswell microarchitecture
  - Haswell (22nm) vs. Broadwell (14nm)
  - 5~10% performance improvement (on average)



Source: http://www.pcworld.com/article/2940489/the-truth-about-intels-broadwell-vs-haswell-cpu.html