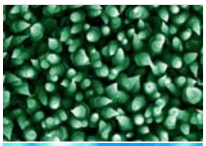
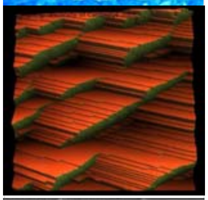
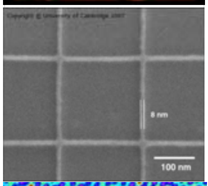
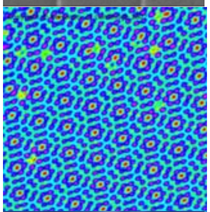
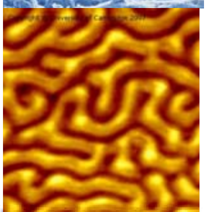
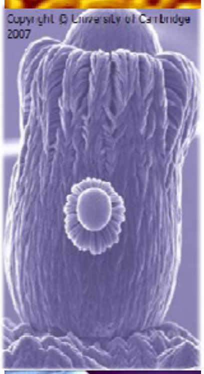
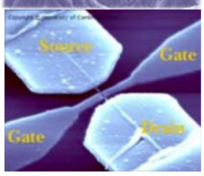
Nanotechnology and ICT



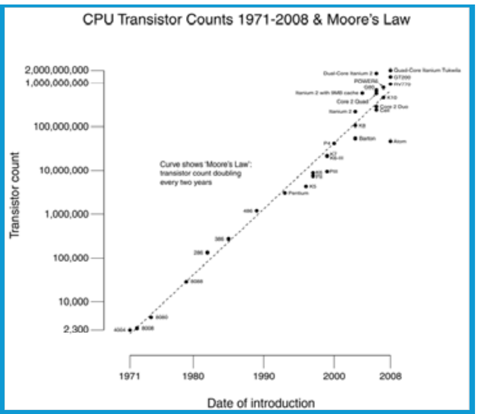




Miniaturisation and Nanotechnology

The Information and Communication Technology (ICT) sector has undergone rapid expansion as work and social activities are transformed by new and varied technologies. This has required computers to become faster, enabled by the production of smaller transistors through advanced fabrication processes. Decreasing the size of the transistor allows more to be placed on an integrated circuit, increasing the performance of the computer. Moore's Law predicts that the number of transistors placed on an integrated circuit doubles every two years.

There are now challenges to continue this miniaturisation path because as the materials of semiconductors, metals and insulators are reduced to a nano-size, their properties begin to be determined and dominated by quantum effects. Nanotechnology offers the opportunity to exploit, rather than avoid, quantum effects for the development of the next generation of integrated circuits. As miniaturisation cannot proceed forever with the methods and tools that have been used so far, new approaches will be needed.

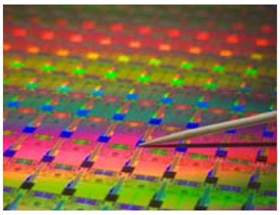


Graph shows the increase in number of transistors on a computer chip, which follows Moore´s prediction. (Image credit: http://commons.wikimedia.org/wiki/User:Wgsimon, Creative Commons Attribution ShareAlike 3.0)

Emerging technologies in ICT

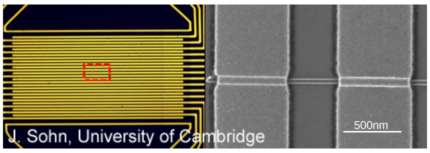
Devices will be faster, more powerful and have a greater number of features thanks to Nanotechnology.

Conventional transistor manufacturing is constantly striving for smaller transistors. New architectures and increased fabrication complexity enable more advanced circuitry to be developed.



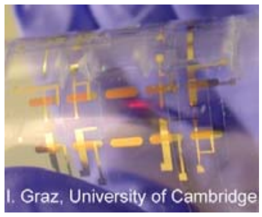
Photography of processors on an Intel 45nm "Penryn" Wafer.

By using the inherent properties of nanomaterials to perform calculations, future computers may not need to rely on traditional Si-based technology. Materials such as single nanowires or quantum dots could be used.



A memory device built around a single zinc oxide nanowire. Each nanowire is less than 100 nm in diameter.

New fabrication techniques allow the synthesis of compliant circuits, making flexible and stretchable devices a reality. These devices can be rolled or folded without damaging the performance of the device.



Compliant thin film transistors using organic semiconductor molecules on a rubbery substrate

Beyond Miniaturisation: Integration of Nanotechnology in everyday gadgets

The evolution of the ICT sector will go beyond what we consider as "electronics" (i.e., devices that perform a task for us). There are visions of having electronics embedded in our clothing or in the environment around us in what is conceived as a network of devices that create "ambient intelligence". Future mobile communication devices will have multi-functionality at a far greater level than current models.

Giant Magnetoresistance (GMR) technology

Numerous popular electronic products have components that use an effect called the GMR. The electrical resistance of structures made of very thin layers of magnetic and non-magnetic metals can change by an unexpectedly large amount in the presence of an applied magnetic field.

Modern hard disks make use of GMR.
(Image credit: http://commons.wikimedia.org/wiki/User:Mfield, Creative Commons Attribution ShareAlike 3.0)

Wireless sensing and Communication

The Morph concept device contains nanoscale technologies that will potentially create a world of radically different devices.

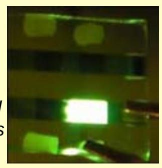
- •New battery technology and power management.
- •Conformable.
- •Transparent electronics and novel display technology.
- •Functional surfaces e.g. self cleaning.
- •Sensor technology for monitoring of the environment.
- •Integration into textiles

Display technology e.g. organic light emitting diodes (OLEDs)

Made using thin layers of organic molecules which can be easily deposited onto a substrate

Advantages
- •Consume less power than LCD displays
- •Good picture quaility
- •Much thinner and lighter than LCD panels
- •Operate well under sunlight and at different angles.

Disadvantages
- •Poor lifetime due to molecular degradation
- •Molecules are sensitive to moisture so expensive packaging is needed
- •Currently designed to need expensive electrode materials.



OLED films about 200nm thick. (Image credit: R. Ovilla, University of Texas at Dallas, NISE Network, www.nisenet.org, licensed under NISE network terms and conditions).

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