BRIEFING MEMO

INFORMATION AGE

It's amazing to think that some of us grew up without the sophisticated tech gadgets we hold in our palms today. As consumers, we are replacing and adding to them on a yearly basis. Machines are getting smaller and a lot more powerful. Every new age is marked by some type of development that ultimately becomes a new driving force of human society. We live in the **Age of Information**. We've also called it **the Computer Age** and the **Digital Age**.

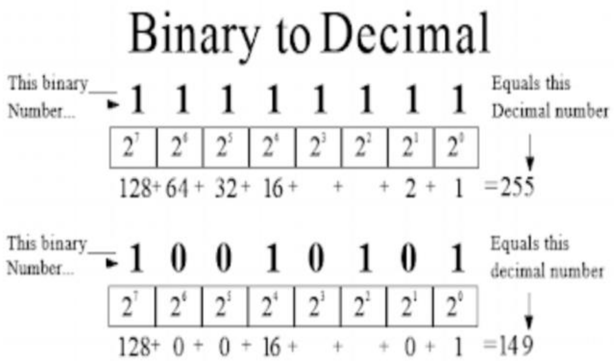
> ***"Imagine a school with children who can read or write, but with teachers who cannot, and you have a metaphor of the Information Age in which we live." – Peter Cochrane***

The Information Age is relatively recent and actually only started in the middle of the last Century. It was preceded for a period of two hundred years by the **Industrial Age**. The invention of the steam engine fired up the industrial revolution. This period was preceded by the **Agrarian Age** which lasted 8,000 years, itself preceded by human society as hunter gatherers for several millions of years. Just look at the breath-taking speed at which the ages have compressed in time!

Most of us have grown up within this Information Age and we have seen different phases of its development. For us, there are three key ingredients that explain the advent of the Information Age. **The first ingredient is all about numbers.** Consider the base-10 numeral system or **decimal system**. This is how most of us learnt to understand numbers & count at school. Our numbers are a combination of the placement of numeric digits which, when next to each other, are multiplied in tens.

The one position is next to the 10 position, next to the 100 position, the 1,000 position, etc. The number configured by 123 is one hundred twenty-three. The decimal system requires 10 digits - 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. The word “decimal” - in Latin ‘*decem*’ - means “ten” and the word “digit” - in Latin ‘*digiti*’ - means “finger”. You will know that there are different positional numeral systems.

Decimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010



An entirely different numeral system is the base-2 numeral system or **binary system** which works on the basis of only two digits - 0 and 1. In the binary system, each **position** within a string is represented by the number 2 to the power of the number of where it stands in the queue of the string. In the left-hand table (above), the number 9, for example, in binary is expressed as 1001 i.e. (1x8)+(0x4)+(0x2)+(1x1).

In the left-hand table (above), the decimal number 255 is expressed as 11111111 in binary form i.e. (1x128)+(1x64)+(1x32)+(1x16)+(1x8)+(1x4)+(1x2)+(1x1). Any number can therefore be represented with only 1s and 0s. The smallest binary digit, abbreviated as “bit”, is a single binary value, either 0 or 1. A bit is the smallest unit of data in a computer. You can now start seeing the contours of **digital computing** i.e. processing information using numbers expressed in 0s and 1s only.

The next important ingredient is all about switches. Switching is essential to make rapid decisions about routing information. This applies to the early telephones & telegraphs and, crucially, modern data processing.

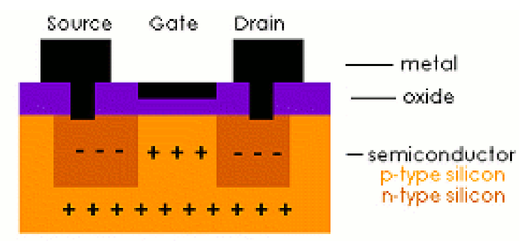
The first concepts of **digital computers** date to the early 1800s i.e. automatic calculating devices using binary digits to express numbers. What limited their development was the physical incorporation into the machine of the many mechanical levers and gears needed to execute logical orders.

The science of electronics produced **the transistor** which proved to be the single most important contributor to the proliferation of information in today's society. "Transistor" is an abbreviation of the word "transresistance" aka "mutual conductance". The material a transistor is made of is **silicon**.

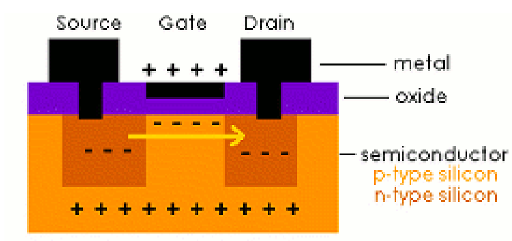
Silicon has the trait of being a semiconductor material i.e. it is neither a good conductor nor a good resistor of the flow of electricity, however it can be efficiently chemically treated (the term is actually 'doped'), which is the process of modulating the conductivity of the semiconductor material such that the silicon can have "more" or "less" conductivity. In chemical terms, you are actually augmenting (or extracting) the number of electrons, which are negatively charged subatomic particles in the substance.

By creating a three-layered physical silicon sandwich - comprised of two slices of n(egative)-type silicon on the outside with good conductivity, with one slice of p(ositive)-type silicon in-between with less good conductivity, you have essentially created a **tiny switch**.

"OFF"

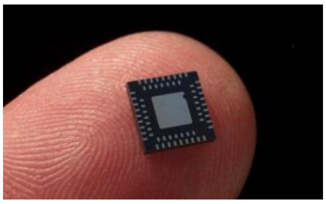


"ON"



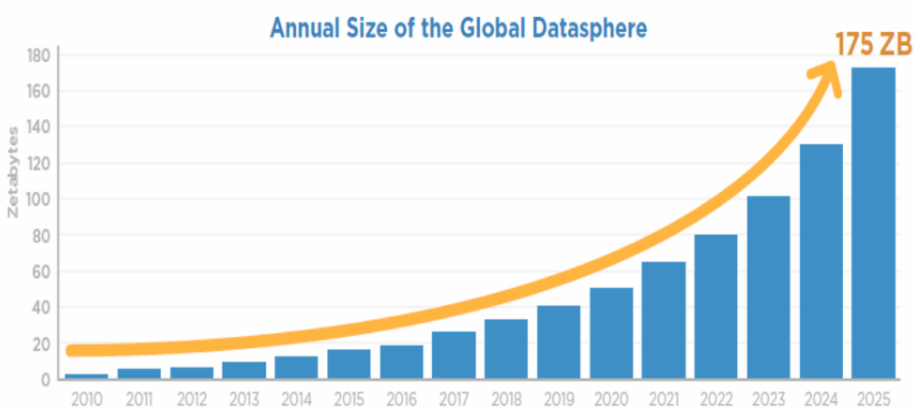
When applying a small positive current to the p-type silicon, the electrons in the first slice of n-type silicon start moving and want to nudge through the p-type silicon middle slice into the second slice of n-type silicon. Not only has the transistor been switched to "on" mode, but it incidentally also "boosts" the current altogether. **Turning a switch on and off lends itself perfectly to the binary numeral system.**

In fact, the transistor is a simple memory device. When "off", the bit stored is "0". When "on", the bit stored is "1". The switch flips to "on" or "off" with alternating current. What remains is to



link transistors together, the interaction of which allows computers to make very simple computational decisions. All of this is engineered on a small flat piece - literally a "chip" - of semiconductor material. **Billions** of tiny transistors are integrated on this digital circuit, itself the size of a baby's fingernail. They make computing power simply explosive.

The third ingredient is all about data. The Information Age has less to do with the evolution of the digital devices. Everything we do involves the integration of intelligent data. Here's one example that should speak to all of us: **MRI imaging**. More images with ever thinner slices, compounded by 3D capacity, can be produced today. An MRI brain scan once captured a mere thousand images. Doctors are looking at 20,000 images for a single scan today. These are phenomenal breakthroughs but are challenging in terms of data storage. Now let's get our head around the explosive growth of data.



1 Zettabyte (ZB) of global data is where we stood at in 2010. If you imagine the average storage capacity of the smart phone you are holding to be 32 Gigabytes (GB), it would require 34.4 billion smart phones at full capacity to be equal to 1 ZB. The world is expected to have computed and stored fully 175 ZB of data by the year 2025.

This explosion of **data** started with the very first stored **binary** digit in a **transistor**. Together these three ingredients have been the driving force of social evolution. This is why we call this **the Age of Information.**

For further insights please consult our homepage (www.kloudwerk.com)