

# The cradle of computing (draft)

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Computer technology has historically existed in a world of abundant resources. A recent trip to Africa caused me to speculate on what computing would be like if it had evolved in a different, resource limited, environment.

Electrical power is the most obvious factor. In Gayaza High School (Uganda) they have an IT suite containing around 50 modern desktop computers. Due to the (common) power outage occurring at the time of our visit these machines were unused and the entire class was gathered around a single machine and projector—any more could not be supported by the school's backup generator. How would these pressures affect the development of desktop computing? PC hardware would be less power-hungry, operating systems would boot instantaneously when power returned, and applications would be designed to make data loss impossible.

The African mobile phone market is the fastest growing in the world. Consumer demand for rugged mobile devices with good battery life has produced a device which transfers very well. In South Africa contracts with bundled minutes and texts are in the minority and there is huge sensitivity to the price of calls. We heard stories of people owning multiple SIM cards for the purpose of manually switching between networks depending on the most cost effective option at the time. This attitude would have pushed for mainstream devices which can automatically make an optimal selection from available networks—a research topic known as fourth-generation (4G) networking.

Internet connections in African schools and universities are very highly contended. In this situation the timeouts on a TCP connection mean that it often becomes impossible to download any data at all. The common solution to this problem has always been to over-provision and to ensure that capacity is available whenever a user wants it. Indeed, IT infrastructure is commonly over-provisioned at every level with spare power supply capacity, spare network capacity and server utilisation below 30%. This is one reason why the energy consumption of IT is as large as it is—in the US servers and associated cooling alone consume 1-2% of total electricity supply. An alternative is to design a system which achieves high utilisation of all its resources. One scheme would be to use batch jobs which have flexibility as to when they are run. A user might request a file, the job gets queued, and the data arrive later. This flexibility allows more efficient use of resources and the possibility of adapting to faults rather than suffering a total failure.

In the above cases the solutions are appealing even when resource constraints are lifted: computers which boot quickly, phones which automatically optimise the cost of calling and cheaper IT infrastructure. As current efforts to close the digital divide make progress we move closer to the all societies participating in the development of technology. An exciting thought for the future is how technology will evolve under these different perspectives and operating environments.

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