

Gutenberg and the Internet

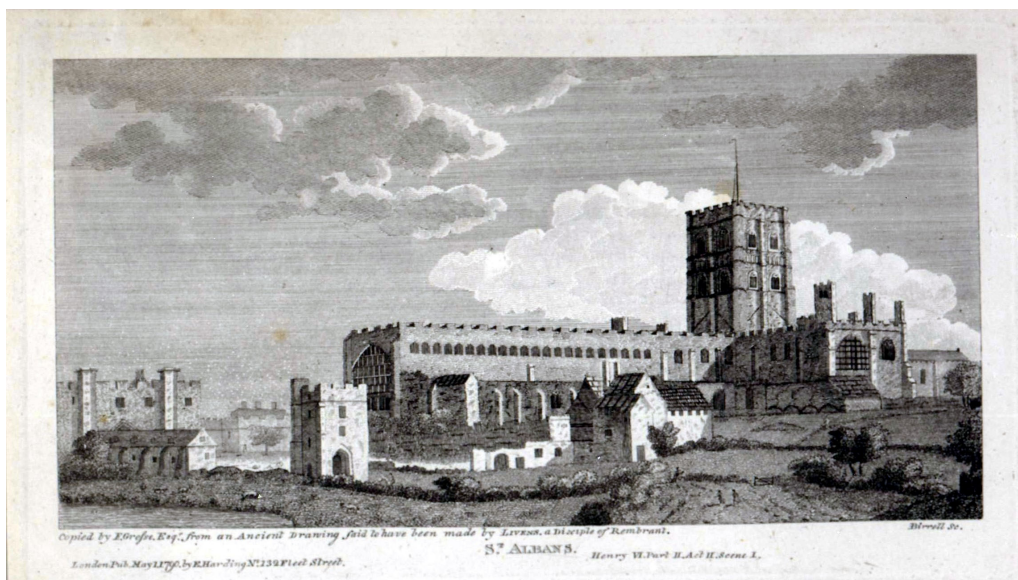
*Steven Pemberton, CWI,
Amsterdam*



1 Same view now



1 Jan Lievens (1607-74)



"Copied by E. Grosser, Esq., from an Ancient Drawing said to have been made by LIVENS, a Disciple of Rembrandt. London Pub May 1790, by E. Harding, No 132 Fleet Street".

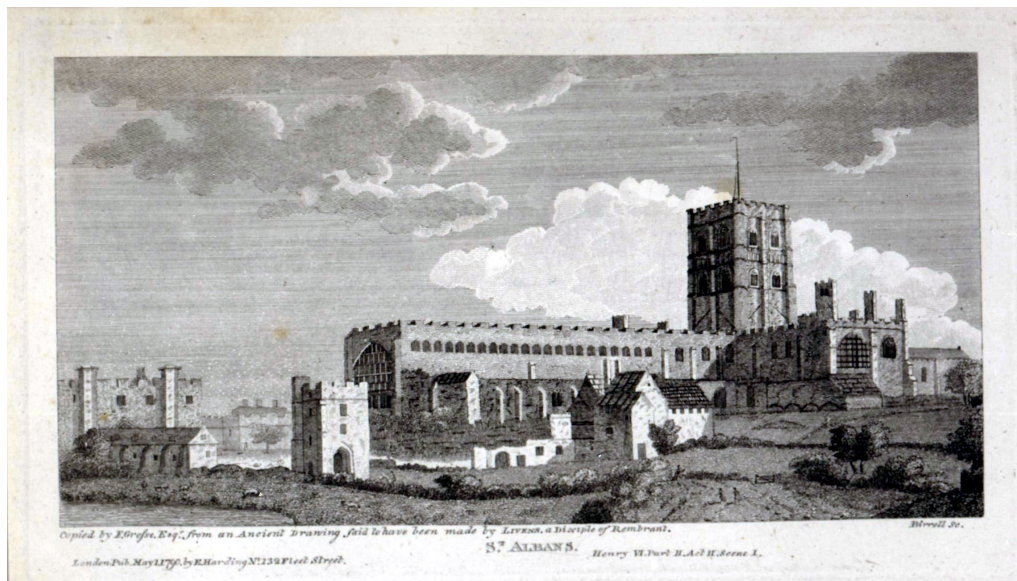
1 Indeed



1 Indeed



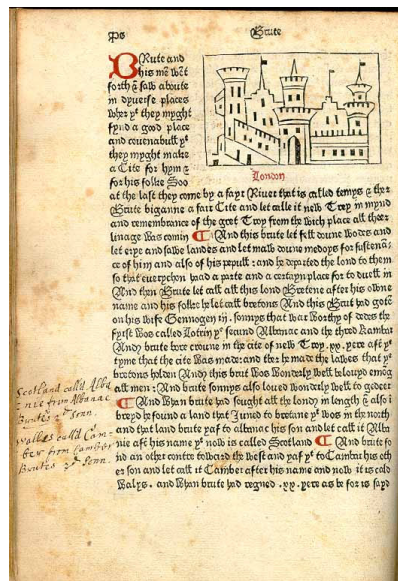
1 Fourth reason



1 Abbey Gateway, St. Albans



1 1485 Chronicles of England



Printed on that press. Note how it imitates a manuscript.

1 The Book

Until the introduction of printing, books were rare, and very, very expensive, maybe something like the same price as a small farm.

Only very rich people, and rich institutions, owned books.

The first Universities were set up before printing; to borrow a book, a student had to copy it as payment. Usually book lenders only lent you part of the book at a time, to speed up the copying.

In 1424 The University of Cambridge had one of the largest libraries in Europe: 122 books.

1 Monasteries

The other producers of books were the monasteries.



"When the Anglo-Saxon Monkwearmouth-Jarrow Abbey planned to create three copies of the bible in 692—of which one survives—the first step necessary was to

1 Comments

Producing books was slow, expensive, time-consuming, and tedious, as evinced by some of the remarks written by monks that have survived in the margins of manuscripts:

Oh, my hand.

Thank God it will soon be dark.

Writing is excessive drudgery. It crooks your back, it dims your sight, it twists your stomach, and your sides.

St Patrick of Armagh, deliver me from writing.

As the harbour is welcome to the sailor, so is the last line to the scribe.

Now I've written the whole thing: for Christ's sake give me a drink.

1 Book 1450



Gutenberg combined known technologies: ink, paper, wine presses, movable type.

1 1450



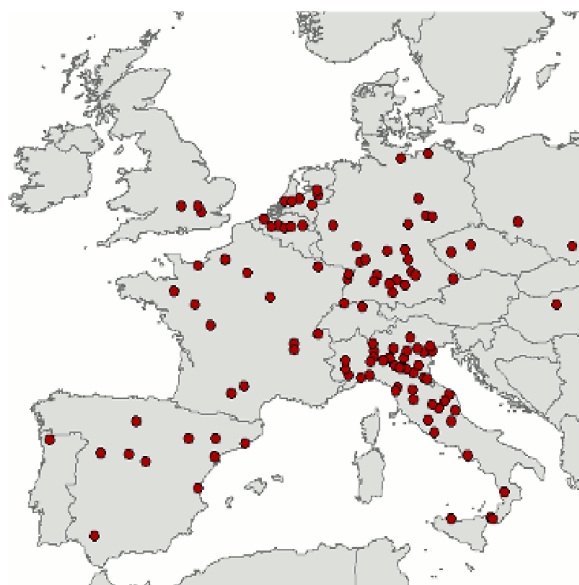
1 1460



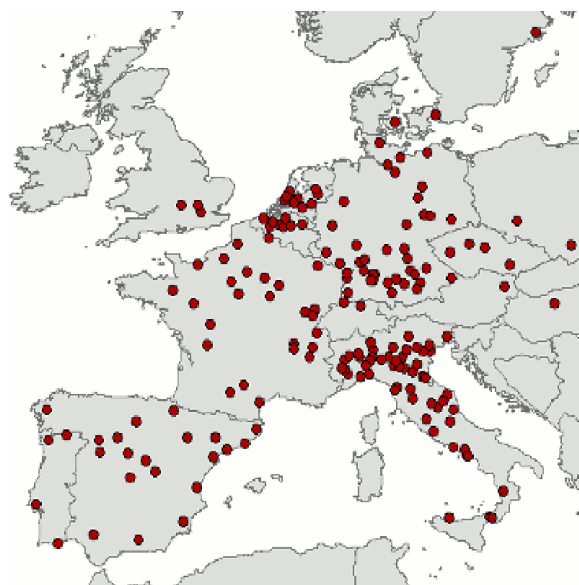
1 1470



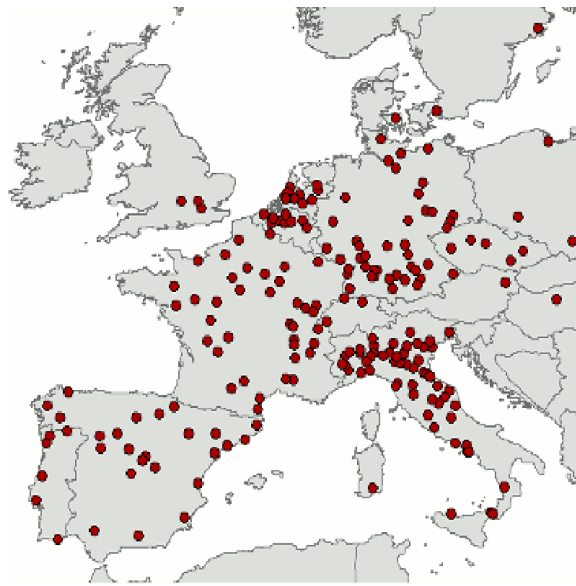
1 1480



1 1490



1 1500



[Image source.](#) [Data source.](#)

1 1500

By 1500: 1000 printing shops, had produced 35,000 titles in 20 million copies.

Price of books tumbled (First bible 300 florins, about 3 years wages for a clerk).

Books became a new means of distribution of information.

It was a paradigm shift - new industries, paper production, binders, publishers, bookshops, newspapers.

People had a reason to learn to read.

Printing enabled the rise of Protestantism, and the Enlightenment is ascribed to the availability of books.

1 Information control

Up until then, all information had been in the hands of the church (even universities were primarily religious institutions run by the church).

The church and state instituted censorship, to try and control information. Writers were killed or imprisoned for saying things that the church didn't like. (Such as Galileo for saying that the Earth moved)

Consequently many thinkers relocated to get out of the reach of the church.

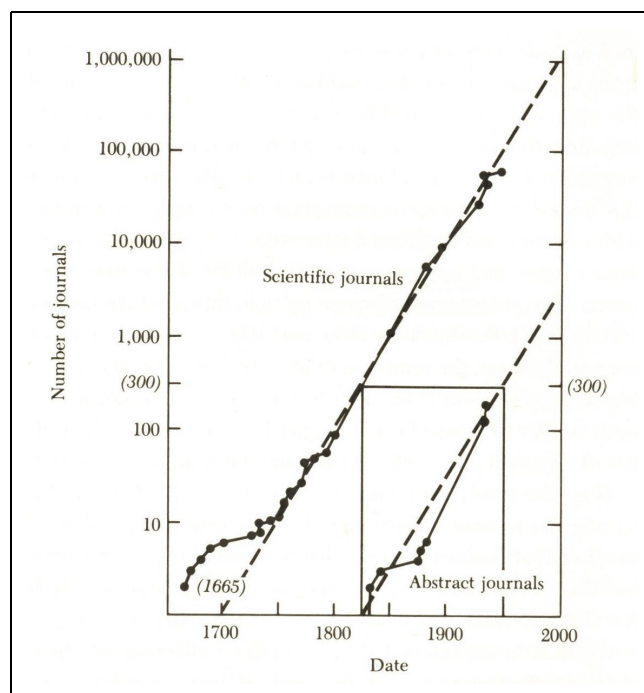
"The twin occurrences -- that the city became a hub for scientists, and that it became the centre of publishing -- fed one another, resulting in the astounding fact that, over the course of the 17th century, approximately one-third of all books published in the entire world were produced in Amsterdam" - Russell Shorto

1 Information increase

1665: first scientific journals French *Journal des Sçavans* and the British *Philosophical Transactions*

From then on the number of scientific journals doubled every 15 years, right into the 20th century.

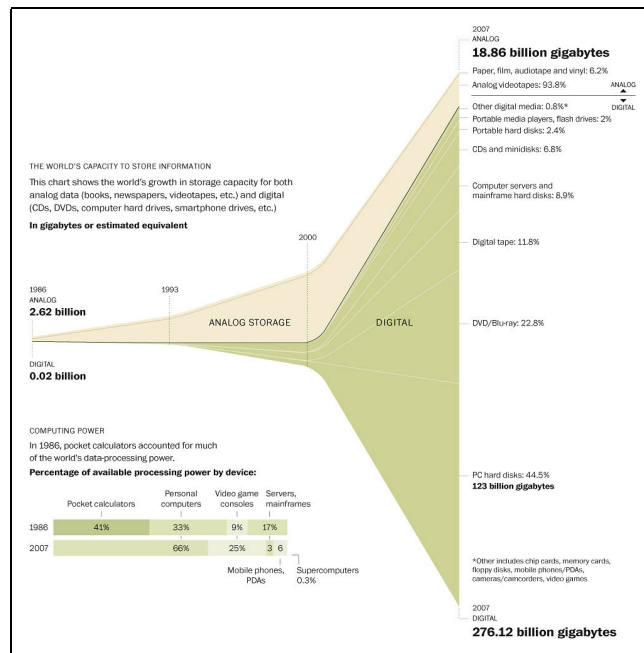
Even as late as the 1970's if you had said "there has to come a new way of distributing information to support this growth", they would have thought you crazy, more likely expecting the growth to end.



Information growth

But now that we have the internet, the amount of information produced continues to increase at an exponential rate. Maybe **doubling every year**.

Source

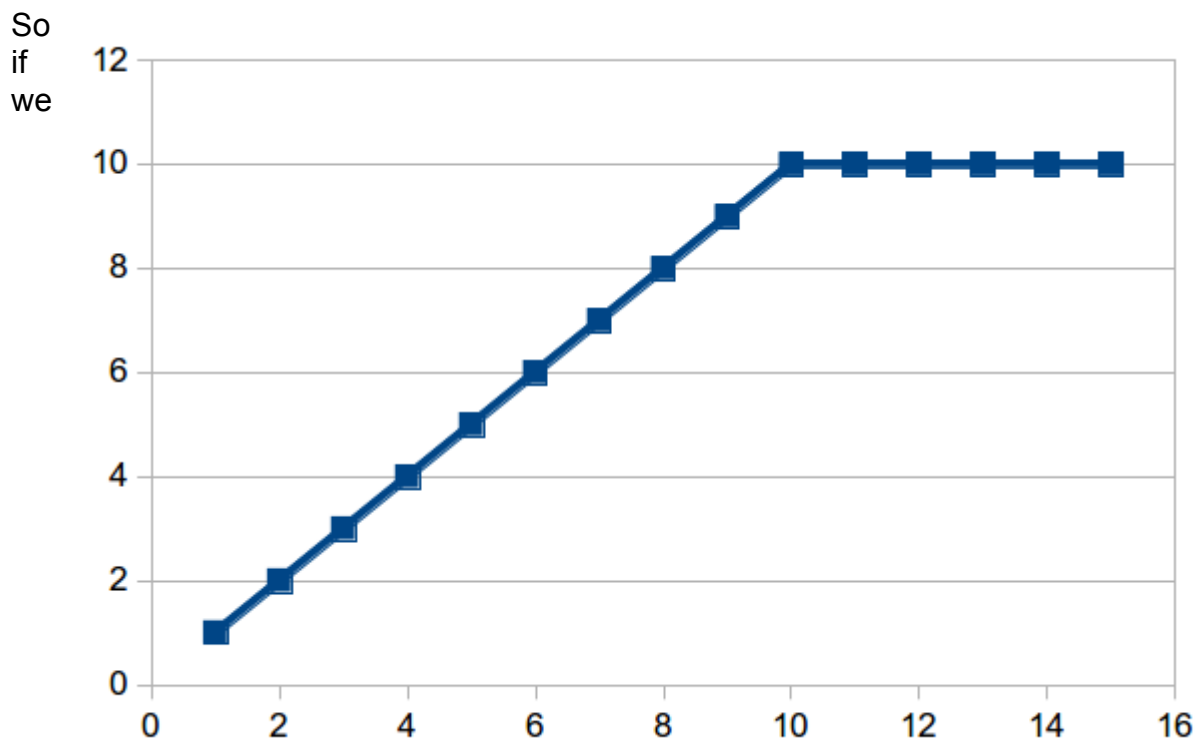


Exponential growth and orders of magnitude

If something doubles at regular intervals, it is called an exponential growth.

Note that a doubling per 2 years is the same as a 10 fold increase every 6 and a bit years; we call a 10-fold increase an *order of magnitude* change.

"An order of magnitude quantitative change is a qualitative change"



1 Multiplying

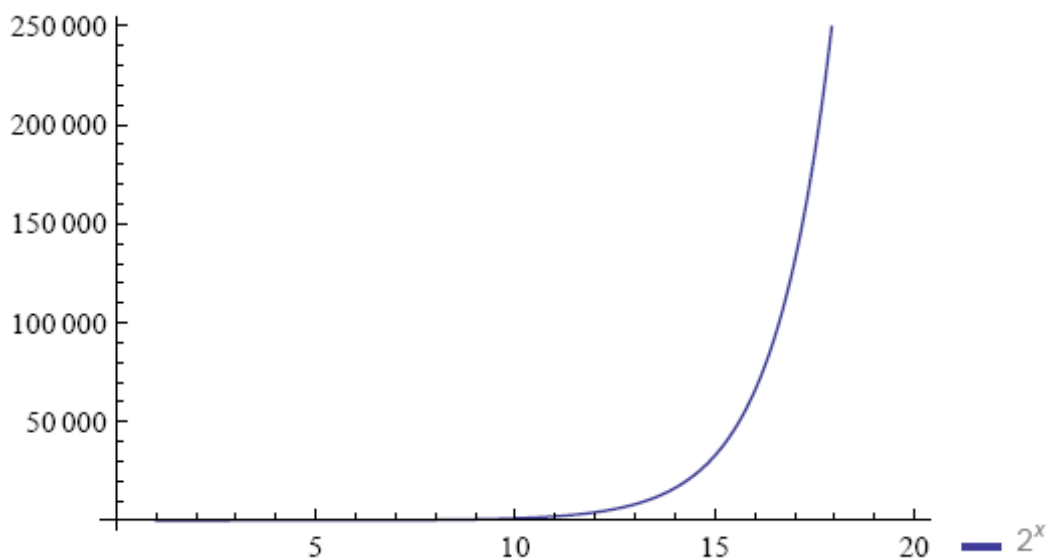
However, for instance, when a bank gives you interest on a bank account, it is not adding a fixed amount every year, but an amount based on how much you already have in the bank.

For instance, if they offer a 3% interest, then every year your money gets **multiplied** by 1.03.

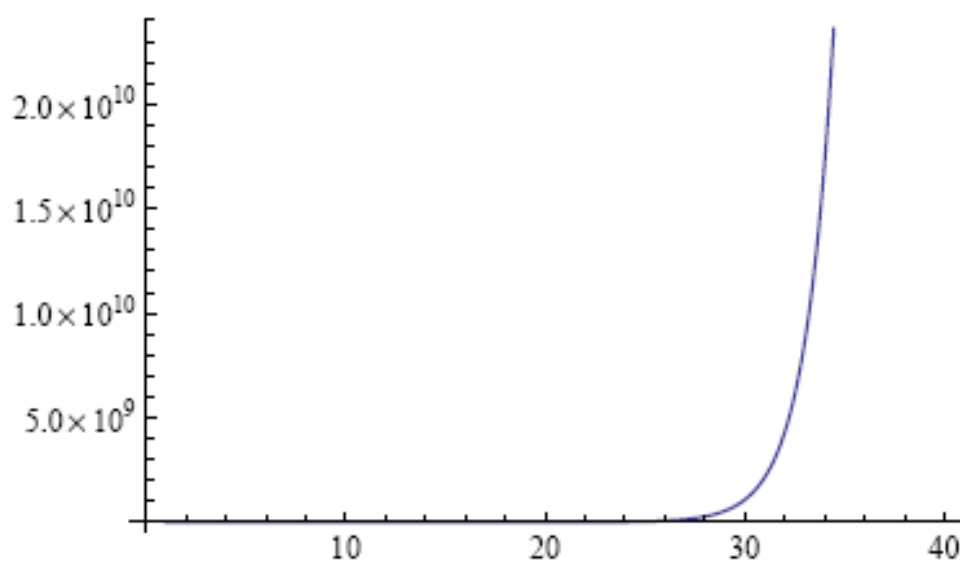
If you have €1000 in your account, then at the end of the year you will have $€1000 \times 1.03$, which is €1030. At the end of the second, you will have $€1030 \times 1.03$, which is €1060.90.

This is called an **exponential** function.

1 Exponential 20 iterations

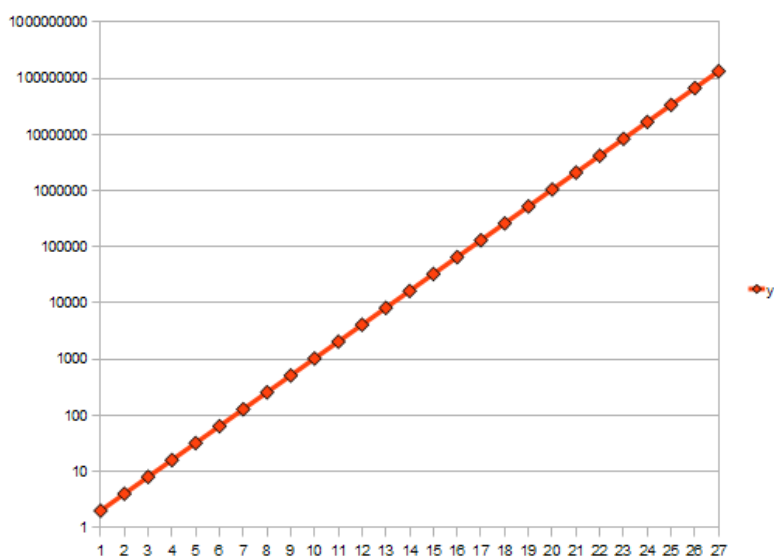


1 Scale, 40 iterations



Note how there now seems to be nearly no action before iteration 26. The 'knee' is a fiction, a visual effect of the scaling used.

1 Logarithmic scale



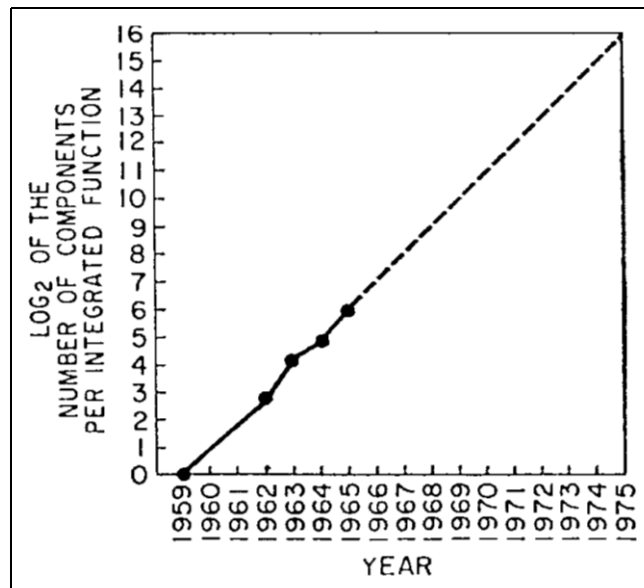
1 Moore's Law

In 1965 Gordon Moore predicted that integrated circuits would double their density each year at constant price 'for at least 10 years'.

In 1975 he adjusted that to a doubling every 18 months.

That's an order of magnitude increase every 5 years.

"An order of magnitude quantitative change is a qualitative change"



1 Reports of Moore's Law's death are greatly exaggerated

The first time I heard that Moore's Law was nearly at an end was in 1977. From no less than [Grace Hopper](#), at Manchester University.

Since then I have heard many times that it was close to its end, or even has already ended. There was a burst of such claims in 2015, which caused [a wag to tweet](#):

"The number of press articles speculating the end of Moore's Law doubles every eighteen months."

1 A data point: The Raspberry Pi

As an excellent example, in February 2015, almost exactly three years after the announcement of the first version, version 2 of the Raspberry Pi computer was announced.

- Six times faster
- Four times as many cores
- Four times as much memory
- Twice as many USB ports
- Same size
- Same price

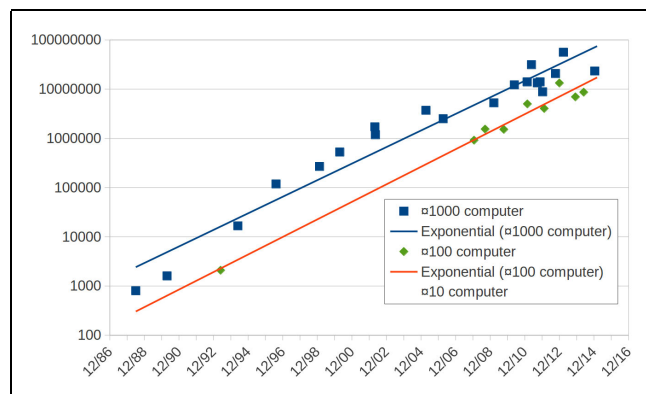


1 Moore's Law

So Moore's Law has been doing its work, and computers have been getting exponentially faster.

In 1988 my laptop had a power of 800. My present one has a power of nearly 30M. That is 15 doublings!

More amazing still: my current *mobile phone* has a speed of almost 115M!



Exponential change

This is November 2006:



What exponential growth really means

Often people don't understand the true effects of exponential growth.

A BBC reporter recently: "Your current PC is more powerful than the computer they had on board the first flight to the moon". Right, but oh so wrong (Closer to the truth: your current computer is several times more powerful than all the computers they used to land a man on the moon put together.)

1 Paper

Take a piece of paper, divide it in two, and write this year's date in one half:

2018	
-------------	--

1 Paper

Divide the other half in two vertically; write the date 18 months ago in half:

2018	2017

1 Paper

Divide the remains in half, and write the date 18 months earlier:

2018	2017	
	2015	

1 Paper

Repeat until your pen is thicker than the space you have to divide in two:

2018	2017	
	2015	2014
		2012

This demonstrates that your current computer is more powerful than all other computers you have ever had *put together* (and *way* more powerful than the computer they had on board the first moonshot).

1 The Internet

The internet was a cooperative effort.

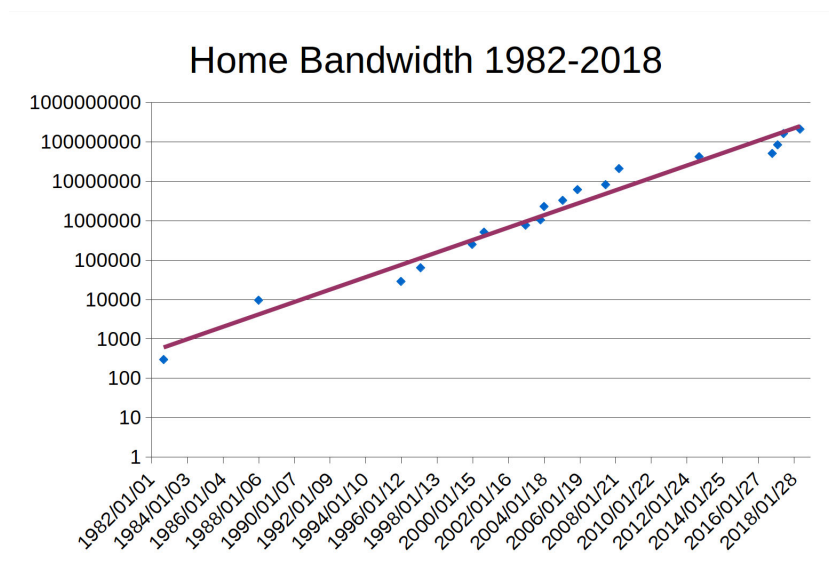
In 1988 arrived in Europe (Amsterdam): speed 64kbps connection for the whole of Europe to the whole of America. A year later that doubled to 128kb.

Since then it has nearly doubled per year. Even faster than Moore's Law!

1 6Tbps



Exponential Bandwidth Increase



The true cost of communication

Before 1988, phoning long-distance was expensive.

The further you phoned, the more expensive it was. This matched people's expectations.

In fact, the expensive part is the local loop: only one person (you) is using that. The long-distance part is amortised over 1000's of calls.

The internet made this all to clear: going to a site in New York is no more expensive than going to one locally (and now, phoning Amsterdam-New York is just as cheap as phoning Amsterdam-Amsterdam!)

1990 The Web

Tim Berners-Lee (and Robert Caillau) created the Web at CERN.

Like Gutenberg with the printing press, they brought together existing technologies (Hypertext, the internet, MIME types) and created a cohesive whole.

The Web is now replacing the book (along with many other things).

Telephone directories, encyclopaedias, train timetables, other reference works are already gone. Others will follow.

Books (as an artefact) will become a niche market. All information will be internet-based.

The true cost of content

To publish information in a book you need an expensive infrastructure: paper manufacture, printing presses, distribution channels, advertising, bookshops.

When you buy a book, the infrastructure consumes most of the price: typically the producer of the information (the author) gets 10%.

But with the internet, you no longer need that infrastructure; anyone can publish, even from home.

The book made everyone a reader.

The internet makes everyone a publisher.

1 **Usage of new technologies**

Typically people expect that we will use new technologies in the same way we use existing ones.

Steam engines in factories: there was one engine, with lots of pulleys to distribute the power over the factory.

It was assumed that the same would happen with electric engines: one engine in the house with pulleys taking the power to where you needed it.

In houses they thought there would be vacuum cleaner tube attachment points in every room, with one central motor in the basement doing the sucking...

Same with mainframe computers: it was assumed 5 would be enough. Why would people want personal computers? They don't need to do payrolls!

1 **The new imitates the old**

The first books looked like manuscripts.

The first cars looked like carriages.

First radio was like plays, actors still had to dress up.

And the Web is (still) imitating old media.

1 The Future

The current internet is still very immature.

It took 50 years before the idea caught hold that books didn't need to imitate manuscripts.

We are still feeling our way in society in how to use and deal with the internet.

1 What is to come

Interlinking of services.

All information freely available.

Internet everywhere, lights, oven, your alarm clock, everything connected.

All communication via internet.

Everyone a publisher.

Nothing unavailable, nothing ever going 'out of print'.

1 Paradigm shift

A lot of existing information is distributed by people who have concentrations of the means of distribution, and that is the reason they exist.

- Newspapers
- Books
- Scientific publications
- Music.

Music industry is healthy, record industry is not.

Old media is struggling to retain ownership.

1 A second enlightenment?

We are at a turning point in history. The internet is going to have as great an effect on society as the book did, only *much* quicker.

We are in a turbulent period now because we are historically seen in the midst of a paradigm shift.

Will we get a second enlightenment?

"We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run." Roy Amara, The Institute for the Future