

Future Networking Needs

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The Brief

Discuss: “the nature and requirements of computer communications networks that will be needed by society 50 years from now”

My thoughts on this question

What if this question had been posed in 1971?

Or even in 1921?

Moving back 100 years

What might we have said in 1921 about the public communications requirements for 2021?

- Postage dominated the mass market and the telegram was the premium service
- Radio and telephony deployment were picking up pace and entering the next phase of mass deployment
- What we would've probably missed (or maybe dismissed) in 1921:
 - The rise and fall of the fax
 - Television
 - Computers
 - Digital environments

Moving back 50 years

What might we have said in 1971 about the requirements for 2021?

- What was happening
 - “mini-computing” was gathering momentum
 - Unix had been developed as a “lightweight” Multix (on a PDP-7)
- What should’ve been seen as significant at the time, but might have been missed
 - Transformation of computers into a consumer product
 - Transformation of the role of data into information
- We thought about communications through the lens of the telephone network
 - Packet networking was being developed, but it was unclear whether these packets were quanta of data or quanta of sessions (datagrams vs virtual circuit)

What's happened since 1971?

It used to be so simple...

1980's:

- The network was the transmission fabric for computers
- It was just a packet transmission facility
- Every other function was performed by attached mainframe computers



Then we went client/server

1990's:

- The rise of the Personal Computer as the “customer’s computer”
- We started to make a distinction between “customers” and “network”
 - The naming system was pulled into the network
 - The routing system was pulled into the network
 - Messaging, content and services were pulled into the network
- We created the asymmetric client/server network architecture for the Internet



Internet Infrastructure of 2000

Rapid expansion of infrastructure in many directions:

- Exchanges, Peering Points and Gateways
- Tier 1 ISPs
- Transit and Traffic Engineering
- Data Centres and Service “Farms”
- Quality of Service Engineering
- MPLS, VPNs and related network segmentation approaches
- Customer Access Networks
- Content Distribution Networks



Aren't these all "different" networks?

- Well, yes they are
- The true genius of the Internet was to separate the service environment from the link technology
 - Each time we invented a new comms technology we could just “map” the Internet onto it
 - This preserved the value of the investment in “the Internet” across successive generations of comms technologies

Then along came mobility in 2007



The iPhone was a breakthrough product that completely transformed the computer and communications environment and touched just about everything else!

The Rise and Rise of the Internet

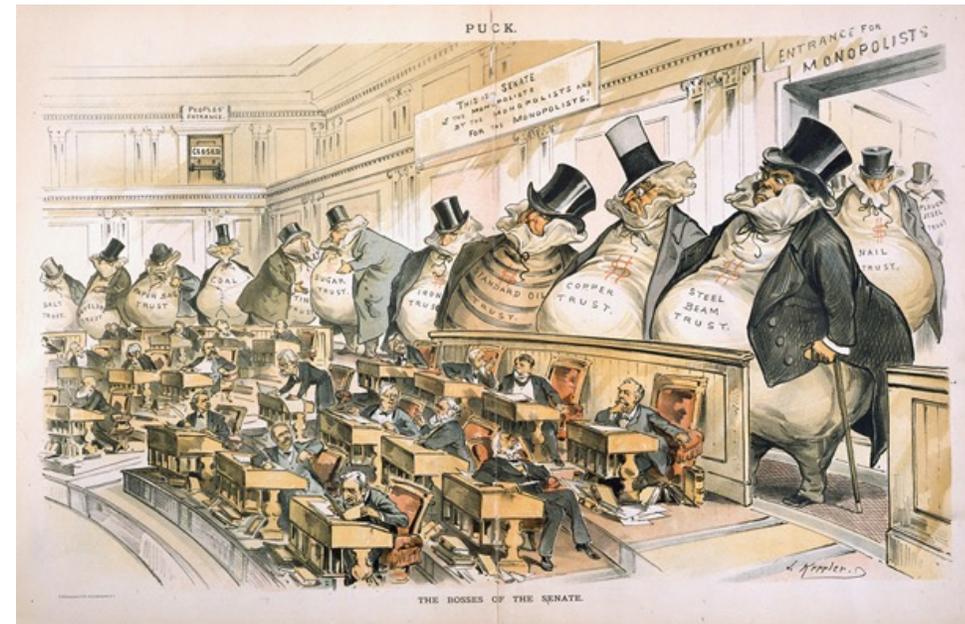
- There were few natural barriers to growth
 - No labour force limitations
 - No geographic limitations
 - No regulatory inhibitors
 - No coherent business models to follow, so investors became irrationally optimistic over future growth potential
- Digital business models quickly became global in scope
 - Uber, WeWork, Cisco, Microsoft, Amazon, Apple, etc
- This “winner take all” environment created an environment that is dominated by a small number of giant enterprises that operate at a global scale

Enter the Giants

- The 90's was characterized by the triumphs of deregulation and innovation
- Thousands of enterprises funded by a relatively small pool of venture capital occupying new digital real estate
- Then moving on to take on the established market players

The Internet's Gilded Age

At some point in the past decade or so the dominant position across the entire Internet has been occupied by a very small number of players who are moving far faster than the regulatory measures that were intended to curb the worst excesses of market dominance by a small clique of actors.



Tech Giants Amass a Lobbying Army for an Epic Washington Battle



Catlin O'Neill, right, listening to Facebook's chief executive, Mark Zuckerberg, testify before a House committee on the protection of user data last year. Ms. O'Neill is now director of United States public policy for Facebook after serving as Speaker Nancy Pelosi's chief of staff.
Tom Williams/CQ Roll Call, via Getty Images

By Cecilia Kang and Kenneth P. Vogel

June 5, 2019

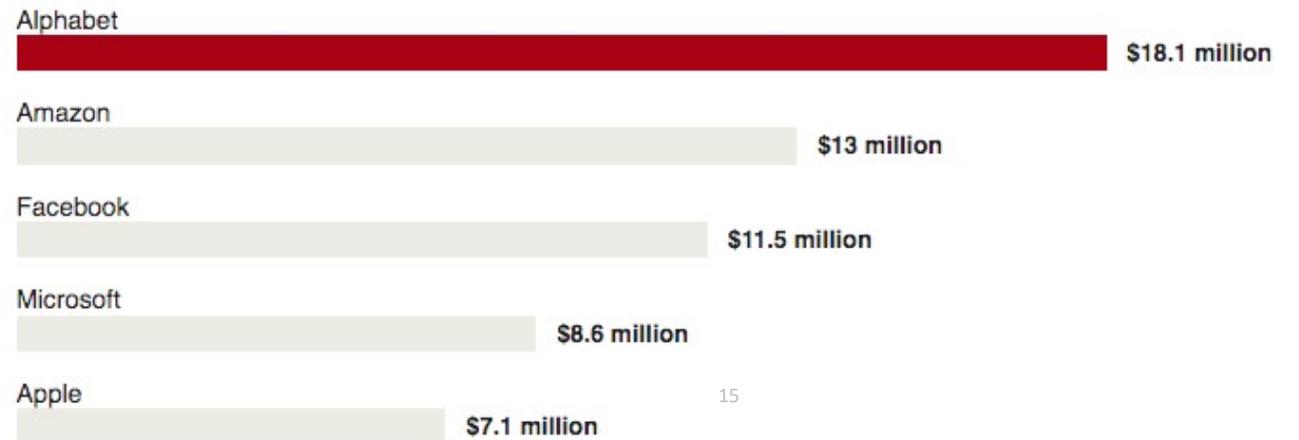


WASHINGTON — Faced with the growing possibility of antitrust actions and legislation to curb their power, four of the biggest technology companies are amassing an army of lobbyists as they prepare for what could be an epic fight over their futures.

Gilded Age



Total 2017 federal lobbying spends by tech giants

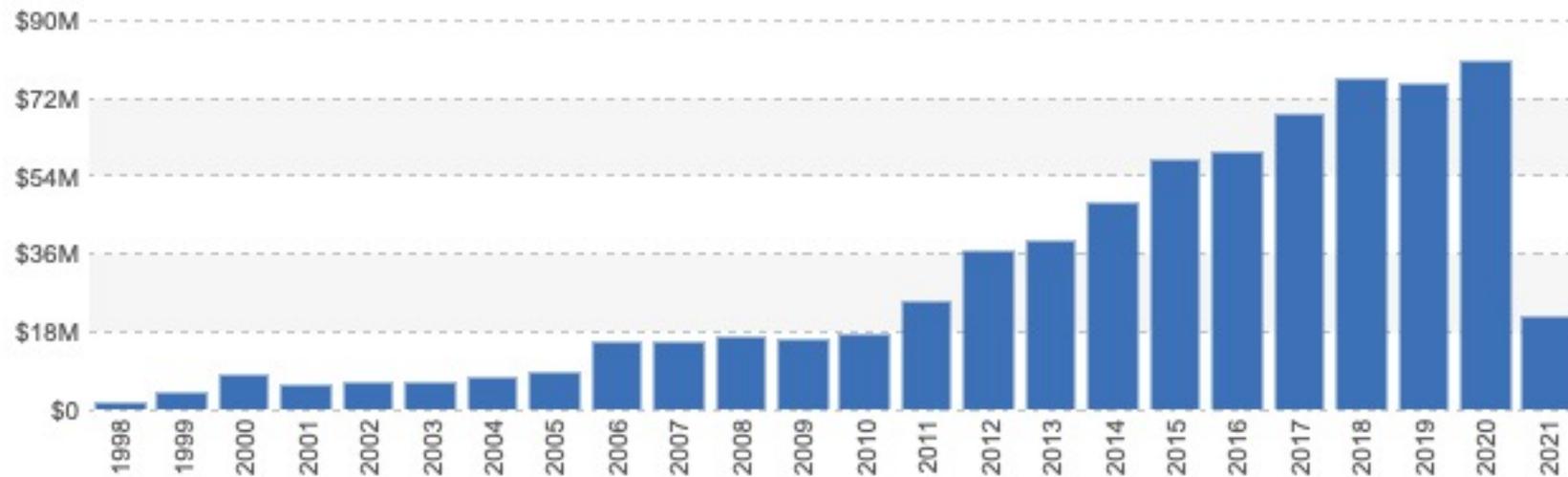


SOURCE: Open Secrets

The Internet's Gilded Age

At some point, the digital Internet will be so small that it will be far from the center of that vast, excess-driven clique.

Annual Lobbying on Internet



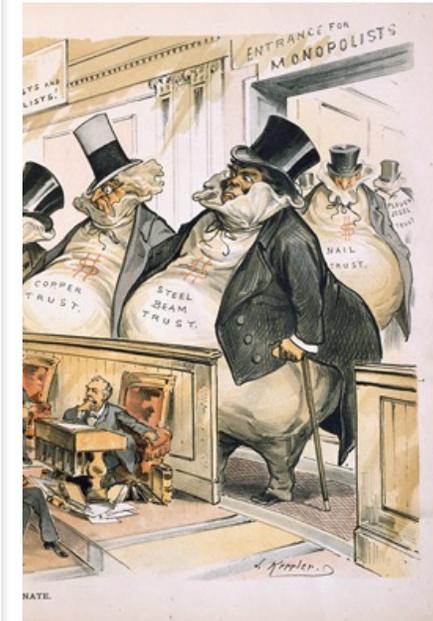
Source: Open Secrets

The Internet's Gilded Age

2020 Lobbying Sources - US

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Client/Parent	Total
Facebook Inc	\$19,680,000
Amazon.com	\$18,685,000
Alphabet Inc	\$8,660,000
Alibaba Group	\$3,160,000
ByteDance Inc	\$2,610,000
SalesForce.com	\$2,050,000
IAC/InterActiveCorp	\$1,810,000
Twitter	\$1,540,000
Tencent Holdings	\$1,524,000



17

Source: Open Secrets

Today's Giants

One fossil fuel extractor, one investment fund and a legacy carryover from the last gilded age – and all the rest are technology enterprises

And only 1 is Chinese.

Rank	Name	Market Cap
1	 Microsoft MSFT	\$2.496 T
2	 Apple AAPL	\$2.468 T
3	 Saudi Aramco 2222.SR	\$2.003 T
4	 Alphabet (Google) GOOG	\$1.926 T
5	 Amazon AMZN	\$1.696 T
6	 Tesla TSLA	\$1.175 T
7	 Meta (Facebook) FB	\$912.04 B
^{^1} 8	 NVIDIA NVDA	\$655.08 B
[∨] 1 9	 Berkshire Hathaway BRK-A	\$651.12 B
10	 Tencent TCEHY	\$590.14 B
11	 TSMC TSM	\$588.66 B
12	 JPMorgan Chase JPM	\$505.50 B

The Internet's Gilded Age

These actors have enough market influence to set their own rules of engagement with:

- Users,
- Each other,
- Third party suppliers,
- Regulators and Governments

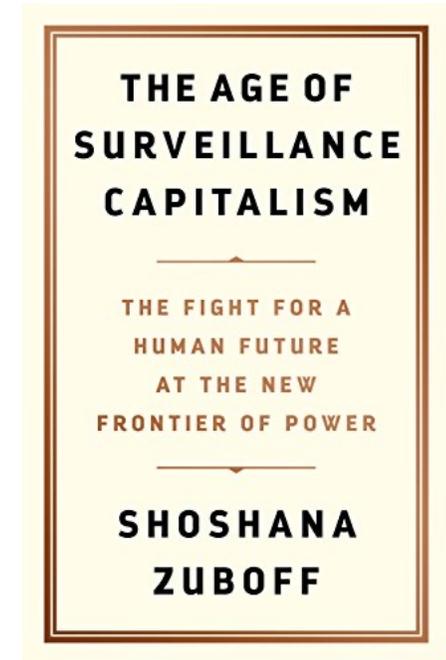
By taking a leading position with these emergent technologies, these players can amass vast fortunes, with little in the way of accountability to a broader common public good

There are side-effects

- In order to understand what each consumer wants, the service provider needs to understand the consumer
- Which brings us to...

Surveillance Capitalism

- Much of the wealth and impact of these activities is built upon a foundation of aggregation of individual user behaviour and construction of personal profiles
- It also has benefitted from a cavalier attitude towards data security and privacy concerns and the absence of regulatory imposts that attempt to safeguard some basic common aspects of personal privacy



Change and Monopolies

- We are now communicating with a computer-mediated environment rather than with each other
- The network itself is largely incidental to this evolving story, and this is not really about the Internet any more
- It's about a set of revolutionary social changes on a par with the industrial revolution that have been triggered by abundant computing, storage and comms
- And it's dominated by a very small cartel of monopolists

Change and Monopolies

- We are now communicating with a computer-mediated environment rather than with each other

• “Every monopoly and all exclusive privileges are granted only at the expense of the public interest”
Andrew Jackson, 1830

- Social changes on a par with the industrial revolution that have been triggered by abundant computing, storage and

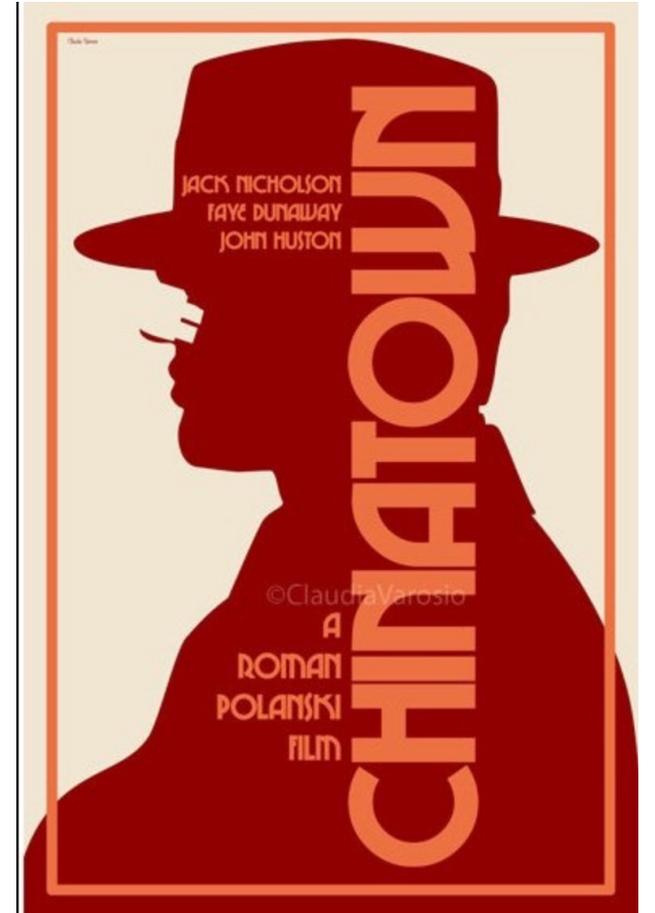
- And it's dominated by a handful of monopolists



Incumbency Rewards

Gittes: How much are you worth?
Cross: I've no idea. How much do you want?
Gittes: I just want to know what you're worth.
Over ten million?
Cross: Oh my, yes!
Gittes: Why are you doing it? How much better can
you eat? What can you buy that you
can't already afford?
Cross: The future, Mr. Gittes - the future!

Chinatown (1974)



What about the next 50 years?

- The seeds of the dominant factors of the environment in 50 years from now are probably with us today
- The problem is that a lot of other seeds are here as well, and sifting out the significant from the merely distracting is the challenge
- So with that in mind lets work out the big drivers in today's environment...

What's driving change today?

Scale

“The only real problem is scaling. All others inherit from this.”

Attributed to Mike O'Dell

Bigger



- Increasing **transmission capacity** by using photonic amplifiers, wavelength multiplexing and phase/amplitude/polarisation modulation for fibre cables
- Serving content and service transactions by distributing the load across many individual platforms through **server and content aggregation**
- The rise of high capacity mobile edge networks and mobile platforms add massive volumes to content delivery
- To manage this massive load shift we've stopped pushing content and transactions across the network and instead **we serve from the edge**

Faster



- Reduce latency - stop pushing content and transactions across the network and instead **serve from the edge**
- The rise of CDNs serve (almost) all Internet content and services from massively scaled distributed delivery systems.
- The “Packet Miles” to deliver content to users has shrunk - that’s faster!
- The development of high frequency cellular data systems (4G/5G) has resulted in a highly capable last mile access network with Gigabit capacity
- Applications are being re-engineered to meet faster response criteria
- Compressed interactions across shorter distances using higher capacity circuitry results in a faster Internet

Better



- If “better” means “more trustworthy” and “more privacy” then we are making progress at last!
 - Encryption is close to ubiquitous in the world of web services
 - TLS 1.3 is moving to seal up the last open TLS porthole, the SNI field
 - Oblivious DNS and Oblivious HTTP is moving to isolate knowledge of the querier from the name being queried
 - The content, application, and platform sectors have all taken the privacy agenda up with enthusiasm, to the extent that whether networks are trustable or not doesn’t matter any more – all network infrastructure is uniformly treated as untrustable!

Cheaper



- We are living in a world of abundant comms and computing capacity
- And working in an industry when there are significant economies of scale
- And being largely funded by capitalising a collective asset that is infeasible to capitalise individually
- The result is that a former luxury service accessible to just a few has been transformed into an affordable mass-market commodity service available to all
 - but provided by a small clique of providers!

So it's all good!

Right?

So it's all good?

Or maybe not.

Some issues to think about

What matters in such a network?

- Addressing – IPv4 / IPv6 / IPv? Absolute? Relative?
 - Is universal unique end-point addressing a 1980's concept who's time has come and gone?
- Naming and Name Spaces – DNS evolution?
 - Are "names" a common attribute of the network, or an attribute of a service environment?
- Referential Frameworks?
 - In a world of densely replicated service delivery points how does a client rendezvous with the "best" service point? Does the client work it out? Or the network? Or the service?

Some issues to think about

What matters in such a network?

- If we don't try to share our transactions across a common network then what are we asking from common infrastructure?
- If anything!

Longer Term Trends?

Pushing EVERYTHING out of the network and over to the edge!

- Transmission infrastructure is becoming an abundant commodity
 - Sharing technology (multiplexing) is decreasingly relevant
- We have so much network and computing that we no longer have to bring consumers to service delivery points - instead, we are shifting services towards consumers and using the network to replicate servers
- With so much computing and storage the application is becoming the service, rather than just a window to a remotely operated service

Do Networks matter any more?

- We have increasingly stripped out network-centric functionality in our search for lower cost, higher speed, and better agility
- We are pushing functions out to the edge and ultimately off “the network” altogether and what is left is just dumb pipes
- What defines “the Internet”?
 - A common network, a common protocol and a common protocol address pool?
 - or
 - A disparate collection of services that share common referential mechanisms?

What will "Internet Governance" mean anyway?

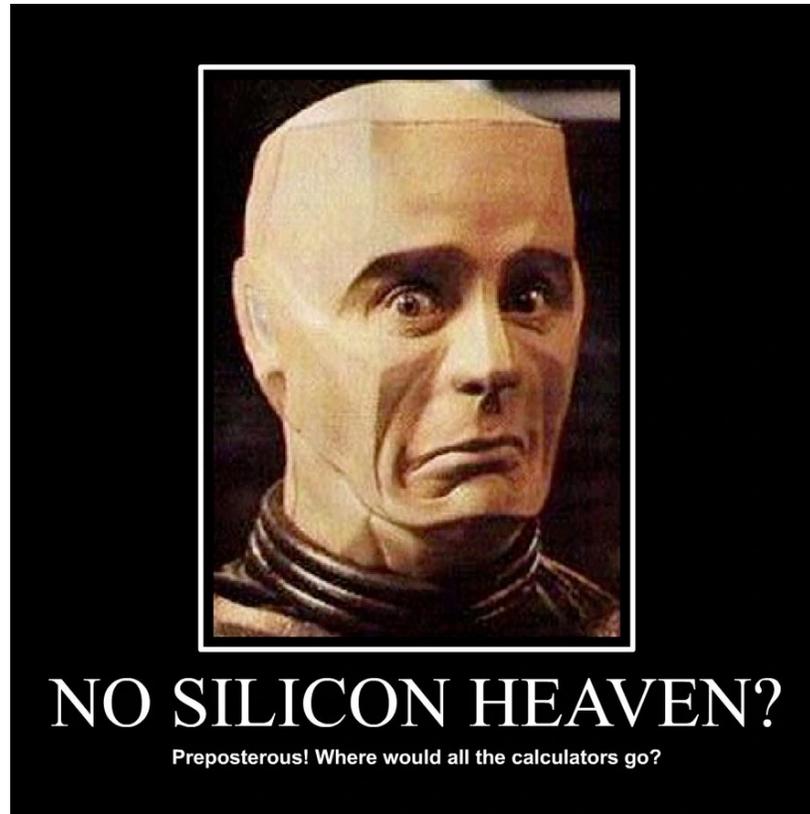
- There has been no governance at all in the Internet's 50 year old history so far
 - Its just been the relentless pressure of deregulated markets
- The only discernible trend has been the progressive shift in value up the protocol "stack"
 - From networks to platforms to applications
 - As value moves up commodity economics comes in its wake
 - Networks are cheap utilities, platforms are now valueless

Maybe it's just User Preference

- Dismantling the telco monopoly ripped apart the command and control economy of communications
 - And when governments stopped investing they lost their seat at the table
- What's left is a market where user preferences rule
 - Forecasting user preferences is good
 - Shaping user preferences is better
 - And monetising user preferences is better still!

Wherever we're heading...

- It's not the Internet any more
- That has already died and gone to silicon heaven!



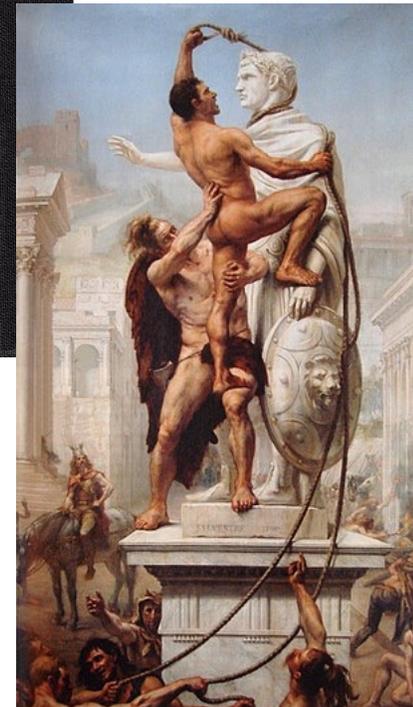
Sic transit gloria mundi

In 1776 English historian Edward Gibbon published a mighty 6 volume work tracing the Roman Empire (and Western Civilisation) from the height of Empire to the fall of Byzantium

The seeds of of the empire's eventual decline and fall were sown early in its rise

The 100 best nonfiction books: No 83 - The History of the Decline and Fall of the Roman Empire by Edward Gibbon (1776-1788)

Perhaps the greatest and certainly one of the most influential history books in the English language retains its power today



Thanks!