The Evolution of Carriage and Content

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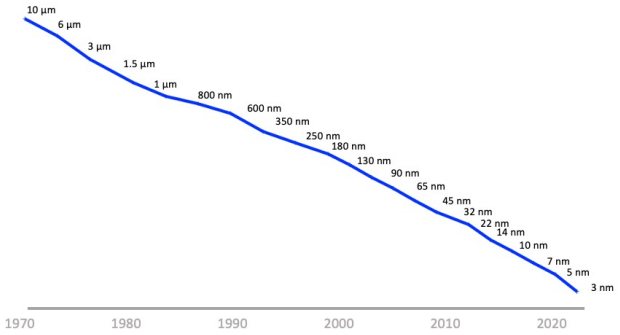
Conversations change

When we talked about the Internet:

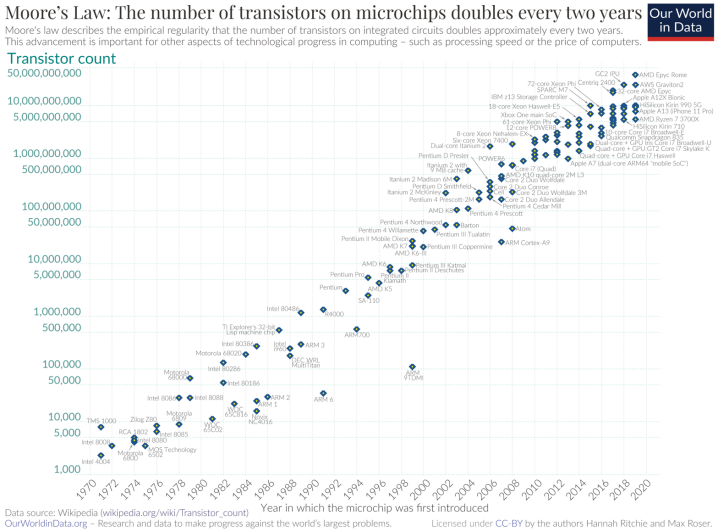
- We used to talk about *Tier 1 transit providers*, *peering*, *settlements*, and *customer cones*
- Then we talked about *Exchange Points*, *Data Centres* and *content peering*
- Now we are talking about *autonomous content distribution networks* and embedding content in access networks

Why is this such a rapidly changing environment?

The Driver of Change: Moore's Law



Silicon Chip Track Width over time



Silicon Chip transistor counts

Year	Mode	Baud	Capacity/Lambda	Cable Capacity	DSP
2010	PM-QPSK	32 GBd	100G	8T, C-Band	40nm
2015	PM-16QAM	32 GBd	200G	19.2T, Ext C	28nm
2017	PM-32QAM	56 GBd	400G	19.2T, Ext C	28nm
2019	PM-64QAM	68 GBd	600G	38T, Ext C	16nm
2020	PS-PM-64QAM	100 GBd	800G	42T, Ext C	7nm
2022	PCS-144QAM	190 GBd	2.2T	105T, Ext C	5nm

Table 1 – Coherent Fibre Evolution

Year	Processor	Cores	Transistors	Clock	Cost	$/core
2019	Rome	64	40B	2.25GHz	$6,950	$109
2022	Milan	64	26B	2.20GHz	$8,800	$138
2022	Genoa	96	90B	2.40GHz	$10,625	$110
2023	Bergamo	128	82B	2.25GHz	$11,900	$92

Table 2 – CPU performance and unit price over time – AMD processors

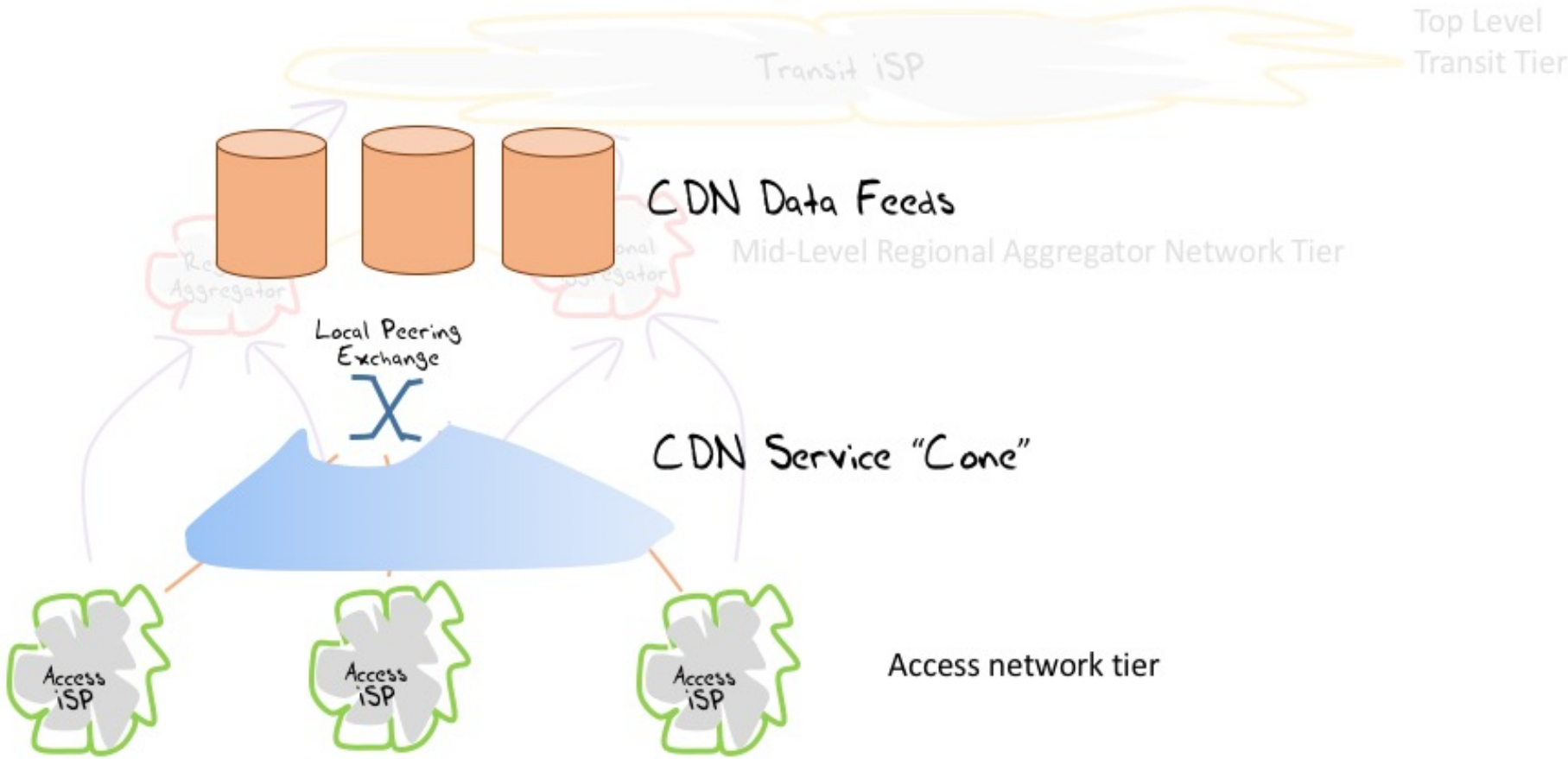
What does this mean?

- The economics of silicon chip evolution have a profound impact on the computing and communications space - **no technology can survive more than 5 years in this sector**!
- No business plan can survive more than 5 years!
- And given that the carriage sector is now a digital carriage platform, the carriage sector is no exception here

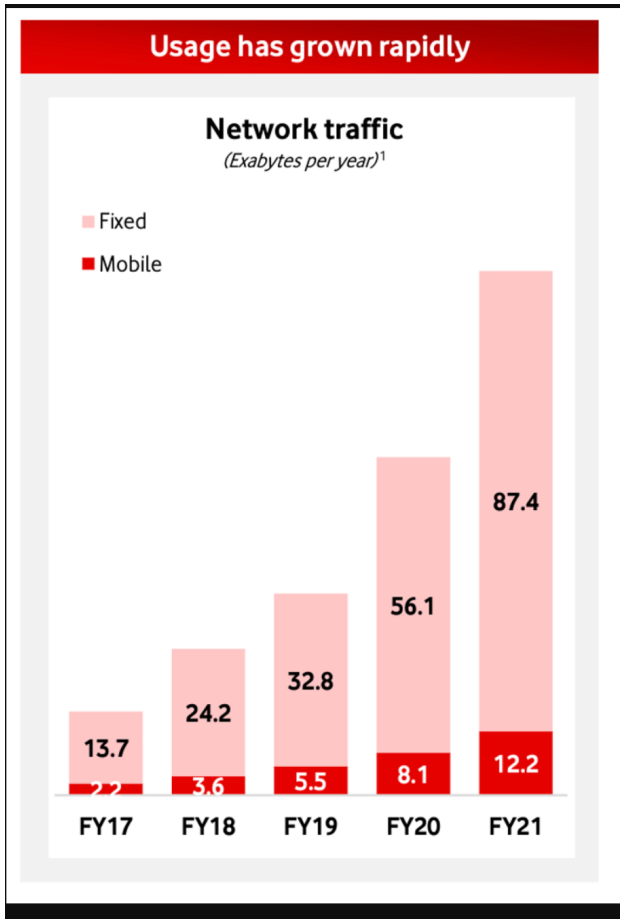
Change

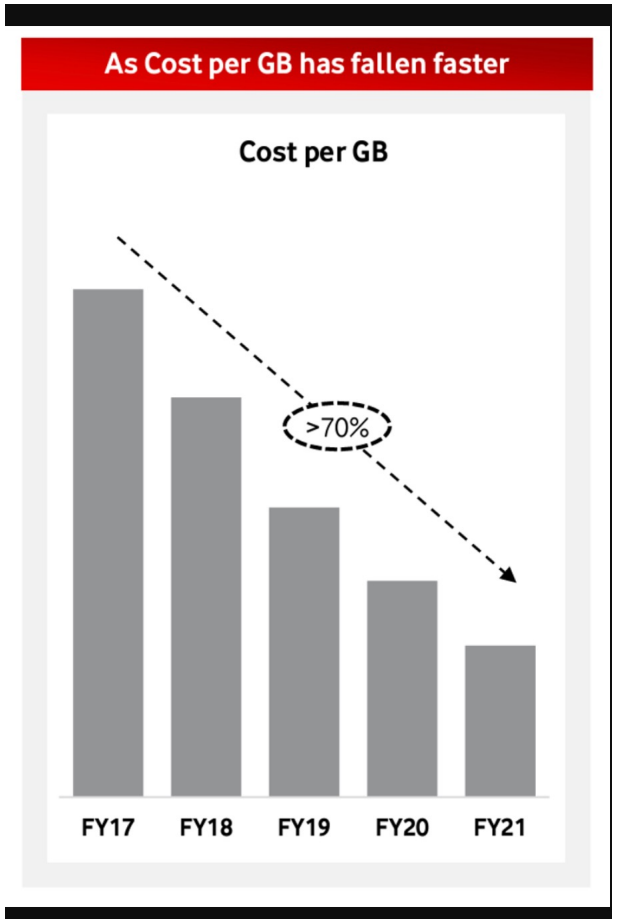
- Networks are no longer transit services that connect users to services
- Content distributors are using abundance of computing, storage and capacity to **bring content to users**
- We pre-provision content and service at the edge of access networks and no longer rely on networks to carry user's traffic to remote service points.

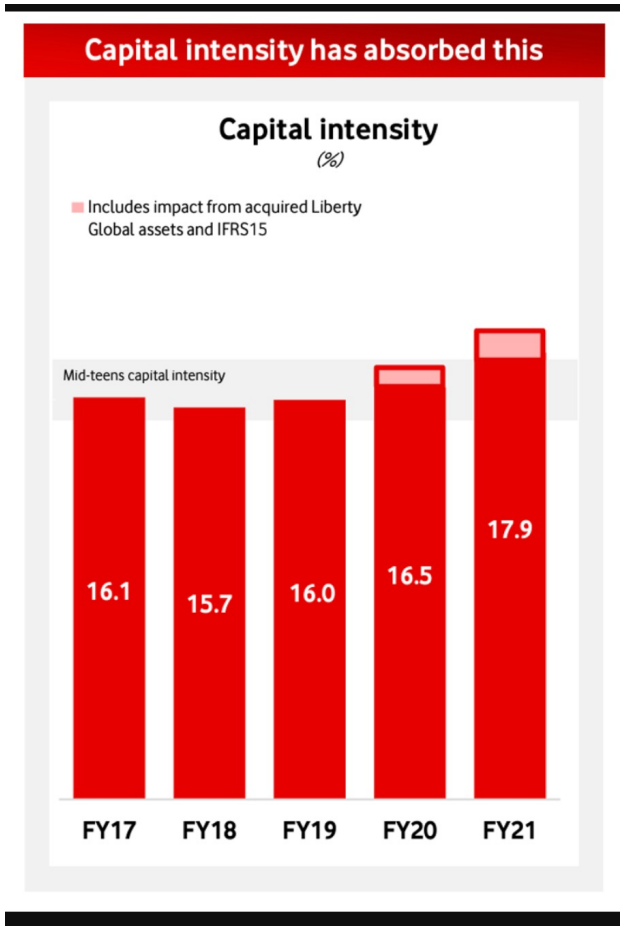
Today's Internet Architecture



Change







Source: [Vodaphone 2021 Investor Briefing]

Transit?

- Once the CDN caches sit “inside” the Edge NAT of the Access ISP then the entire wide area network becomes a marginal activity compared to the value of the content feeds!
- There is no public transit any more
  - Its just a collection of private distribution systems

Internet Names and Addresses?

If the Internet is just a collection of discrete CDN service ‘cones’ then why should we expect end users to pay for the maintenance of:

- A global address plan?
- A global name system?
- A single global network?

It's not just the Death of Transit

It’s the re-purposing of the entire network

- Service provisioning sits within cloud providers and distributed data centres
- Edge computers are now acting as televisions into the clouded world of data
- The distinction between personal and public data realms is disappearing into the realm of corporately owned private data empires

Exactly where are we?

- We started this journey in the 1970's wanting to build a telephone network for computers to communicate with each other
- We ended up building the digital counterpart to television networks
- One-way content distribution lies at the core of today's Internet volume and value
- This content distribution role is an enterprise service framework rather than a public carriage service
- The internal parts of the carriage network are now being privatized and removed from public regulatory scrutiny

Policy?

If CDN feeder networks are private networks, and there is little residual public carriage other than last mile access networks, then what do we really mean by “public communications policy”?

In the regulatory world ‘content’ is ***commerce***, not ***carriage***!

Policy?

In today's Internet what do we mean in a policy sense by concepts such as:

"***universal service obligation***"

"***network neutrality***"

"***rights of access***" or even

"***market dominance***"

when we are talking about diverse CDNs as the dominant actors in the Internet?

The Large and the Largest

2023 [edit]

This list is up to date as of 30 September 2023. Indicated changes in market value are relative to the previous quarter.

Rank	First quarter	Second quarter	Third quarter	Fourth quarter
1	Apple ▲2,609,000[28]	Apple ▲3,050,000[28]	Apple ▼2,677,000[28]	
2	Microsoft ▲2,146,000[29]	Microsoft ▲2,532,000[29]	Microsoft ▼2,346,000[29]	
3	Alphabet ▲1,332,000[30]	Alphabet ▲1,530,000[30]	Alphabet ▲1,662,000[30]	
4	Amazon ▲1,058,000[31]	Amazon ▲1,337,000[31]	Amazon ▼1,312,000[31]	
5	Nvidia ▲686,090[32]	Nvidia ▲1,044,000[32]	Nvidia ▲1,074,000[32]	
6	Berkshire Hathaway ▼677,770[33]	Tesla ▲829,670[34]	Tesla ▼794,200[34]	
7	Tesla ▲656,420[34]	Berkshire Hathaway ▲745,010[33]	Meta ▲772,490[35]	
8	Meta ▲549,480[35]	Meta ▲735,450[35]	Berkshire Hathaway ▲769,260[33]	
9	TSMC ▲482,410[36]	TSMC ▲523,410[36]	Eli Lilly ▲509,890[37]	
10	Visa ▲473,870[38]	Visa ▲497,370[38]	Visa ▼480,990[38]	

https://en.wikipedia.org/wiki/List_of_public_corporations_by_market_capitalization

Content Really is King

- None of these companies are a telephone company, or even a transit ISP, or even an ISP at all!
- Eight of them have pushed aside intermediary distribution networks in order to maintain direct relationships with billions of consumers
- These valuable consumer relationships are based on content services, not carriage

Content Consolidation

- There are **not** thousands of content service platforms
  - There are just a few left
- And the space is dominated by a small number of dominant actors who set the rules of engagement for all others

Content Consolidation

"The size and scale of the attacks that can now easily be launched online make it such that if you don't have a network like Cloudflare in front of your content, and you upset anyone, you will be knocked offline.

…

In a not-so-distant future, if we're not there already, it may be that if you're going to put content on the Internet you'll need to use a company with a giant network like Cloudflare, Google, Microsoft, Facebook, Amazon, or Alibaba.

…

Without a clear framework as a guide for content regulation, a small number of companies will largely determine what can and cannot be online.

https://blog.cloudflare.com/why-we-terminated-daily-stormer/ August 2017

What is truth anyway?

When everyone uses just one search engine then that engine defines a de facto “truth” and all others have to match its results

Consolidation?

Alphabet is primarily an advertising company that dabbles in blue-sky technology projects.

Never in the history of the world has a single company had so much control over what people know and think. Yet Washington has been slow to recognize that Google's power is a problem, much less embrace the obvious solution: breaking the company up.

Google accounts for about 90 percent of all Internet searches; by any honest assessment, it holds a monopoly at the very gateway to information in the modern world. From there, the company's power radiates outward, dominating everything from maps to smartphone operating systems to video distribution — vacuuming up huge quantities of highly specific data about users along the way.

Boston Globe , June 14 2018

Competition or Cartel?

With a small number of truly massive enterprises at the heart of the area of digital content and service is this still a space that is shaped by competitive pressures?

Or do these dominant incumbents get to set their own terms of engagement with each other, with users, and even with the public sector?

Competition or Cartel?

With a small number of truly massive enterprises at the heart of the area of digital content and service is this concerning as it is shaped by competitive pressures?

Or do these dominant firms set their own terms of engagement, with users, and even with the public?

As concerning as this might sound, it's not a novel situation!

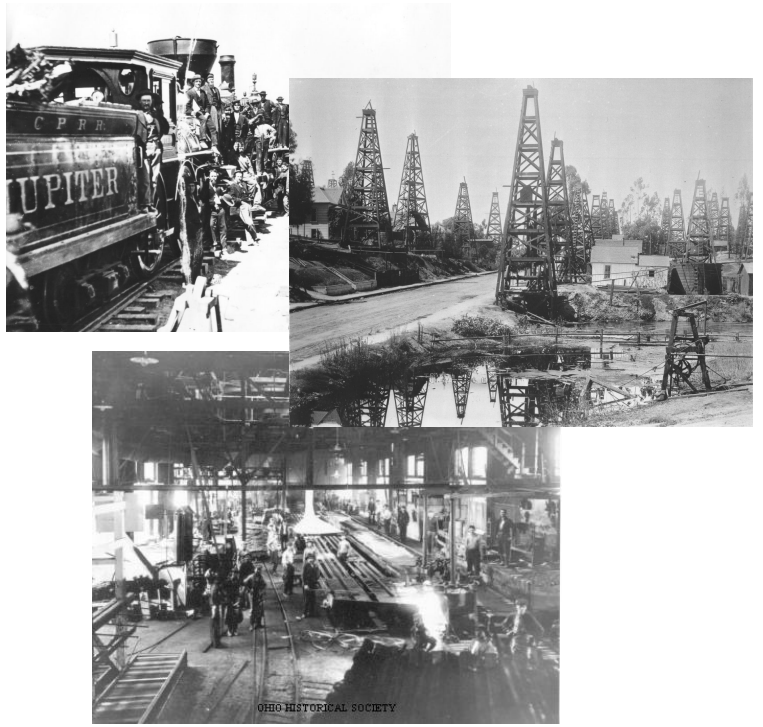
We've been here before…

High Museum of Art, Atlanta

The Gilded Age

A term applied to America in the 1870 – 1890's about the building of industrial and commercial corporate giants on platforms that were a mix of industrial innovation and enterprise with elements of greed, corruption and labor exploitation

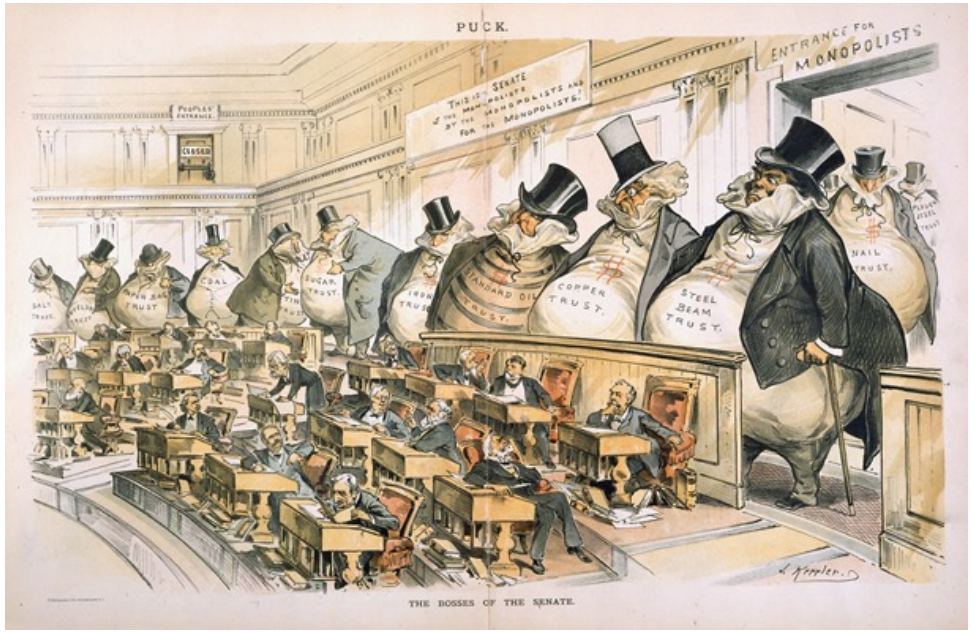
Andrew Carnegie - US Steel
John Rockfeller - Standard Oil
Theodore Vail - AT&T
George Westinghouse – Rail Brakes
Thomas Edison – General Electric
J P Morgan - Banking



The Gilded Age

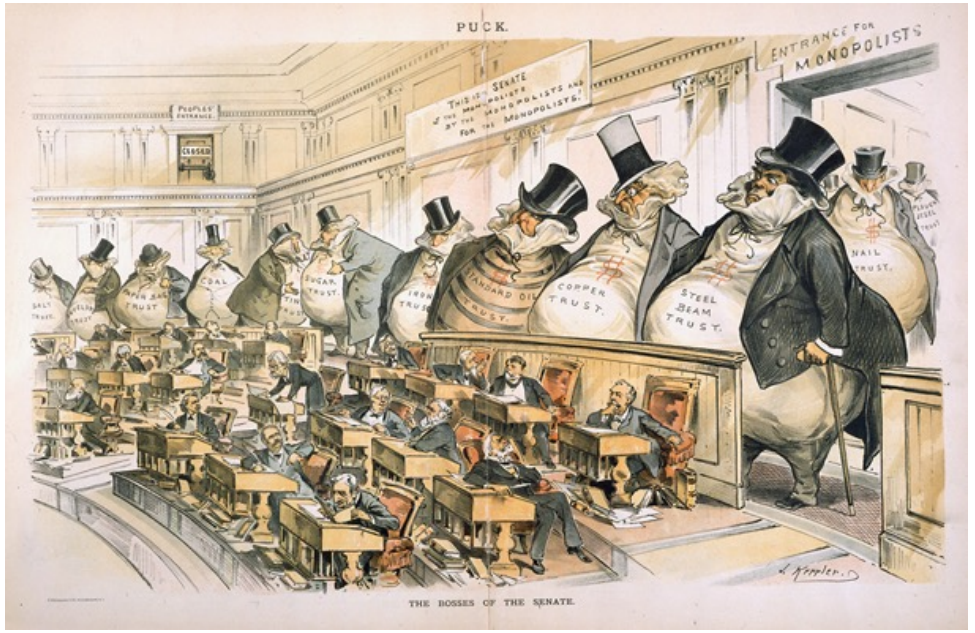
During this period in the United States the dominant position within industry and commerce was occupied by a very small number of players who were moving far faster than the regulatory measures of the day.

The resulting monopolies took the US decades to dismember, and even today many of these gilded age companies remain dominant in their field



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.



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 are able to amass vast fortunes, with little in the way of accountability to a broader common public good

The Internet's Gilded Age

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'is this the 'internet we were dreaming of?

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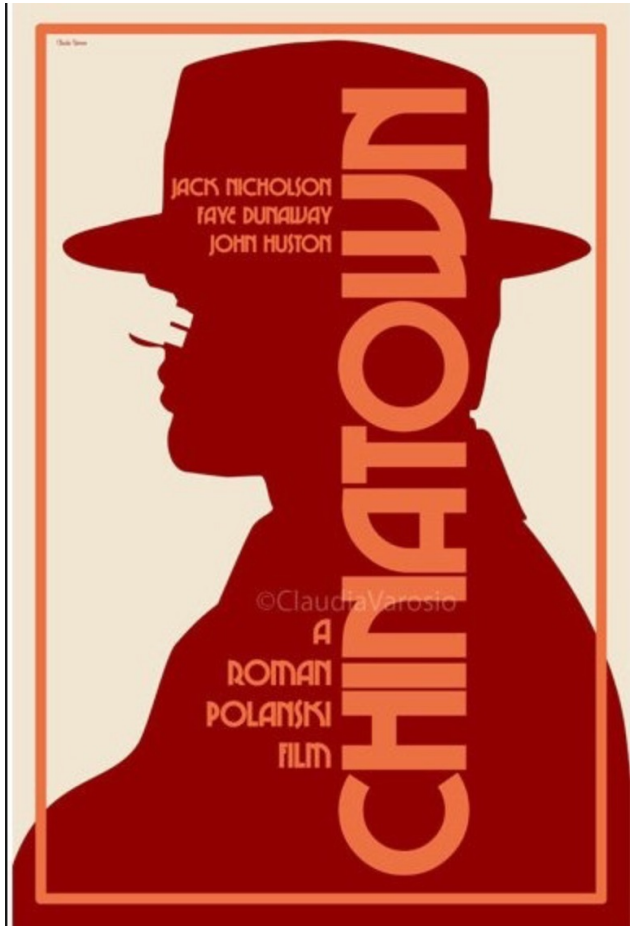
The Internet's Future

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 is this all about?

This is no longer just a conversation about incremental changes in carriage and communications within the Internet.

For me, the essential topic of this conversation is how we can strike a sustainable balance between an energetic cartel that has rapidly amassed overarching control of the digital service and content space, and the needs of the larger society in which we all would like some equity of opportunity to thrive and benefit from the outcomes of this new digital age.


The Economist
The next space race
Immigration's poisonous politics
Something's coming: Bernstein at 100
Our Big Mac index
The new titans

Thanks!