The Evolution of Internet Markets

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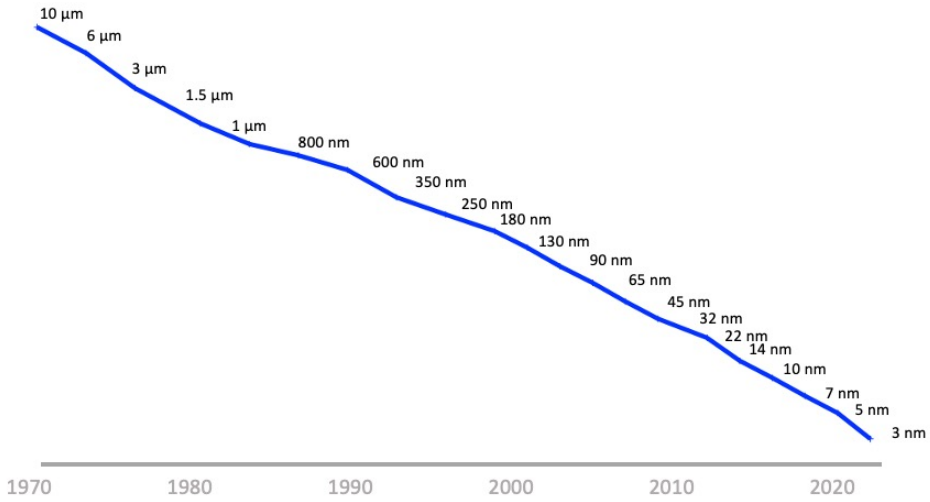
Conversations change

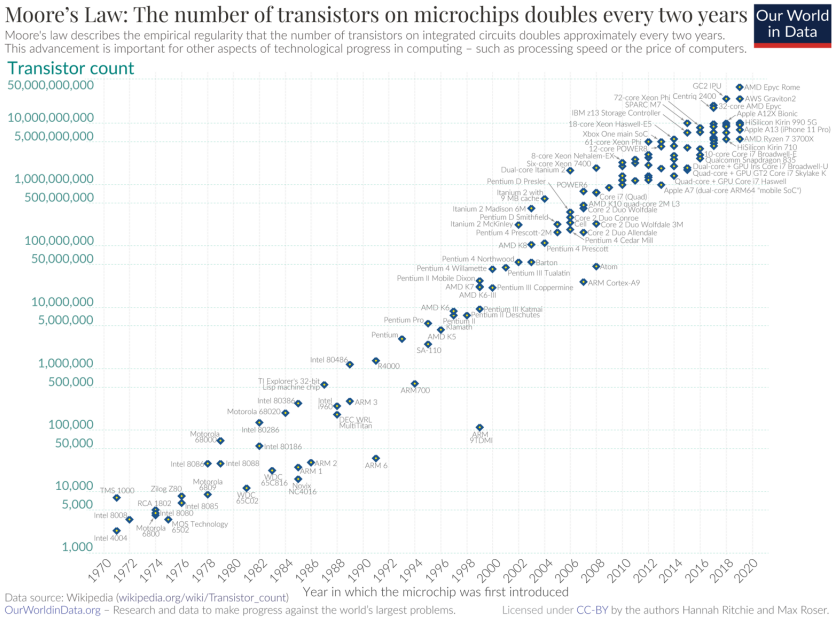
- In the Internet infrastructure world we used to talk about “Tier 1” transit providers, peering, paid peering, and customers
- Then we talked about Exchange Points, Data Centres and Peering
- Then autonomous content distribution networks and embedding content in access networks
- Today, the only topic we appear to talk about is AI!

- 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 space - few technologies has been able to survive more than 5 years in this sector!
  - What was too expensive, too slow, or just impossible to scale up becomes quickly viable when the currency of computation and storage changes so quickly
- The result is that no business plan has been able to survive more than 5 years in the computing/communications marketplace!
- From planning, to debut, to consolidation, maturity, and then to obsolescence, a market service offering has at best just 5 years to do it all!

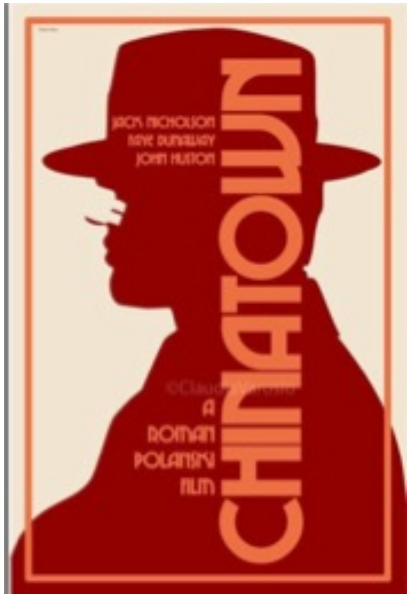
Moore's Law is BRUTAL!

This is a BRUTAL market environment:

- Smaller entities almost always fail
- Some larger entities may get sucked up by being acquired by yet larger entities
- And only the very largest of entities can afford to buy a 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!

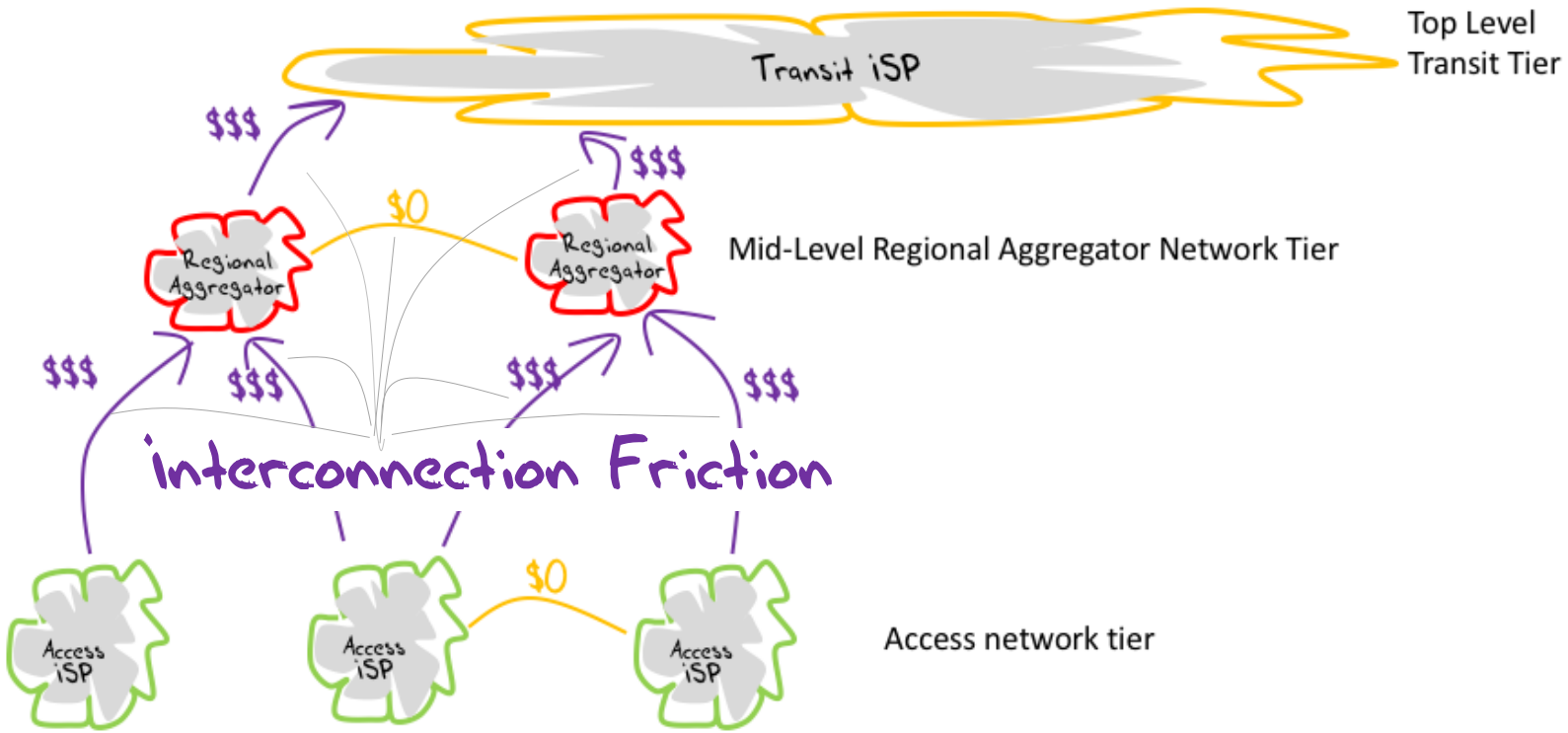
Chinatown (1974)



Moore's Law is BRUTAL!

- Consolidation and Centrality of goods and service provision is not a surprising outcome in this space – its INEVITABLE
  - What would be far more surprising would be if consolidation and centrality was NOT the outcome!

The 1990's Internet

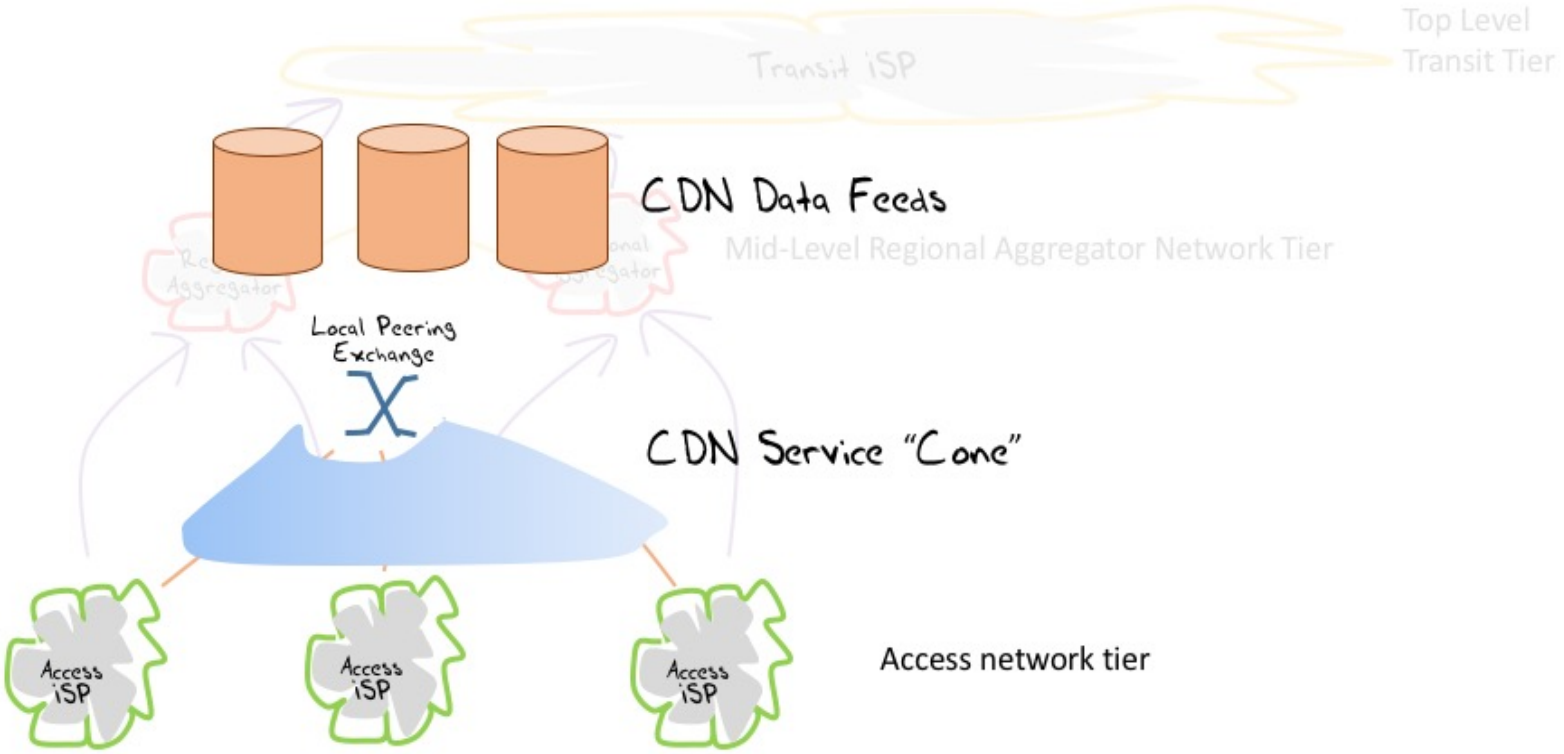


Change

Abundance and scale have driven radical changes across the Internet's basic architecture

- Networks are no longer shared transit services that connect users to services
  ("sharing" is so yesterday!)
- Content distributors are using abundance of computing, storage and communications capacity to bring content and service replicants to each user in advance of actual use

Today's Internet Architecture

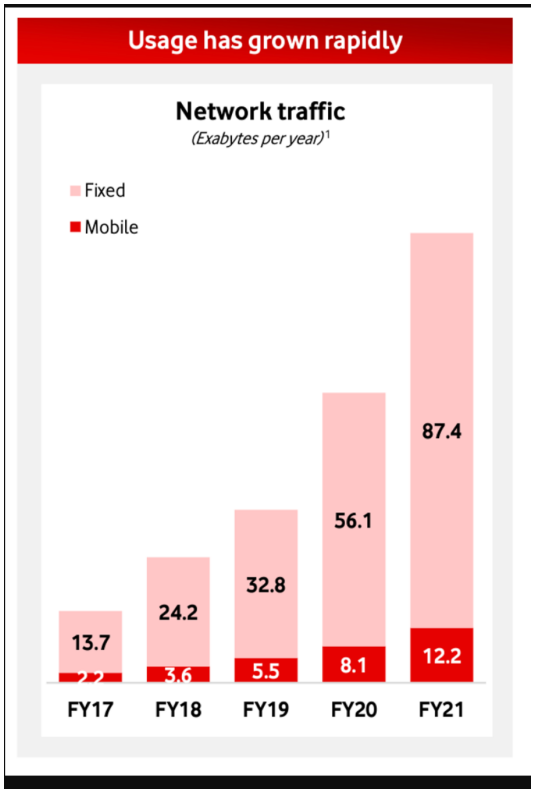


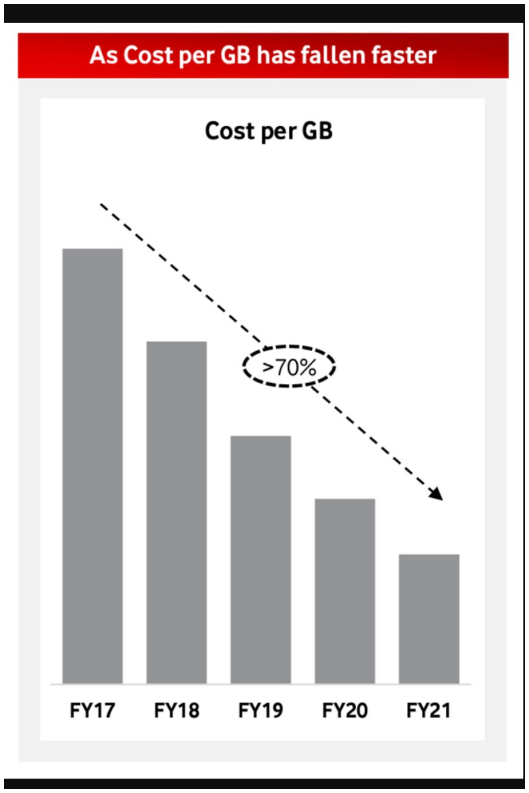
Change

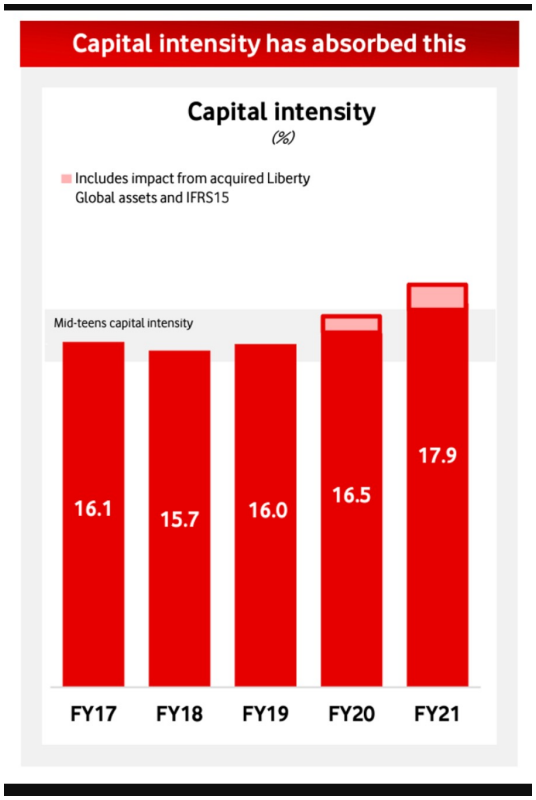
- Greater capacity in edge networks has enabled…
- Greater use of high-volume streaming content, which has lead to …
- Adoption of higher capacity technologies in edge networks, which generates economies of scale that enables …
- Reductions in the unit cost of carriage in edge networks

“Bigger” induces “faster” and “cheaper”!

Change







Source: [Vodaphone 2021 Investor Briefing]

Change

- Refreshing edge network technologies allows for significant capacity increases
  - 3G -> 4G -> 5G mobile access
  - DSL -> VDSL -> Fibre in wired access
- Failure to reinvest in edge access places the operator in a disadvantaged competitive position

Changing Internal Arrangements

The comprehensive domination of over-the-top service provision

- The carriers' case that increases in carried traffic volumes should be funded by content streamers is based on a desire by the carriage sector to cling to outdated technology and financial models for carriage that are well and truly over their Use By dates!

Regulatory Responses?

- Regulate the interconnection regime?
  - Poor outcomes that distort the interconnection market when regulators have attempted this
- Regulate inter-provider pricing?
  - Allows the less efficient operators to be cross-subsidised by more efficient operators
  - Inhibits technology refresh in carriage networks

How to deal with termination monopolies?

- Neutralise the capital investment infrastructure as a competitive level and facilitate competition at the retail level
  - Australian NBN-style of common access network, or New Zealand's Crown Infrastructure Partners program
  - Allow seamless consumer switching between retail providers
  - Encourage MVNO operators in the mobile space

What are we learning?

- At no time in the past 70 years has the pace and impact of technology-induced change slackened off
  - Moore's Law has, remarkably, just kept on delivering outcomes!
- Conventional responses to market distortions have little leverage in markets already dominated by small cliques of massively scaled providers
- For these providers, speed to market is far more important than quality and resilience of the offering
  - So, we are in crisis-mode attempting to resource the public sector to react to the frightening level of malicious and disruptive attacks which exploit the weaknesses of immature and poorly understood infrastructure platforms and service offerings that come from an overly exploitative private sector
- And we just can't seem to be able to change this situation!

How can we measure this?

By measuring the money!

- As a general metric, market capitalization if market actors appears to be one of the few useful metrics that describe the extent of market centralization and consolidation
  - And the enthusiasm of capital markets to support further consolidation by these entities!

How can we measure this?

Publicly traded companies [edit]

All market capitalization figures are in USD millions. Only companies with free float of at least 15% are included; the value of unlisted stock classes is excluded. Investment companies are not included in the list.[2]

2024 [edit]

This list is up to date as of 31 December 2024. Indicated changes in market value are relative to the previous quarter.

Rank	First quarter	Second quarter	Third quarter	Fourth quarter
1	Microsoft ▲3,126,000[39]	Microsoft ▲3,322,000[39]	Apple ▲3,543,000[40]	Apple ▲3,785,000[40]
2	Apple ▼2,648,000[40]	Apple ▲3,230,000[40]	Microsoft ▼3,198,000[39]	Nvidia ▲3,289,000[41]
3	Nvidia ▲2,259,000[41]	Nvidia ▲3,182,000[41]	Nvidia ▼2,979,000[41]	Microsoft ▼3,134,000[39]
4	Alphabet ▲1,893,000[42]	Alphabet ▲2,267,000[42]	Alphabet ▼2,058,000[42]	Alphabet ▲2,331,000[42]
5	Amazon ▲1,874,000[43]	Amazon ▲2,011,000[43]	Amazon ▼1,956,000[43]	Amazon ▲2,307,000[43]
6	Meta ▲1,238,000[44]	Meta ▲1,279,000[44]	Meta ▲1,448,000[44]	Meta ▲1,478,000[44]
7	Berkshire Hathaway ▲912,130[45]	TSMC ▲901,390[46]	Berkshire Hathaway ▲993,020[45]	Tesla ▲1,296,000[47]
8	Eli Lilly ▲739,660[48]	Berkshire Hathaway ▼879,670[45]	TSMC ▼900,670[46]	Broadcom ▲1,087,000[49]
9	TSMC ▲705,690[46]	Eli Lilly ▲815,210[48]	Tesla ▲835,810[47]	TSMC ▲1,024,000[46]
10	Broadcom ▲614,220[49]	Broadcom ▲747,360[49]	Broadcom ▲805,670[49]	Berkshire Hathaway ▼978,890[45]

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

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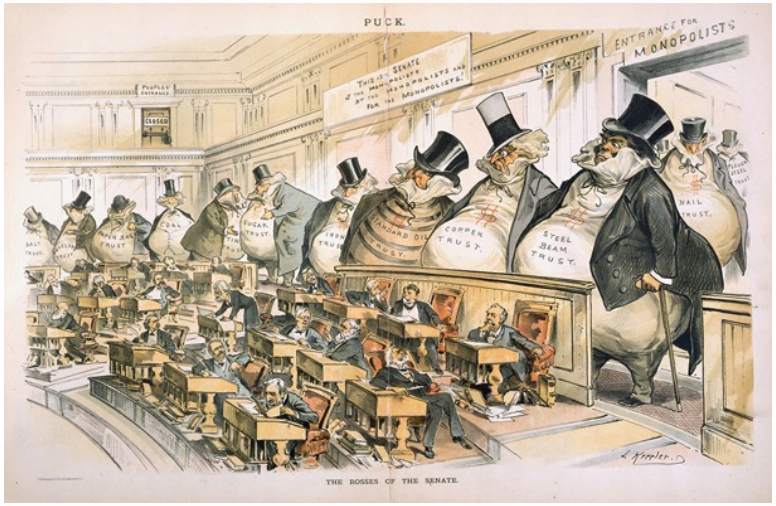
By measuring the money!

- There's the reported sums spent by market actors on political lobbying

In the US in 2024 the communications and electronics sector spent some $585M on political lobbying

https://www.opensecrets.org/federal-lobbying/ranked-sectors



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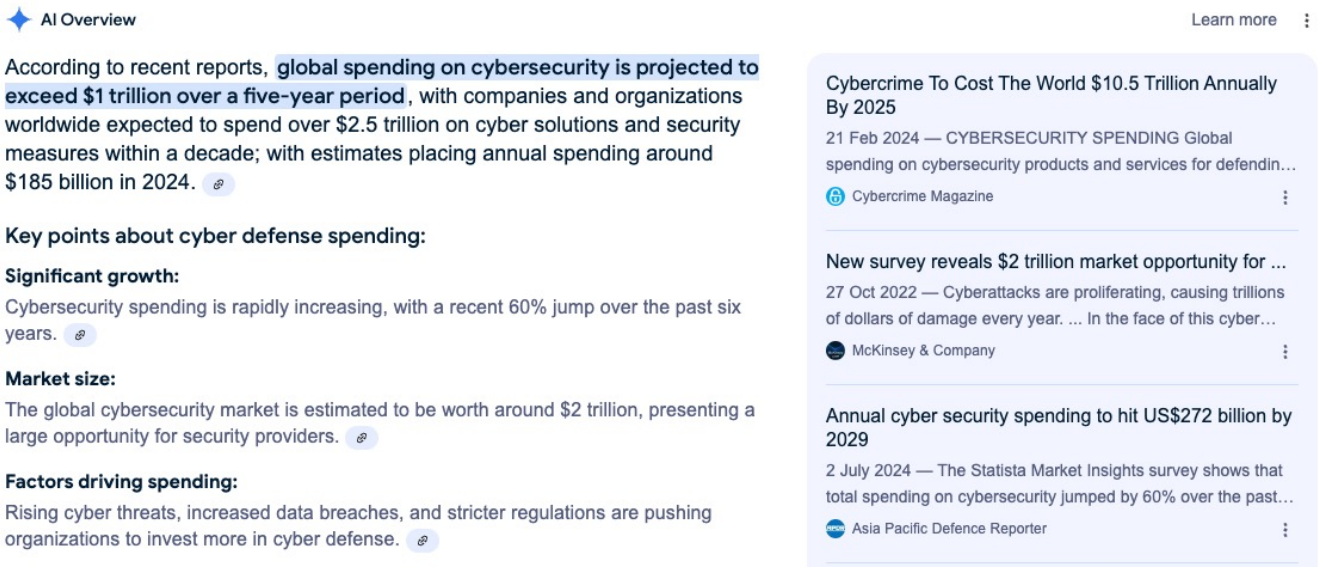
- And the sums spent by the public sector in cyber response and resilience measures



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We are playing on the edge of a number of tipping points....

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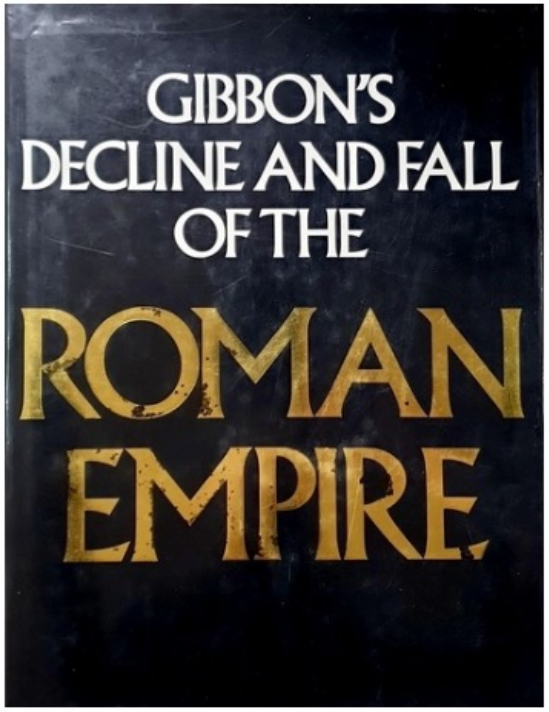

Thanks!