Decentralised Services

Geoff Huston

APNIC

Today's Service Delivery Network is not yesterday's Internet

- Instead of using a network to connect local users to remote services in a "**just in time**" service delivery model we now are able pre-provision services to multiple network locations that are local to users in a "**just in case**" service provisioning model
- When local users access locally provided services there is no reliance on the network to span a distance gap
- No distance implies that we can deliver services that are faster and cheaper

Changes

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

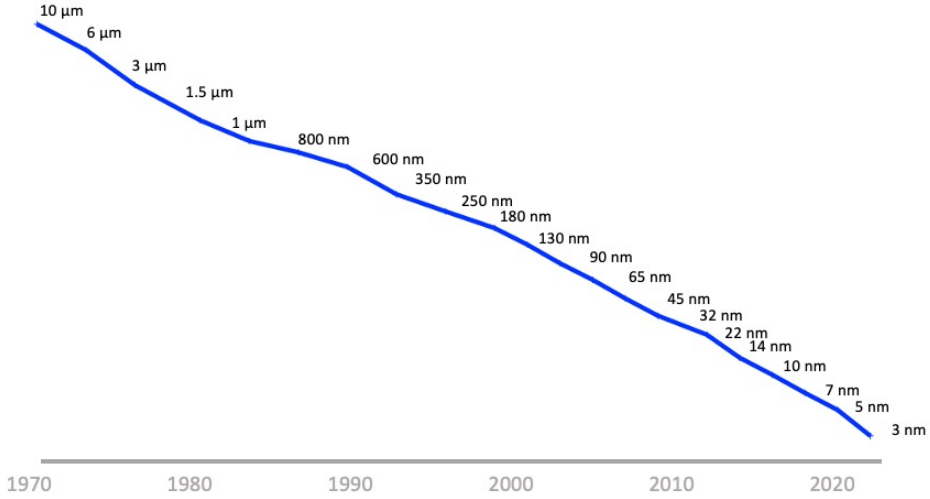
“Bigger” induces “Faster” and “Cheaper”!

How did this happen?

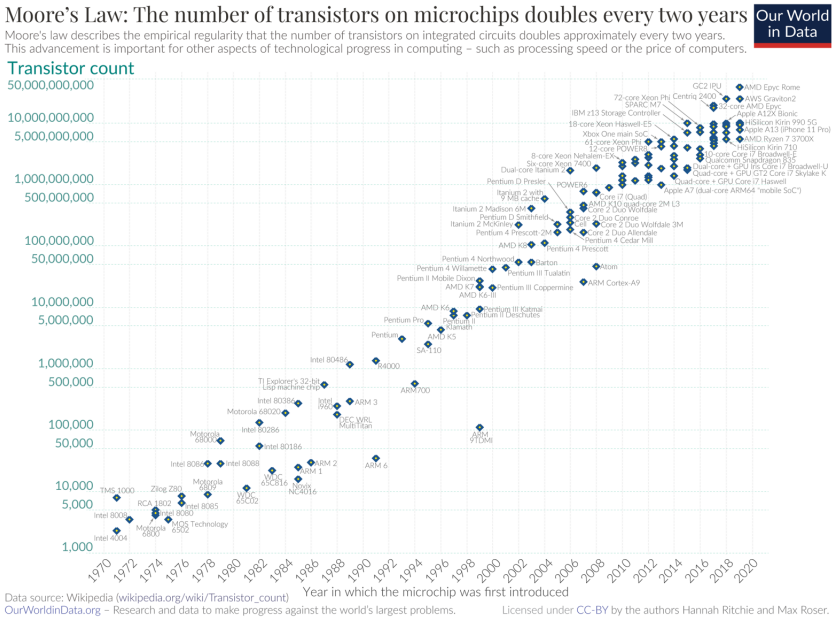
- The Internet is constructed on the foundation of a market-based economy, not a command-and-control economy
- It was assumed that an open market-based activity would generate efficient outcomes based on competitive pressures between providers
- Yet the Internet is not a highly competitive environment!

  (indeed, it's strongly consolidated and not very competitive at all!)
- What's driving this evolution in the Internet's basic architecture if competition is not the main factor?

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

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

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 for many decades 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!

- What is driving the economics of digital delivery systems in today's networks is **not** the historical use of pricing as a means of rationing access to a **scarce** common resource
- This is an environment that has switched over to **abundance** of processing, storage and communications
- 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!

Aside: Innovation, Competition and Regulation

- It was Peter Thiel who once said “competition is for losers”
- High risk ventures with innovative services tend to fixate on a “winner take all” approach (much higher rewards for a small quantum of increased risk)
- It was hoped that the discipline of competition would moderate the actions of market actors who abuse their position and abuse the relationship with their user base and regulatory impositions would impose undue inefficiencies on the market
- In a rapidly evolving market neither competition or regulation imposes sufficient control to counter the momentum towards centralization through monopoly formation

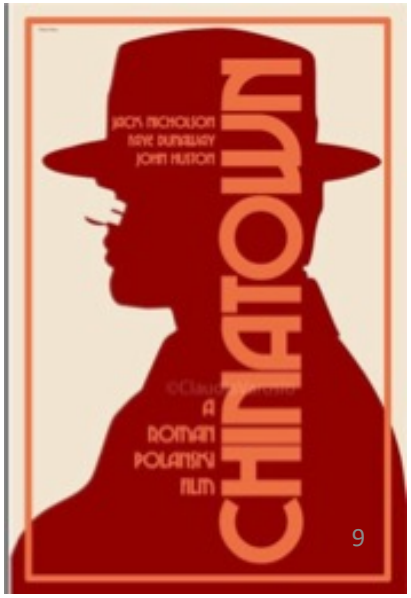
Moore's Law is BRUTAL!

This is a tough environment where:

- 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)



Change

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

- Networks are no longer share common 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 (pre-provisioning just in case)

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.

What about network architecture?

- We've moved beyond address-based network architectures
  - Address uniqueness is a "relative" concept, not a "universal" requirement
  - Routing has largely been replaced by DNS service selection
- Service names are the basic distinguisher in the network
  - We use service names to establish a secured transaction context (TLS)
  - We use service names to provide authenticity of the service (Domain Name Certification)
  - We use the DNS to map a service description to a network rendezvous profile

Where is this heading?

- We are where we are as a result of the inexorable pressures of Moore's Law on the technology underpinnings of the Internet, combined with the more chaotic forces of market pressures and macro-economics
- This coupled with the scaling pressures bought about by the displacement of more traditional service delivery models by their digital analogues through ubiquitous low-cost digital capability

Is "Distributed" the same as "Decentralized"?

I guess it depends on your perspective

- Widely distributed service systems can remove any single locus of control and orchestration of service delivery
  - Is this what we meant by “decentralized”?

- Widely distributed systems have high barriers to entry in terms of logistics and cost, with the result that this environment is dominated by larger operators and it resists entry to new providers
  - Is this concentration of service operators in the market the opposite of what we meant by “decentralized”?

Where are we?

- Is today's service delivery environment about as decentralized as we are going to get?
- Does further technology evolution reduce barriers to market entry and cause increased competitive pressure being placed on incumbents?
- Or does further technology evolution lift user expectations of the capability of services, which imposes yet higher barriers to competitive entry?
  - Dare I mention AI infrastructure as an example here?

Thanks!