

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?
 - 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



Mobility - 2007



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

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?

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

So it's all good!

Right?

Some issues to think about

What matters:

- 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?
- Nature of network transactions – Bilateral? Synchronised?

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?

Thanks!