

# Future Network Needs

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# The Internet used to be 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

*“dumb” network, “smart” devices*



# 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
- Transit and Traffic Engineering
- Data Centres and Service “Farms”
- Quality of Service Engineering
- MPLS, VPNs and related network segmentation approaches
- Mobility Support
- 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

# What about the coming decades?

- The seeds of the dominant factors of the future environment 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?

- From scarcity to abundance!

# 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 much 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 applications

- Transmission infrastructure is becoming an abundant commodity
  - Network 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 bringing services towards consumers and using the content frameworks to replicate servers and services
- 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!