

Complexity - The Internet and the Telco Philosophies

A Somewhat Heretical View

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- First commercial ISP in Japan
- Asia, Europe, and US backbone
- Commercial customer base
- Internet, not telephant, MPLS, ...
- First commercial IPv6 deployment
- WIDE, Kame, the IPv6 code base you are running on UNIX, ...

We're Old Fashioned

- Internet, not ATM-2 / MPLS, etc
- VoIP etc. over IP, it is possible!
- IPSec is a big seller, the P in VPN
- High touch, a lot of services
- Quality, quality, and quality
- And we're profitable!

The Internet DOES Work

- IP forwarding is just as fast as switching, they're all just one-table lookups
- Actual measurements show backbone QOS is just fine due to proper provisioning, and proper provisioning is cheaper than adding a layer
- QOS is a decision of which packets to drop. Do you get paid to drop packets?
- There are reasons the Internet has taken over the data world and threatens voice

The Internet DOES Work (cntd)

- Reliability and Resiliency are core strengths, the Internet was designed for them
- Our weakness is security, as was the telco's once (2600)
- IP routing yields as good service as MPLS Layer-2.5 switching, and better in cases of multiple or extreme failures

The Only Real Problem is

Scaling

All the others inherit from that one

If you can scale, everything else must be working.

-- Mike O'Dell - Chief Technologist UUNET

Complexity is the Arch-Enemy of Scaling, Hence of the Bottom Line

- Telco culture started to glorify complexity as a competitive tactic in the '70s
- But look what it has done to OpEx
- We are all in a commodity market and buy from the same vendors as the competition
- RFC 1925 section 2(3), "With sufficient thrust, pigs fly just fine." This does not mean we can afford the fuel costs, and who wants to fly pigs anyway?

- Too many control plane researchers have only studied the one particular large ISP who has wide-scale control plane disasters more often than they have management reorgs, hard as that is to believe.
- And guess what their solution to all these failures is, add more complexity and control to the network! Rinse, repeat, ... I wish all my competitors did this.

Where the Smarts are

- Traditional Voice has stupid edge devices, phone instruments, and a very smart core
- The Internet has smart edges, computers with operating systems, applications, ..., and a simple stupid core, which just does packet forwarding
- Adding an entirely new Internet service is just a matter of distributing an application to a few consenting desktops (until NATs)
- Compare that to adding a service to Voice

Where the Reliability Is

- The Voice network has smart central organs which are heavily armored, have rooms of battery backup, etc.
- The Internet **assumes** major component failure and achieves reliability through redundancy in the protocol designs
- I.e., the DNS root servers can be seriously attacked without customers noticing
- The internet - **building a reliable network with unreliable components**

Carrier Class Reliability

- The famous 5ESS switch regularly has five nines in operation and has even hit six nines in the field
- We all think we want that in routers and other internet boxes
- Can we achieve this?

The Truth About How Telcos Do It

- There is a supervisory function which runs continually cleaning up **internal inconsistencies in the data structures**
- Without this, the 5ESS crashes in a few hours
- Can you imagine this approach scaling to internet routing?

Spread it Across Layers

- RFC 1925 2(5) "It is always possible to agglutinate multiple separate problems into a single complex interdependent solution. In most cases this is a bad idea."
- This is why ATM-1 failed in the Internet, it tried to solve QOS, traffic engineering, ...
- RFC 1925 2(11) "Every old idea will be proposed again with a different name and a different presentation, regardless of whether it works."

Trade-offs Across Layers

Yield Power and Simplicity

- L2/L3 technologies such as Frame, IP, MPLS, ... have costs analogous to software costs, they drop very slowly
- Fiber bandwidth costs and pricing seem to follow Moore's law, with cost per gigabit halving every 1-2 years
- Maybe we should not increase the L2/L3 costs with pseudo-muxing games like MPLS, but rather use L1's DWDM to give each their own channel/lambda

Bet on Simple and Cheap

- Layer-1 fiber costs are falling at rates driven by hardware costs and overbuild
- Layer-2 is driven by software costs, which are not falling, but rising
- Provision the bandwidth you need, don't complicate and drive up costs forever

What Happens When

- Fiber keeps falling and Google, Yahoo, etc. and everybody provides cheap transport
- The last kilometer monopoly is broken, wireless WiMAX, ...
- Peer-To-Peer becomes even more dominant, and VoIP keeps exploding

There is only so long the government
and lawyers can save the telcos

Telcos Must Save Themselves!

- Climb up the stack
- Get in front of the technology
- If VoIP is so cheap, if they provide it, they might actually make a profit
- Provide innovative services
- Not just Video on Demand, but mediated peer-to-peer

A Sarcastic Researcher's Approach to Operations

- With enough complexity we strongly suspect that we can operate an approximate internet in polynomial time and dollars
- We are working on a proof that operating the internet can be made to be NP hard
- And then we'll just wonder where the profits went

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**A Large American Telco
which did Not Listen**