To Overlay or Not To Overlay

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Outline

- How and why it all started...
- Resetting the clock
  - Debunking the myths
- What overlays can and cannot (should not) be
- Looking into the crystal ball
The Internet Mantra

- The *hourglass* paradigm
  - A thin-waisted network layer (the KISS principle)
  - Anything that thickens the Internet waist is heresy
- But what if we need more?
  - IP layer as the lowest common denominator
- The “answer:” Overlays!
  - Stick to the paradigm, don’t touch the network layer, build on top of it

Many different applications

The “nimble” network layer

Many different link technologies
The Pro-Overlay “Arguments”

- Previous attempts at thickening the waist have failed miserably
  - Multicast (MBONE – an overlay network?)
  - QoS (the next big thing for the past 10 years)

- There are way too many emerging requirements for the network to handle
  - Traffic engineering
  - VPN
  - Security
  - Etc.
Revisiting the Arguments

- Yes, there have been failures; yes, there are many more requirements than the network can handle. But does this imply that overlays are the answer?

- Let’s find out by going back to first principles and ask some basic questions
  - How many users need a given functionality?
  - What are users willing to pay for it?
  - How much do different solutions cost?
The Multicast Case

Who needed it?
- Very few users and applications

Willingness to pay?
- Very little

What did it cost?
- Significant performance hit on the data path
- Additional, complex routing protocols
  - DVMRP → CBT → PIM (sparse/dense mode)…

A first solution (MBONE)
- An overlay network
- Complex to configure, complex to use, limited performance, marginal use

Today’s reality
- Unicast (inefficient but simple)
- Application-level multicast
- Sender-Specific Multicast
  - The right “model”
The QoS Case

■ Who needed it?
  ● Everybody and nobody
  ● High-end users

■ Willingness to pay?
  ● No one knew

■ What did it cost?
  ● Small data path cost
  ● Significant control path (management) cost

■ The IntServ/RSVP debacle
  ● Hardly an incremental step
  ● No user ready for it
  ● No one to charge for it

■ Today’s reality
  ● No meaningful deployment
  ● Adaptive users
  ● Over-provisioning
  ● DiffServ if and when needed
So What Can We Conclude?

- Past attempts at thickening the waist failed because
  - A big solution for a small problem
  - The best solution rather than a good enough one
  - A higher cost than the corresponding savings

- None of those reasons point to overlay as the right answer!

- So let’s move on and take a look at some of the other functionalities used to justify overlays
  - The traffic engineering example
Traffic Engineering: The Overlay View

■ The premises:
  ◆ We need to control network performance to support the service level agreements that business users require
  ◆ We have to rein in capital expenses through better use of existing resources
  ◆ IP networks are too unpredictable
    ◆ Routing instability
    ◆ Hard to predict the impact of link/router failures

■ The answer: The MPLS suite…
  ◆ CR-LDP, RSVP-TE, OSPF opaque LSAs, and so on
  ◆ Now we can control the network
Traffic Engineering: The Reality

- With MPLS it’s not that you *can* control the network, it’s that you HAVE TO!
  - A control cost that exceeds resources savings (the QoS quandary)
- Incremental changes to IP give you 90% of what MPLS provides
  - Load balancing through proper setting of (link) weights
  - Routing robust to link/router failures through proper setting of (link) weights
- MPLS: A technology in search of a problem
  - From fast forwarding, to traffic engineering, to optical control plane,…
What’s Wrong with This Picture?

- Where is the overlay logic?
  - What benefits to a common network layer?

- Back to square one
  - A world of many parallel networks, one for each possible service
  - Did someone say scalability?

- We’re doomed if they interact, and they will!
What Successful Overlays?

- The network will never do everything that everyone needs
- An overlay is fine then, BUT it doesn’t have to be over IP!
  - If it’s very important to me and IP cannot do it, I’ll pay for a network that can
    - The tele-surgery or nuclear power plant control scenarios
- An overlay is fine, BUT it does not have to be a network
  - TCP is the most successful overlay I can think of
So What’s Next?

- As (network) technology improves, the “tolerable” thickness of the network waist increases
  - The OS analogy
- If it’s *really* important, it will be added to the network
  - FEC or retransmission on wireless links (*when needed*)
  - DiffServ or even IntServ at the access points, **if and when needed**
  - IP traceback for DDOS protection, **if and when needed**
In Case I Was Not Clear

- Overlays are a really, really bad idea

- Past and present arguments in support of overlays are flawed

- We’ve been trying very hard to get rid of them
  - Why do we want IP over WDM?

- If we need something more and it’s not there
  - We’ll find a way around it
  - It will get added when enough people want it