

To Overlay or Not To Overlay

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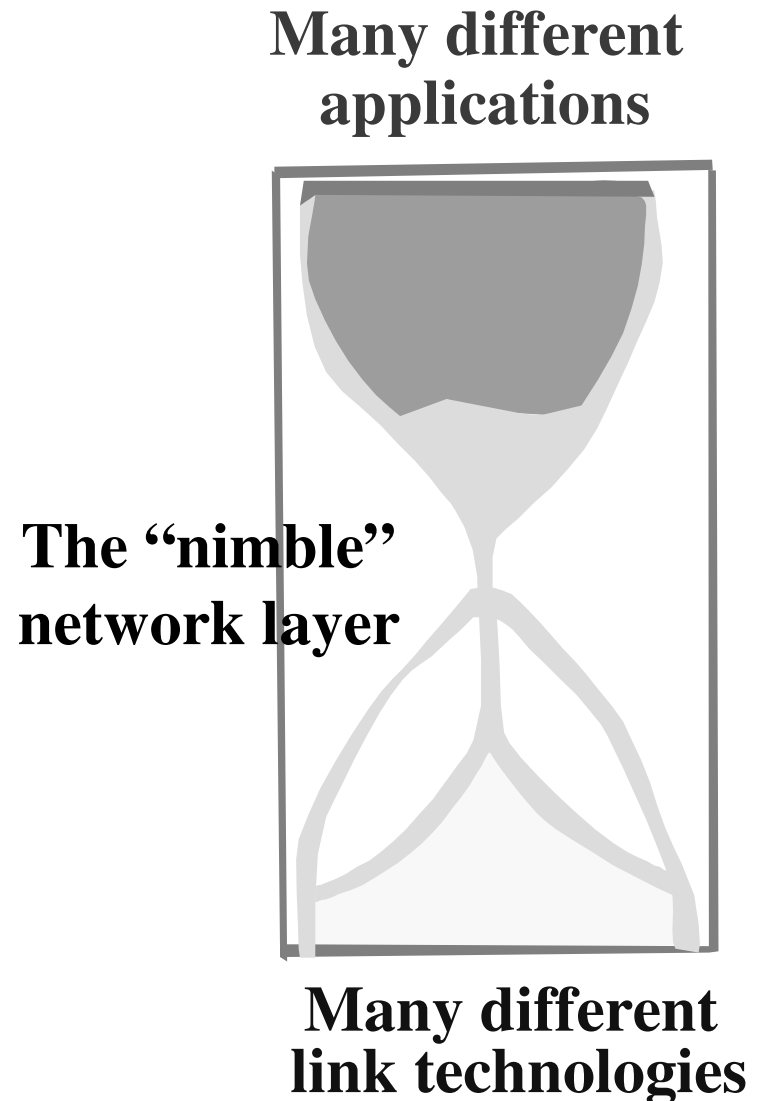
Outline

- 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



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



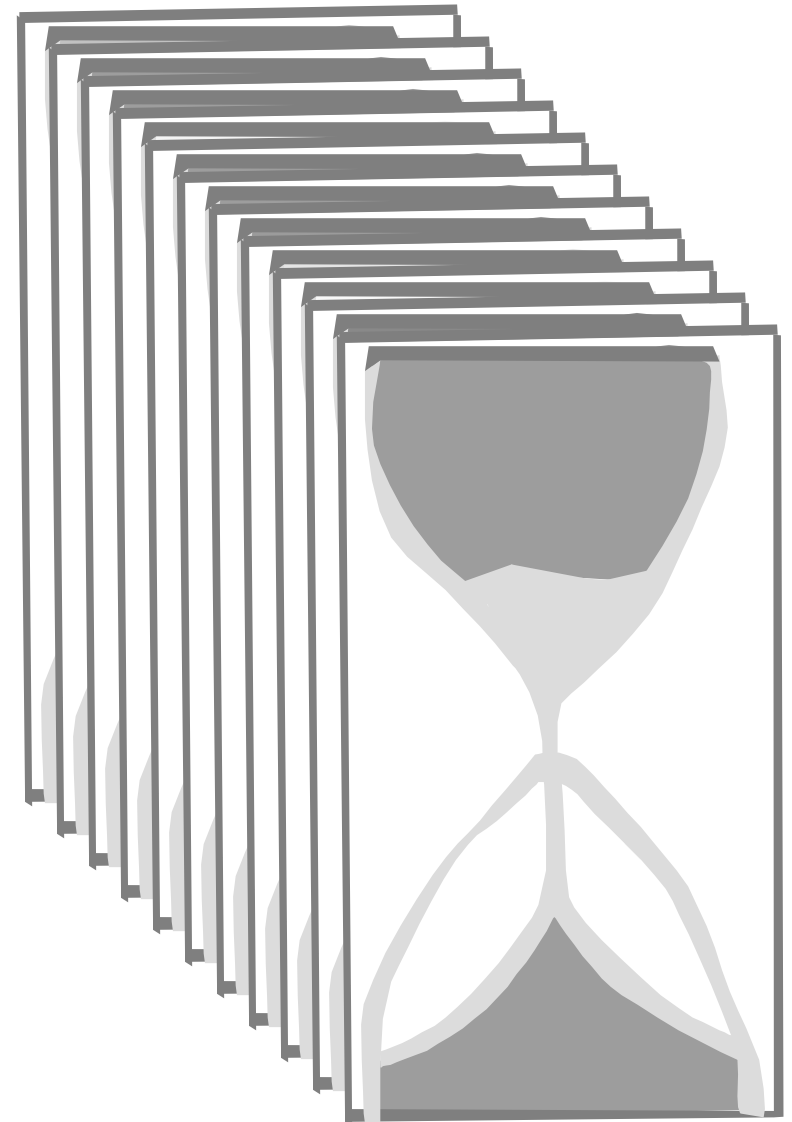
Traffic Engineering: The Reality

- 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

