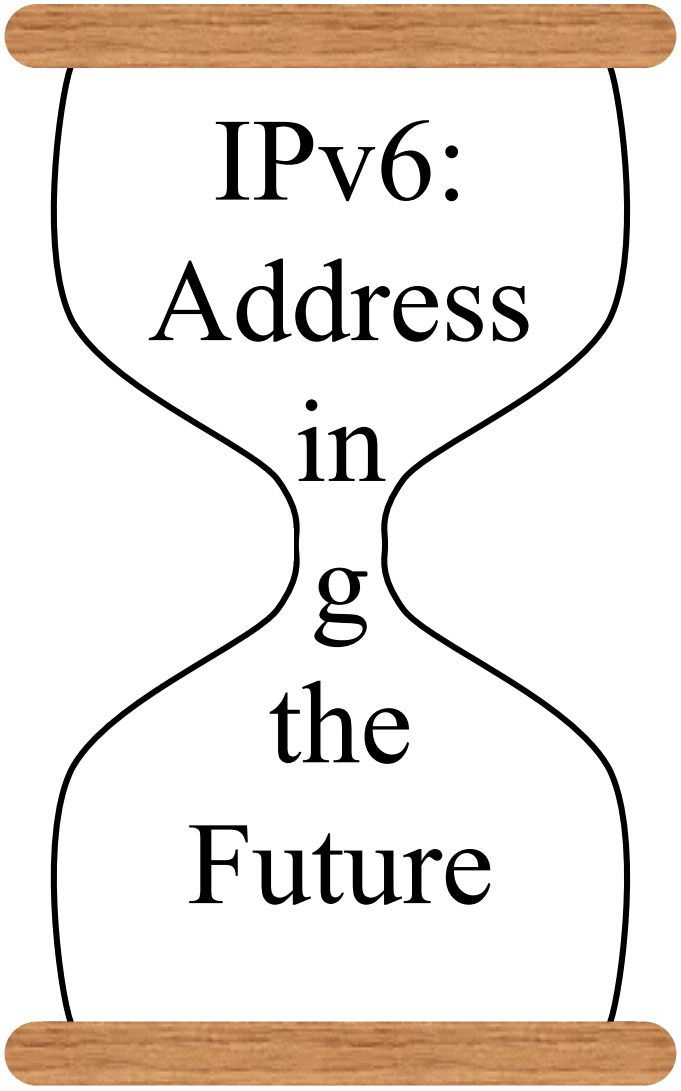
IPv6: Addressing the Future



Global
IPv6 Summit
Seoul, Korea

July 2001

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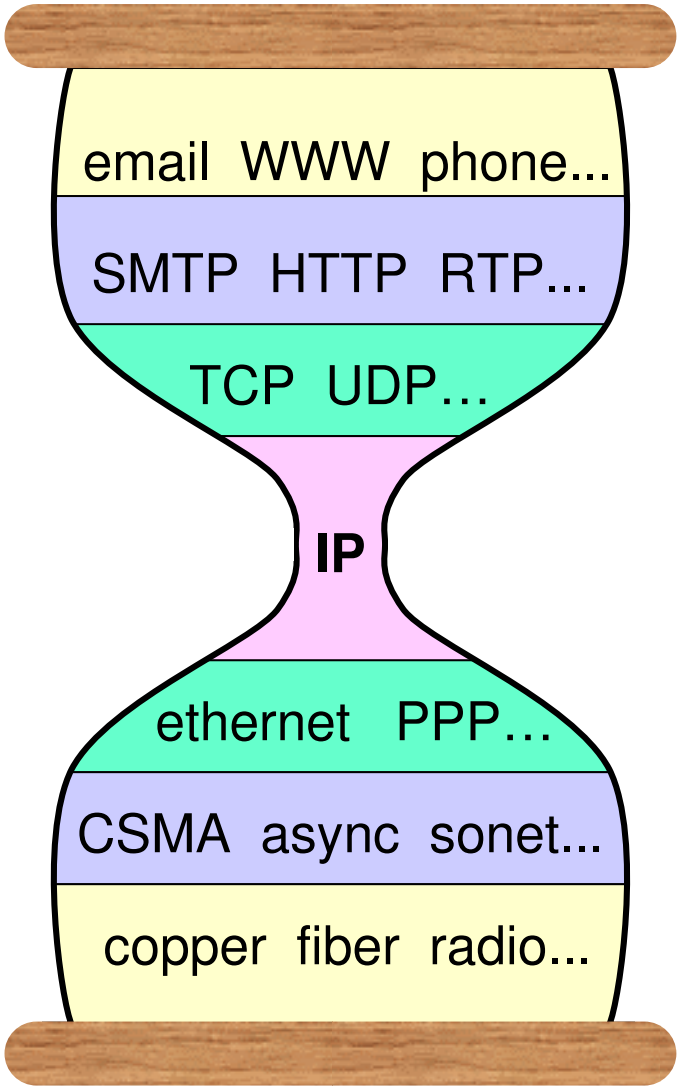
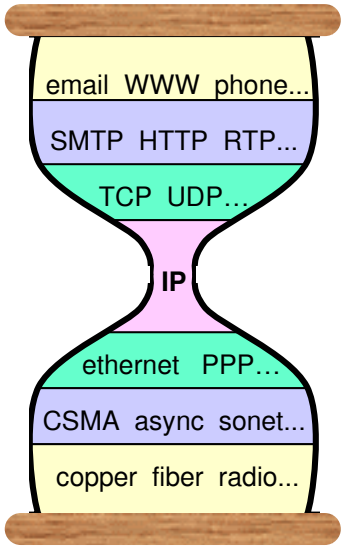
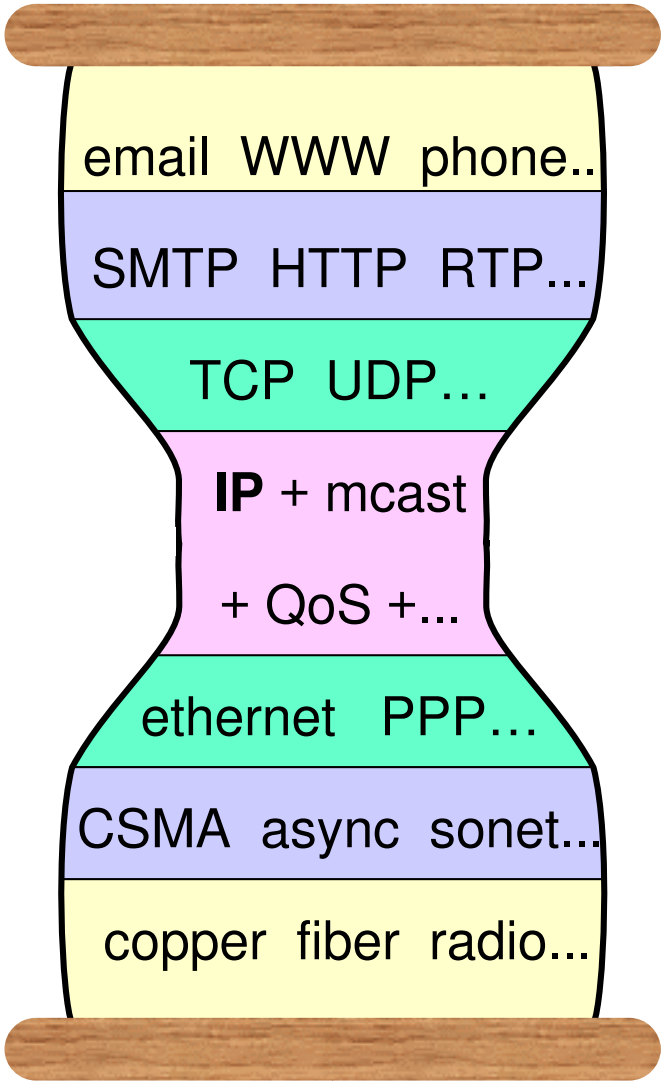

email WWW phone...
SMTP HTTP RTP...
TCP UDP…
IP
ethernet PPP…
CSMA async sonet...
copper fiber radio...

Why the Hourglass Architecture?

- Why an internet layer?
  - make a bigger network
  - global addressing
  - virtualize network to isolate end-to-end protocols from network details/changes
- Why a *single* internet protocol?
  - maximize interoperability
  - minimize number of service interfaces
- Why a *narrow* internet protocol?
  - assumes least common network functionality to maximize number of usable networks

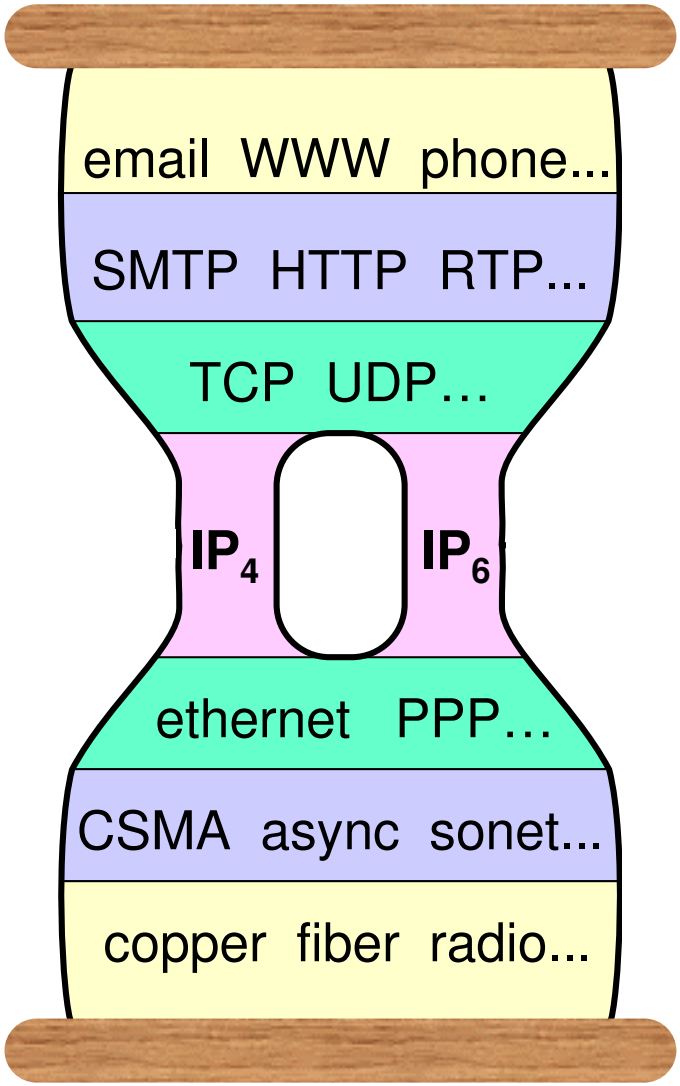


Putting on Weight



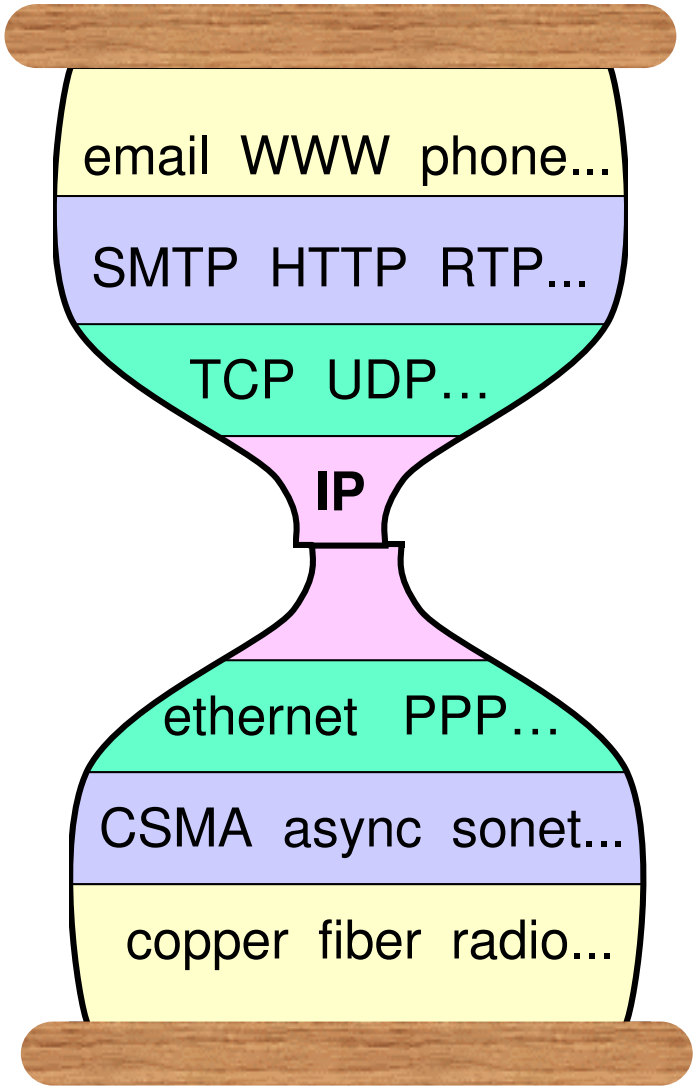
- requires more functionality from underlying networks

Mid-Life Crisis



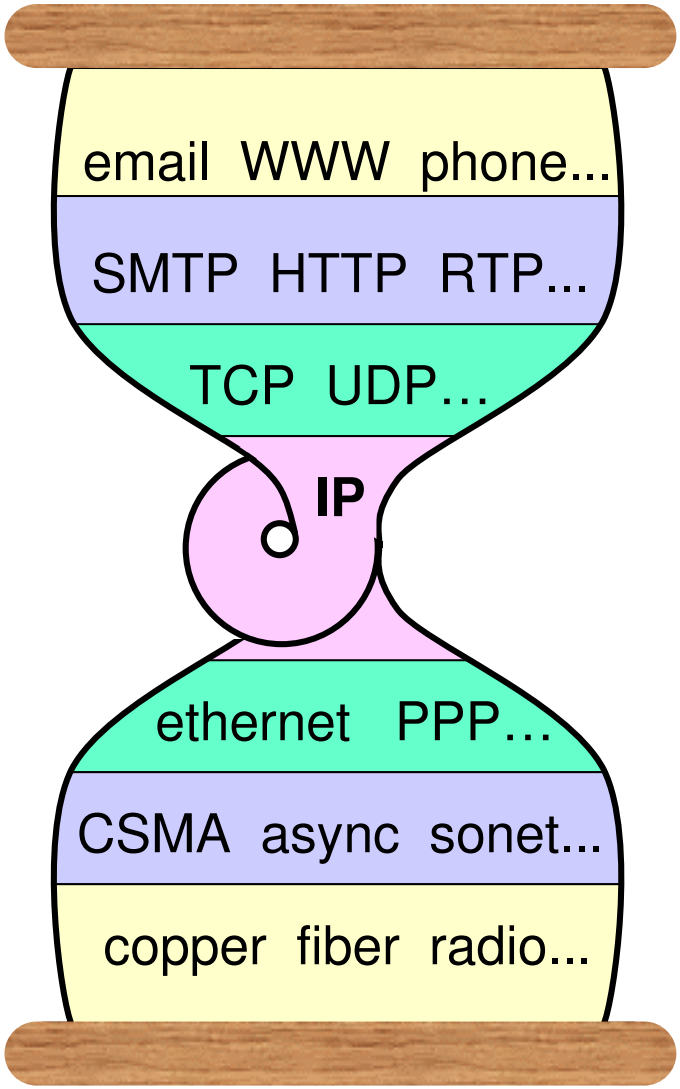
- doubles number of service interfaces
- requires changes above & below
- creates interoperability problems

Oops! An Accident



- NATs & ALGs used to glue the broken pieces
- lots of kinds of new glue being invented—ruins predictability
- some apps remain broken, since repairs are incomplete

But Still Supple



- IP-over-IP tunneling has become more and more common
- this is not so bad: retains benefits of hourglass model

Lost Features of the Internet

- transparency
- robustness through “fate sharing”
- dynamic routing
- unique addresses
- stable addresses
- connectionless service
- always-on service
- peer-to-peer communication model
- application independence

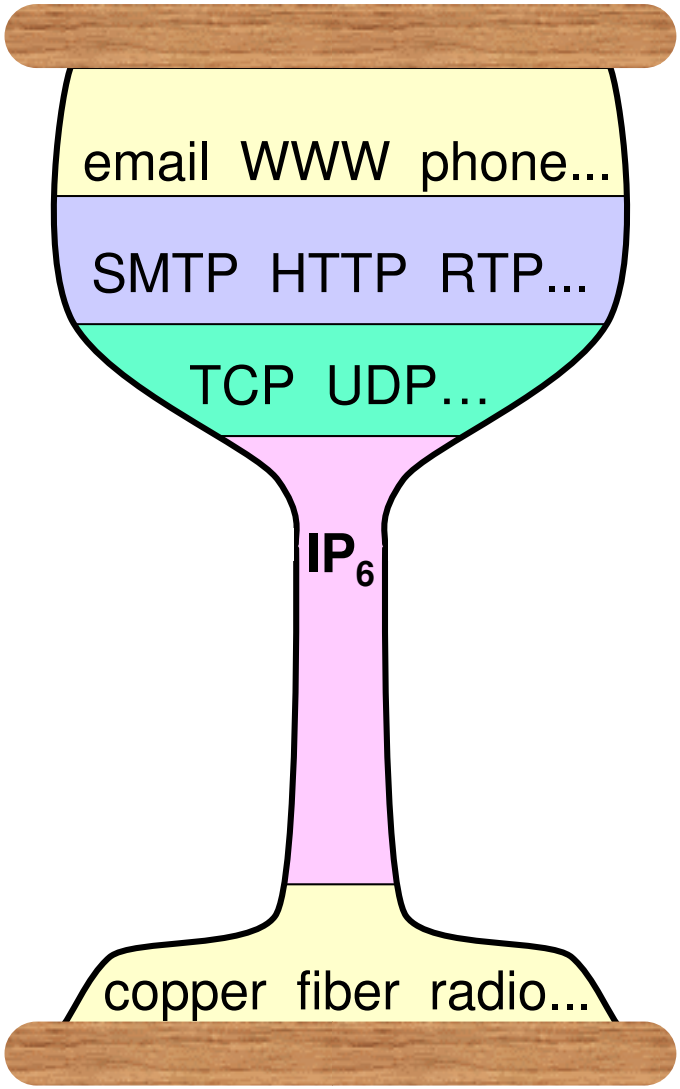
Below-the-Waist Bulge

- mostly reinventing, badly, what IP already does (or could do):
  - VLANs
  - LANE (LAN emulation / “interworking”)
  - layer 2 tunneling protocols
  - MPLS, PPPoE,… (“layer 2.5”)
- lower layers mostly seem to just make IP’s job harder
  - cells, circuits, QoS, multicast, large clouds, opaque clouds

Entropy or Evolution?

- looks like the normal entropy (decay) that besets all large, engineered systems over time
- to fight entropy must apply energy — hence the IPv6 effort
- less worrisome to view as *evolution* instead?
  - the Internet as an evolving lifeform or ecosystem?
  - just let nature (the market) take its course
  - though result is undesigned and unpredictable, should not be viewed as decay

Survival of the Fittest?



- may evolve from an hourglass to a *wineglass*
- early signs: IP-over-SONET, IP-over-WDM
- need IPv6 to restore simplicity *and* functionality

Only Time Will Tell…