Will the real David D. Clark please stand up?

CLARK'S PARADOX

"The Internet should support a mechanism for choice of source routing that would permit a customer to control the path of his packets at the level of providers."

Clark, et al. **Tussle in Cyberspace: Defining Tomorrow's Internet.** *SIGCOMM'02, August 19-23, 2002. Pittsburgh, Pennsylvania, USA*

"Low-level network functions are justified only as performance enhancements."

Saltzer, J. H. , Reed, D.P. and Clark, D.D. **End-to-End Arguments in System Design.** *2nd International Conference on Distributed Systems (Paris, France, April 8-10) 1981, pp. 509-512.*

1. Why ☞

2. How ☞
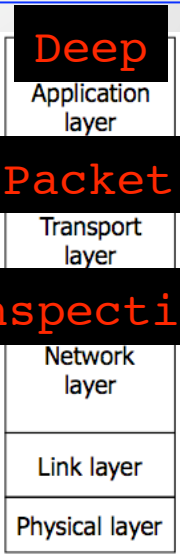
Consumer chooses network path based on own criteria:
- Economic (least congestion, highest data rate)
- Political ("Free Speech" routes)
- Environmental (IEEE 802.3az, green DCs)

Bit 0			Bit 31
Version (4)	Hdr Len (4)	TOS (8)	Total Length in bytes (16)
Identification (16 bits)		Flags (3)	Fragment Offset (13)
Time to Live (8)	Protocol (8)	Header Checksum (16)	

Source Routing

Data (variable length)

3. Or ☞

Gotcha

Deep Application layer

Packet Transport layer

Inspection Network layer

Link layer

Physical layer

- Undermines flexibility (SSR):
  - Overrides most protocols
  - Requires detailed knowledge of network topology
- Undermines security (LSRR):
  - Enables source address spoofing
  - Enables private address routing

- Enables/encourages ISP misuse:
  - QoS manipulation
    - Comcast BitTorrent packet drops
  - Privacy violations
    - Warrantless wiretapping

http://www.ietf.org/rfc/rfc0791.txt

Tony Lincoln, Info 250, 4/1/10