# The Internet - a Tutorial for Physical Layer Engineers

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### The Basic Problem

- Internet and Telcos are oil and water
  - different skill sets
  - different culture & philosophy
- The telco culture (unfortunately) permeates wireless cellular
- Little cultural exchange

#### The Need

- There's a real need for an IETF-blessed BCP document that tells telcos & physical layer designers what they need to know about the Internet
  - now that they actually care
- This would have been *very* useful to me 5-6 years ago at Qualcomm
  - it's still not too late, though

## Experience: IP over IS-95 CDMA

- Proselytized end-to-end principle
  - still a lot of resistance just as with the theory of evolution
- Designed lightweight radio link protocol
  - reduce frame loss rate to tolerable level
  - TCP, etc, still ultimately responsible
- Major battle, internally and externally
  - "We don't like where this Internet stuff is leading"

## Misplaced Priorities

- Missing stuff:
  - multicast support
  - TOS control of linklayer retransmission
  - DEPLOYMENT!
- Less-than-totally useful stuff:
  - short messaging

- Stuff better done at higher layer:
  - Wide-area mobility
  - Compression
  - Encryption
- Totally gratuitous stuff
  - AT modem & fax emulation
  - voice/data switching

### Other Issues

- FEC & ARQ
  - what's the appropriate packet loss rate?
- "It's the latency, stupid!"
  - bandwidth & reliability matter only as they affect latency
- Management of connection-oriented channels
- Forget OSI

### The real message

- "In protocol design, perfection has been reached not when there's nothing left to add, but when there is nothing left to take away"
  - Ross Callon, RFC 1925