

# Grand Challenges in Networking

Larry Peterson  
Princeton University / Intel Research



## Catch-22

---

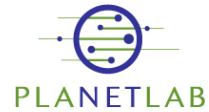
- The Internet is a huge commercial success
  - increasing our dependency on it
  - making it increasingly ossified
- Ossification makes the Internet vulnerable
  - susceptible to attacks
  - increasingly brittle
  - growing management burden
- Ossification also marginalizes researchers
  - difficult to deploy new solutions



## Central Challenge: Evolving the Internet

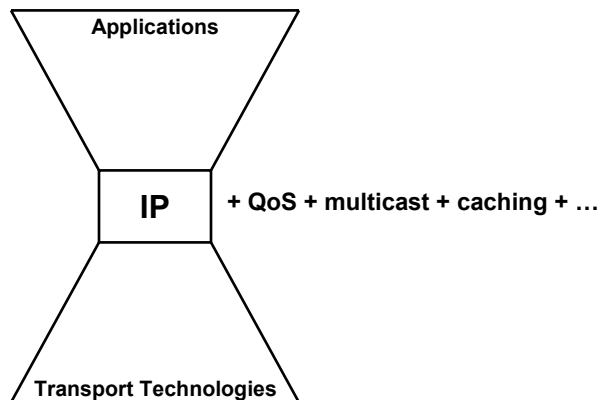
---

- Lesson from the Internet...
  - Flexibility, deployability, and evolvability are achieved only when the truly *universal* portions of the architecture are truly *minimal*.
  - Not all questions can be answered quantitatively; attention must also be paid to how interest groups affect protocol design, so called *tussles in cyberspace*.



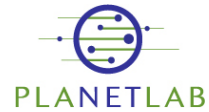
## Evolvability by Widening the Waist

---



## Evolvability through Overlay Networks

- Add a new layer to the network architecture
  - use overlays to deploy disruptive technology
  - use overlays to application-tune the network
- Multiple vantage points...
  - enables observing and adapting to network behavior
  - allows close proximity to data sources & sinks
- Examples
  - network-embedded storage / content distribution
  - anomaly detection / measuring the network
  - robust routing / multicast routing



## Technical Challenges

- Resource Allocation
  - create an efficient market for acquiring resources
- Information Discovery & Dissemination
  - enable information flow between layers
- Virtualization
  - deploy version  $n$  on version  $n-1$

