Preserve and Enhance:
Balancing Goals for the Internet

APRICOT

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<http://brandenburg.com/current.html>

Things *Are* Different Today
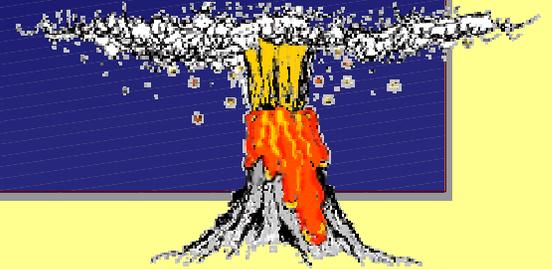
- **The Net's operation is more complex and less reliable**
  - Firewalls, NATs, Routing partitions, Spam, Worms, internationalization (localization), "Governance"

- **The Net's architecture is reaching serious limits**
  - Collaboration, Wireless, Mobility, Multihoming, Real-time audio and video, Peer-to-Peer

- **The Net's technical community is fragmented**
  - Poor cross-area communications, Long standards cycles, Narrow and complex specifications, political factions

Lessons: Recent Personal Experiences – I

- **Facsimile**
  - Improve service, by copying related, existing service
  - Saves on debate about "needs" and "utility"

- **Instant messaging**
  - Needs a QOS that is incompatible with today's email
  - Difference between "protocol" and "service"

- **Internationalized Domain Names and Spam**
  - Local criteria and actions, within global service
  - Technical response to social issues

Lessons: Recent Personal Experiences – II

- **Emergency services**
  - Demand for periodic QOS
  - Possibility of local structure, without global coordination

- **Multiaddressing (mobility/multihoming)**
  - Infrastructure vs. Endpoints
  - Common core vs. specialized mechanisms

- **IETF**
  - Reduced timeliness and productivity
  - Fragmented, complicated mechanisms

- **And *(sigh)* ICANN**
  - Nothing is mundane

Basics in Scaling: *More and Faster*

Continue what we have been doing for 35 years

Bandwidth: **56 kbps → 1+ gbps**
  Tune performance parameters

Networks: **1 → 140,000+**
  Hierarchical and area routing

Hosts and routers: **4 → 4 million(?)**
  Address space, and maybe namespace

Users: **500 → 500 million**

User Application Protocols: **5 → 13**
  Not so impressive…

Threat to End-to-End Model?

- **End-to-End has never been about "direct" exchanges**
  - Packet-switching is based on mediation
  - Inter-networking – AS, OSPF vs. BGP
  - Email, of course

- **Mediation is our friend**
  - Divide-and-conquer makes scaling tractable
  - Even "peer-to-peer" requires mediation, e.g., rendezvous

- **These are *"tussle"* boundaries** *(Clark, et al)*
  - One challenge is that we have more tussles, at more levels
  - The real challenge is to make designs that *anticipate* boundaries

End-to-End *Should* Mean…

- **Design a peer-to-peer *model*, if possible**
  - Design for interactions between endpoints

- **Internet model of minimal infrastructure service**
  - Design complexity at the edges
  - When it becomes popular, it looks like infrastructure
  - Design for edge *network* versus edge *host*
  - Infrastructure net vs. edge net vs. edge host *operation*

- **When design must specify new infrastructure**
  - Add it as *adjunct* to endpoints
  - Add it for special cases, only, if possible

Multiaddressing

- **Overlapping requirements**
  Mobility: Different addresses over time
  Multihoming :   Different addresses at the same time

- **Hosts need to add/remove locators dynamically**
  - And it would be nice to preserve existing connections

- **Architectural challenges**
  - Find a destination that is mobile or behind a firewall
  - Change the infrastructure versus add to transport or new "wedge" layer?
  - Separate identifiers from locators
  - New identifier space versus use existing one?
  - Put Identifier into every payload packet?

Spam

- **Email is more complex than people usually realize**
  - And having to worry about human factors is distracting

- **Spam is a social problem**
  - Technical solutions need to follow the social assessment
  - Technicians make bad social scientists
  - Social scientists make bad engineers

- **Complicated and simplistic solutions will be damaging**
  - There is no such thing as an "interim" solution
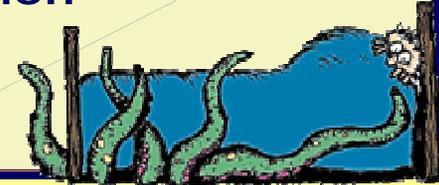
Observations
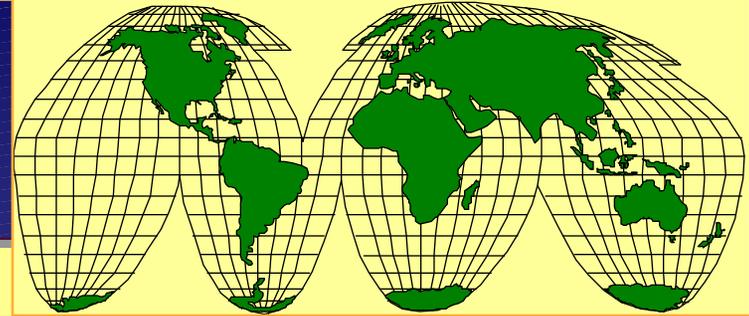
- **New applications propagate *very* slowly**
  - Modified applications propagate *much* slower
  - Rate of adoption depends of adoptee incentives

- **Internet architecture is getting more fragmented**
  - Uncoordinated, piecemeal designs
  - Large, cumbersome designs
  - Failure to incorporate reality of user-driven intermediaries

- **Scaling issues get little serious attention during design**
  - Large-scale use
  - Large-scale administration and operations

The Balancing Act

- **Simpler designs**
  - Long list of "requirements" is for the future
  - Only a subset needs to be satisfied initially

- **Much quicker specification cycles**
  - Permits incremental enhancement, based on experience

- **More cross-area coordination, sooner**
  - Applications, operations, security, management

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