Preserve and Enhance:
Balancing Goals for the Internet

APRICOT
Kuala Lumpur - 2004

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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

Continuing 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?
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

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Apricot – KL, 2004
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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