Next Generation Network Architecture Challenge: the "...ities"

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Challenge: on beyond the data plane

- Q: data plane performance really the major roadblock?
 - "robustness"
- adaptability
- "complexity of control" * reconfigurability
- maintainability
- security
- evolvability
- manageability

the "...ities"

- Fundamental advances here are hard!
 - * "efficiency" not always the most important measure
 - little/no past work on the "...ities"
 - * metrics and models still to be defined

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Example: soft state control

- conventional wisdom: "soft-state is robust, less complex than hard-state signaling"
 - * really?
 - how to define "robustness"?
 - how to define "complexity"?
- posing/answering such a question is:
 - * hard: no well-accepted models, paradigms
 - * easy: little/no past research
 - * important: a fundamental question
 - * religious: beliefs, rather than formal analysis

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Soft-state versus hard-state

spectrum of signaling choices (not totally ordered)

SS w/ removal: (SSER) □ IGMPv2

hard-state w/ heartbeat removal

state timeout

"Pure" soft-state (SS) soft-state w/ removal, reliability (SSRTR)

explicit. reliable state install, remove

HS: "Pure" hard-state

refresh RSVP, IGMPv1,.. RSVP

reliable triggers

SS7

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Soft-state versus hard-state: a performance comparison

unified Markov model for approaches

- state installer, state holder: (in)consistency
- message loss
- *signaling overhead cost
- cost of inconsistent state: e.g., receipt of unwanted multicast data

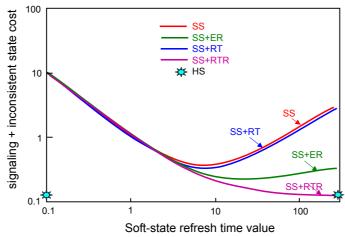
J. Ping, G. Zihui, J. Kurose, D. Towsley "A comparison of hard-state and soft-state signaling protocols," *ACM Sigcomm 2003* (to appear)

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Soft-state versus hard-state: a performance comparison



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Soft-state versus hard-state

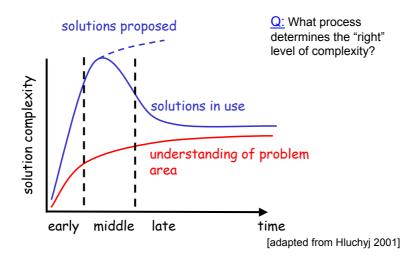
- □ so far: performance only, no "..ities"
- □ theory for design of soft-state systems
 - * self-stabilizing algorithms
- implementation, operational complexity
 - * resilience to bugs, misconfiguration, attacks?
 - operational overhead/management required?
 - * measures of such complexity?
 - quantifying performance/complexity tradeoff

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The right level of complexity

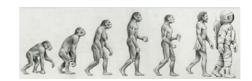


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Evolvability



- difficulty: extending existing infrastructure
 - investment in legacy systems
 - economic incentives?
 - works well enough: "if it ain't broke, don't fix it"
- ossification as a result of success?
- □ approaches towards evolution:
 - active (extensible) networks: programmability in net "core"
 - overlays: programmability at the "edge"

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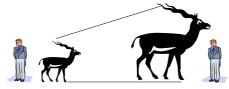
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Middle age: narrowing mind, widening waist? Applications TCP UDP **Applications** IΡ "love TCP UDP handles" IΡ client application overlays NAT diffserv IPSEC mobile IP mcast intserv server Eth token apps overlay PPP 802.11 services Eth token PPP 802.11 radio, copper, fiber TCP UDP radio, copper, fiber IP "hourglass" Middle-age IP: one view Eth token PPP 802.11 radio, copper, fiber Middle-age IP: another view NeXtworking'03 June 23-25,2003, Chania, Crete, Greece 10 Kurose The First COST-IST(EU)-NSF(USA) Workshop on EXCHANGES & TRENDS IN NETWORKING

On being the right size

"For every type of animal there is a most convenient size, and a large change in size inevitably carries with it a change of form" [J. Haldane, 1928]



On being the right complexity?

For every type of networked system, there is a most convenient complexity of control, and a large change in size or function inevitably carries with it a change of form of control... [Adapted from L. Zhang]

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