Scalability Issues in ICN

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PURSUIT: Publish Subscribe Internet Technology - http://www.fp7-pursuit.eu
Motivation

- ICN involves named data
  - Names may be hierarchical or flat
  - But they are definitely too many!
  - Orders of magnitude more than hosts
  - How can we handle such numbers?
- At least two issues need work
  - Name resolution scalability
  - Forwarding scalability
- Discussion starter presentation
  - Problems & some ideas
Name resolution

• Obvious problem: the namespace is huge
  – Trillions of named items to begin with
  – Plus tons of data from the Internet of Things
  – Can we maintain huge PITs?
  – Can we maintain huge DHTs?

• Less obvious problem: the names are also huge
  – Simply because there are too many
  – Can we use huge names in packets?
  – Can we survive with shorter versions?
Name resolution

- DNS relies on locality and caching
  - Similar names lead to similar name servers
  - Name server addresses can be cached
- CCN/NDN names are hierarchical, but different
  - Prefixes do not lead to unique locations
  - Caching pointers based on prefixes does not work
- Are name prefixes expected to be controlled?
  - For example, /aueb is assigned to, well, AUEB
  - If they are, maybe the problem is tractable
  - But this is a back door for location/identity binding!
Name resolution

- DHTs scale well and distribute load, but...
  - They assign names to potentially unwanted servers
  - They violate routing policies
  - They stretch resolution paths
  - Hierarchical DHTs only partially help
  - Caching not nearly as effective as in DNS
- DONA-like solutions work better than we thought
  - Huge amounts of storage are needed at the top
  - But, we do have huge server farms
  - We may be able to throw hardware at this problem
Forwarding

- The actual packet transfer is also problematic
  - Assume that we aim for native transfers
  - Otherwise we are passing the problem to IP!
- We use single-source multicast as an example
  - Multicast is supposed to be an ICN strength
  - Single-source is commercially more interesting
- Two general options
  - Hop-by-hop (as in CCN/NDN)
  - Source routing (as in PSIRP/PURSUIT)
Forwarding

- Hop-by-hop forwarding (CCN)
  - Forwarding state distributed to routers
  - Fast join/leave for multicast
  - Large forwarding table (PIT) size
    - Especially with very fast routers
    - Trickier with variable-length names
    - State compression ideas need to be evaluated
- Strictly symmetrical paths only
  - The resolution part fixes the forwarding part
  - Can be either a feature or a bug
Forwarding

- Source-routing (PSIRP)
  + Flexible path selection
    - Content/cache awareness
    - Steiner tree multicast
  + Stateless router operation
    - Large multicast trees hard to handle
      - Processing delay at the path computation engine
      - Slow join/leave for multicast
    - Forwarding inefficiencies due to false positives
      - Bigger problem with larger groups
      - Solutions for large trees need to be evaluated