Supporting Mobility in Global Scale

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Setting Up the Stage

As networking researchers, exactly how do we get our job done?

- Physicists: interpret the given-world
  - No dispute over whether the design was right or wrong
- Networking research
  - God did not build the Internet; we did
  - We designed all the rules (protocols)
  - We create artifacts through (informed) trials and errors: define problem ⇒ design ⇒ implement ⇒ experiment ⇒ learn lessons ⇒ revise/next design (hopefully better)

This talk is ~~an attempt to~~ an attempted start to

- Define the problem,
- explore the design space, and
- identify open issues

- What are the Fundamental Challenges?
- What are the Fundamental Principles to guid our mobility deployment effort in next few years?

Why Mobility Support in Global Scale?

- Cellphone providers already have it
- Need Internet mobility support in global scale
- Why? Why now?

From Dr. Wakikawa's presentation on Monday:

Mobiles are no longer minority

Internet Population Changes to Mobiles

- Automobiles (800,000,000), Cell phones (1,500,000,000) People (???)

"Mobility Support" = ??

- Being able to reach nodes that may have moved / may be moving (host mobility)
- Being able to reach a group of nodes that may be moving together (network mobility)
- Being able to reach moving entities through forwarding nodes that may be moving themselves (ad hoc network)

A Side Note: ID vs IP Address

A topic that has trigged lots and lots discussions lately ...

- IP address is for data delivery == IP address is topologically-dependent
- To identify a mobile node or a multihomed node: need a node identifier
- What to use for that node-ID?
  - An engineering design decision

"Global Scale" = ??

- Measured by geographic distance
- Measured by size
  - Number of nodes in the oveall system
- Measured by the degrees of heterogeneity in technologies
- Measured by the number of autonomous parties in the game
  - Each with diferent interest

Mobility Support: Some Other Variables

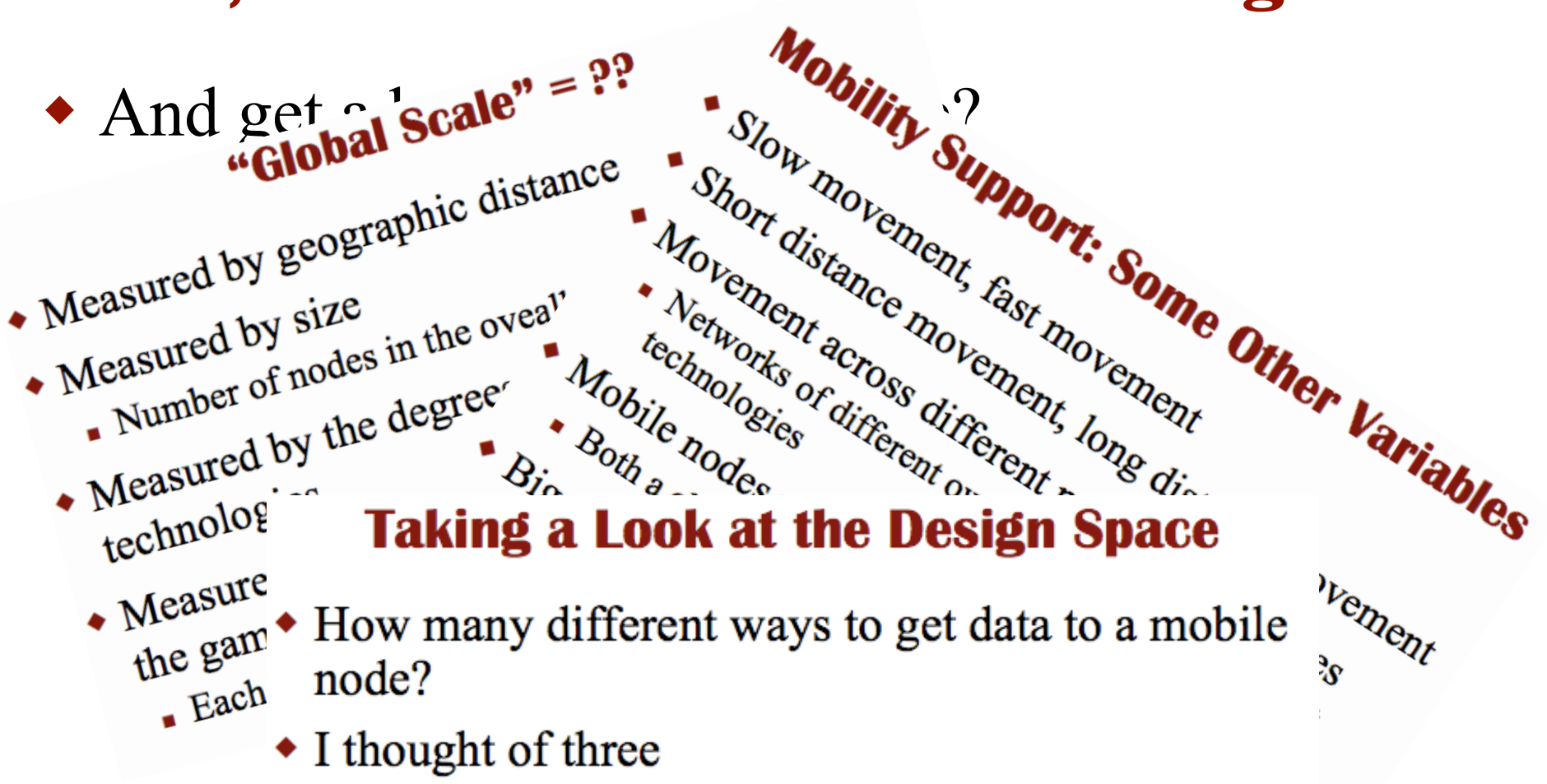
- Slow movement, fast movement
- Short distance movement, long distance movement
- Movement across different network boundaries
  - Networks of different owerns, networks of different technologies
- Mobile nodes with multiple interfaces
  - Both a challenge and an opportunity
- Multiple mobility supports by different networks, at different levels
- Bigger factors:
  - Different parties with different interests
  - Technology trends and progressing speed
    - Much unknown lying ahead in the future

Taking a Look at the Design Space

- How many different ways to get data to a mobile node?
- I can see three
  - Flooding
  - Continuously distributing current mobile location through network routing
  - One level of indirection: find the mobile location through a stationary entity
    - Various solutions as elaborations of this
      - Cellphone network: home provider
      - Mobile IP
      - Dynamic DNS

Now, How do we cook all these together

- And get a ... ?



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Look over the fence

- The wired Internet:
  - Measured by size: a global-scale system
    - The largest cohesive system ever by human?
  - The degrees of heterogeneity in technologies: high
  - Interconnecting very large numbers of autonomous parties, each with diferent interest
  - Driven by

    

    technology advances → system growth → new users and new applications
- What can we learn from 30 years of Internet exprience?

Some principles/lessons from Internet

(an incomplete and unordered list)

- Reachability is number one
- Distributed, not centralized
  - The design must allow one to take care its own business, not affected by others
- Be prepared for things to go wrong
  - Reliability through redundancy
- Keep local changes local
  - Locality: measured by topological relations, geographic distance, network scope, ...
- Keep it simple
- Make it scalable
- Market chooses; end users have the final say
  - God seems unwilling to grant any particular party's wishes

Example: DNS

- Reachability is number one
- Distributed, not centralized
  - Individual domain owners set up their own name servers, manage their own policies
  - Great division of responsibility
- Be prepared for things to go wrong
  - Redundant DNS servers,in distributed locations
- Keep local changes local
  - Name mapping changes at local domain only; DNS server changes propagate one-level up
- Keep it simple
  - The Resource Record design; the simple caching design
- Make it scale
  - There is a relation between the size and frequency of change
  - DNS servers: very large in numbers, infrequent changes

Another Example: the Basic Mobile IP design

- Reachability is number one
- Distributed, not centralized
  - individual mobiles arrange their own home agents
  - Your HA may be failed, mine still working
- Be prepared for things to go wrong?
- Keep local changes local
  - mobile reports back to its own home agent
    - May not be local by topological or geographic distance
- Keep it simple
- Make it scalable
  - By keeping mobile dynamics outside routing infrastructure

Is Mobile IP design a patch-on?

- It *was* added on later
- If we were to start again from scratch, would it have been done differently?
  - Distributed control
  - It scales well as far as distribution of mobility update is concerned
  - Performance is important, but below any of the above consideration

➡Keeping mobile state at home agent

  - Keep the matter in your own hand
  - Simplest design?
  - Not giving highest possible performance: Non-local mobility updates as measured by topological or geographic distance → considered sub-optimal under rapid movement

How to Improve the performance

- Must not sacrificing scalability
- Identify network scope?
- Identify boundary?
- Optimization within scope/boundary
  - Flooding?
  - Via routing?
  - Rapid binding?

What to take away

- Keep the global picture in mind
- Learn from the past!
  - A rich set of lessons
  - A rich set of working solutions
- Understand where we came
  - May help us better understand where we are going
- Technology moving forward at an accelerating speed
- Successful designs → facilitating technology advances → potential change of the playground

One more quick departing note

- Yes we can learn a lot from the past
  - What applies?
  - What doesn't?
- “one must think through everything on his own. One must not blindly accept others opinions; one must not worship ‘the principles’ ”

Thank you!

Questions?

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