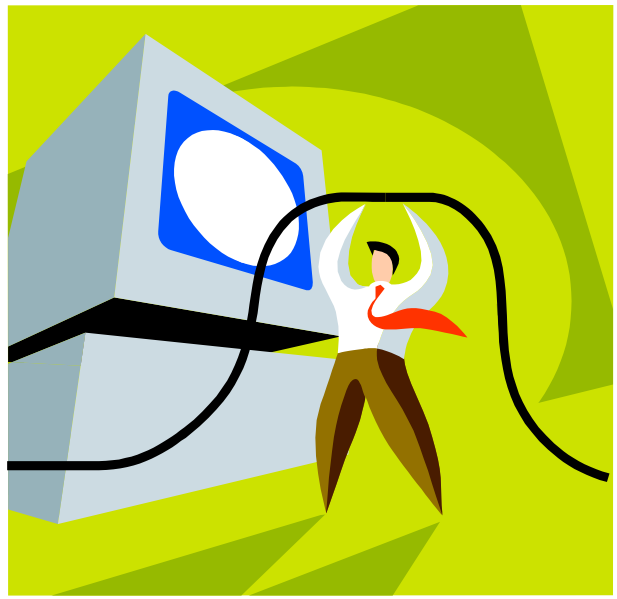
Community Oriented Network Measurement

March 30, 2005

Welcome



Internet Measurement

- Kleinrock and Naylor, 1974:
  - Original ARPANET had built-in abilities to:
    - Trace a single packet's passage through the network
    - Obtain instantaneous traffic matrix
    - Obtain instantaneous queue lengths in IMPs
    - Obtain per-IMP traffic summaries and histograms
    - Obtain any IMP's routing table

Some Successes

- Router & AS topology characterization
- Characterization of interdomain system
- Inference of hidden properties
- Traffic modeling (short and long timescales)
- Statistical invariants (mice & elephants, Zipf laws)
- Characterization of Web graph
- Models of worm propagation
- Science driven engineering (AT&T, Sprint,…)

Big challenges ahead

- Engineering
  - Performance evaluation
  - Capacity planning
  - Security
- Science
  - Interaction of network and people / society
  - Growth laws
  - Statistical properties

How is Internet Measurement Done?

- Three models
  - Internet Measurement Organizations
    - CAIDA, NLANR, RIPE, …
  - PI driven projects
    - Local measurement infrastructures
    - Built by effort of a single PI / small group
  - Planetlab
    - Community-shared resources
    - But very limited measurement capability

Time Ripe for a Community Approach?

- Community Approach =
  well defined measurement community +
  well defined measurement scope +
  variety of research agendas +
  need for expensive measurement equipment +
  community self-organization

Well Defined Community Exists

- IMW/IMC submissions
  - 2001: 53
  - 2002: 93
  - 2003: 109
  - 2004: 157
- PAM experienced similar growth
  - 2004: 184 submissions
- Books in area
  - "Evolution and Structure of the Internet," Pastor-Satorras and Vespignani

Internet Science

- Measurement Scope: Understanding the Internet at all layers, as it evolves in time
- Does this correspond to any other sciences?
- Can we learn from how other sciences organize their measurement infrastructures?

Astronomy

- Large collection of discrete objects (stars, galaxies, planets, etc)
- Interested in their emissions and reflections
- Can measure these objects, but can't really do much to affect the objects being measured

Biology

- Interested in describing systems (cells, populations) that are
  - Complex
  - Comprised of many interacting mechanisms with
  - Many feedback loops
- Can affect systems in some ways
  - Can "poke" a cell or organism to see what happens
- Can't usefully take apart a functioning system

Earth Science

- Scale of the system studied is global
- Many important effects concern interaction of human society with the system
- Many important effects depend on geography and physical distance

Example Community Approaches

- Astronomy: building and operating large telescopes
- Oceanography: building and operating research vessels

Telescopes

- Range of options (smaller -> more informal)
  - Owned/operated by small groups
    - BU/Lowell 2m telescope
      - BU supports at $150K/year (1/2 time)
  - National Facility
    - Keck
  - Space Based
    - Hubble

Astronomy

- Example: Keck Observatory
  - Governing board for telescope
    - One member per institution (Dean or Scientist)
  - Director appointed by Board
  - Time Allocation Committee
    - Not insiders – peers from across discipline
    - Serve on committee 2-4 years
    - Accepts short (2-page) proposals 1x or 2x / year
    - Ranks and forms a consensus list
    - 20 proposals / semester (one day's reviewing)

Telescope proposal process

- Two parts
  - Science proposed
  - Amount of time being requested
- TAC:
  - Ranks science 1-10
  - Ranks time, makes recommendation
    - Can say "try 10% of time, if it works, come back for more" or "We think you can do this in 1/3 the time"
- Director makes final call if telescope is oversubscribed

Telescope Data

- Most national facilities make data available after some proprietary period
  - 6 months to a year
  - To allow PI to get data analyzed and out
  - Data will become available even if not used by PI
- Smaller facilities may not do this
  - Due to archiving costs
- Sometimes the Director will arrange a "shotgun marriage" if two projects propose to collect similar data

How do you build a new telescope?

- There is something called a "decadal review" – what astronomy needs to be done in the next 10 years
  - The next one is 5 years out, there is already a lot of jockeying going on ☺
- Clearly needs to have community behind it
  - If you can get on the decadal review, you are in good shape
- Usually:
  - Donor + Institutions + NSF/NASA

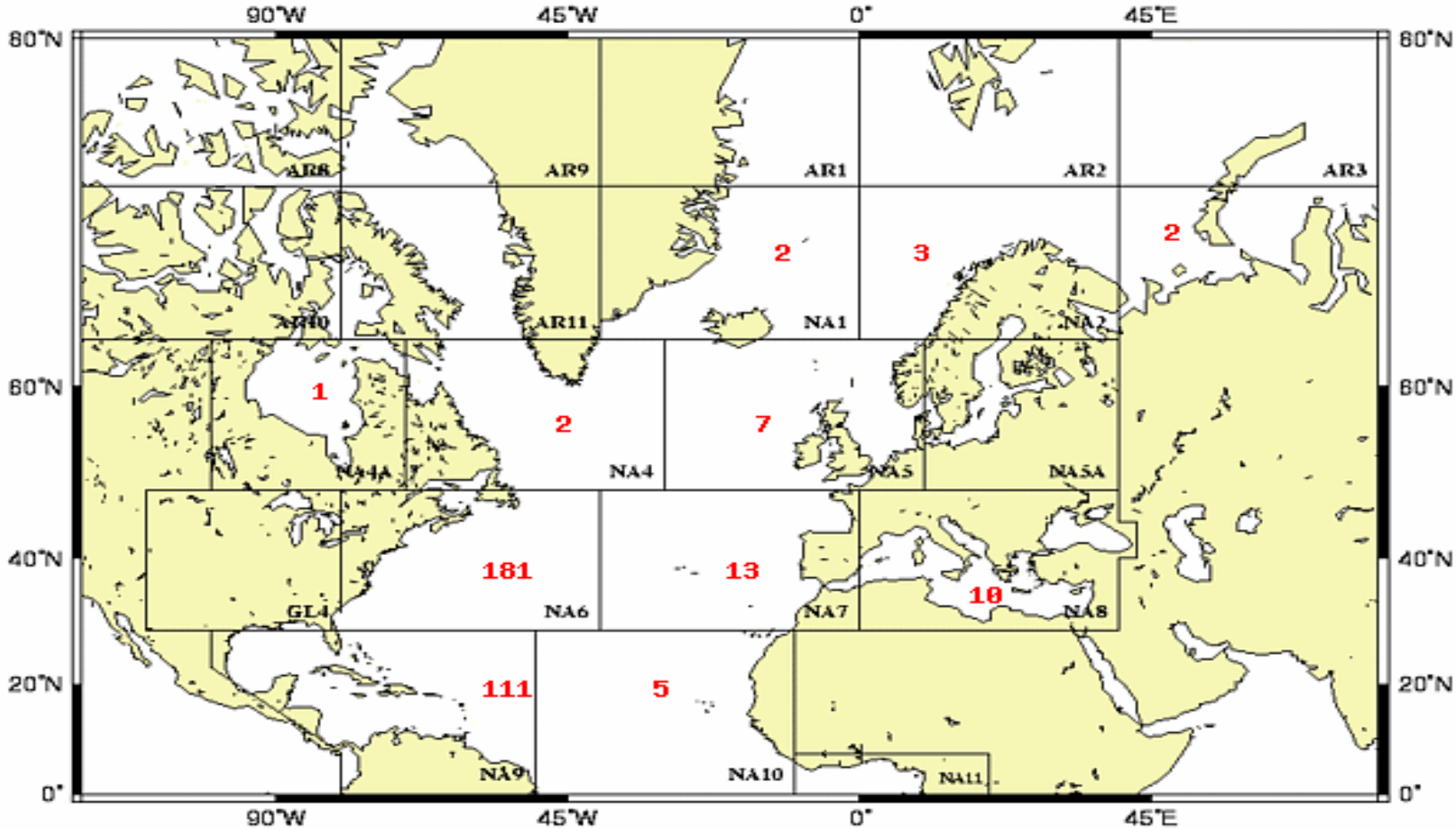
Oceanography – Research Ships

- All research ships are handled by a single organization – UNOLS (61 institutions)
  - 27 research vessels in 20 home locations
  - All schedules publicly available
- Ships are owned/operated by home institutions
  - under contract to NSF
- Chair, Council, and Committees
  - Ex: Ship Scheduling Committee

UNOLS oversees, Funding agency allocates

- $50,000 / day ship time
- Ship time request submitted as part of proposal
  - PI specifies how much ship time is needed
  - About a year in advance
- NSF, ONR, NOAA panel reviews and approves ship time
- UNOLS Scheduling Committee
  - Implements NSF panel recommendations

Ship Scheduling



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UNOLS Ship Time Request Form - Section ONE

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UNOLS Request ID #: 2002022211112010
Version #: 004
Last Modified: 2002/03/03 15:45 EST
Date Issued: 2005/03/28 14:22 EST

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P.I. Name Last: McNichol First: Ann MI: P.

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Institution: Woods Hole Oceanographic Research vessel required for:
Institution X Ancillary Only
Address: Woods Hole, MA 02543 _ Principal Use
_ No Ship Required
_ Long Range Planning Document

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Phone: 508-289-3394 Fax: 508-457-2183 Email: amcnichol@whoi.edu

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Co P.I. Name	Institution	Co P.I. Name	Institution
Robert Key	Princeton University		

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Proposal Title:

Collection and Measurement of DI13C and DI14C samples from the CLIVAR Repeat Hydrography cruises

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Large Program Name: Other Research Purpose: Multi-discipline
If Other, specify: CLIVAR If Other, specify:

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New Proposal? Y Agency Submitted to: Foreign EEZ? N
Funded Grant? N NSF/OCE/Other
Institutional Proposal #: Amount Requested: Area(s) of Operation:
GG11190.00

```
================================================================================
Ship(s) Requested # Science
Year (Name or Size) Days Req. Optimum Dates Alternate Dates
---- ---------------- --------- ------------ --------------
2003 Large 44
2004 Large 66
2005 Large 102
2006 Large 51
2008 Large 89
================================================================================
Total Science & Ship Days Needed: --------------- PORTS ------------
352  Start: Intermediate: End:
353  Number in Science Party:
354  1
355  ================================================================================
356  Equipment Required:
357  _ Vans _ P-Code GPS _ MCS _ Alvin _ DSL 120
358  _ Dynamic Positioning _ Multibeam _ SCS _ ROV _ 680 Cond.
359  _ Helicopter Operation
360  ================================================================================
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Oceanography Data

- Ocean Core Drilling Program
  - 15 years $150M
  - All cores are kept forever (3 locations)
  - Professors send their students to sample cores
  - All data must be made available 1 year after collection
- UNOLS
  - All data must be made available 2 years after collection
  - Researchers on same cruise share data
  - UNOLS matches experiments

Time Ripe for a Community Approach?

- Community Approach =
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  variety of research agendas +
  need for expensive measurement equipment +
  community self-organization

What model makes sense for a CONMI?

- Not single-threaded like a telescope
  - Many experiments should be able to run simultaneously
  - We can exploit virtualization
- Should have some sense of "global" coverage like ocean science
- Data archival
  - Notion of "embargo" or "proprietary period" seems to work in other sciences

Goals for Today

Answer the following questions:

1. What would the characteristics of a good CONMI be?
2. What are the obstacles to achieving this?
   - Research and Engineering
3. What are some reasonable first steps in this direction?

Schedule

- 9:30 round table: 3 minutes each
- 10:30 Passive Measurement
  - Joerg, Colleen, Gianluca
- 12:15 Lunch
- 1:15 Active Measurement
  - David, Tony, …
- 2:15 Abilene
  - Rick / Matt
- 2:45 Break
- 3:15 Round Table / Open Discussion
- 4:15 Capturing Discussion Summary
- 6:30 PAM Reception!