Coevolution of knowledge networks and 21st century cyberinfrastructure

Noshir Contractor
Professor, Departments of Speech Communication & Psychology
Co-Director, Age of Networks, Initiative, Center for Advanced Study
Director, Science of Networks in Communities - National Center for Supercomputing Applications
University of Illinois at Urbana-Champaign
nosh@uiuc.edu
1. Turn on power & set MODE with MODE button. You can confirm the MODE you chose as the red indicator blinks.

2. Lamp blinks when (someone with) a Lovegety for the opposite sex set under the same MODE as yours comes near.

3. FIND lamp blinks when (someone with) a Lovegety for the opposite sex set under different mode from yours comes near. May try the other MODES to “GET” tuned with (him/her) if you like.
SNIF: Social Networking in Fur
Group: Noah Fields, Jonathan Gips, Philip Liang, Arnaud Pilpré

What
We present a system that allows pet owners to interact through their pets’ social networks. Inexpensive, unobtrusive hardware can be affixed to pet collars and paraphernalia in order to augment pet-to-pet, pet-to-owner, and owner-to-owner interactions. SNIF devices aggregate pertinent environmental, social and individual information that can be broadcast or addressed to other participating community members.

Why
Pets already function as social devices. Walking a dog in the park can lead to conversations that one might not otherwise have. Pets function as active icebreakers that will go up to anyone without any notion of social inhibition. Furthermore, pet-owners love buying products for their pets: sweaters, leashes, collars, toys, dishes, and beds. These items provide a set of rich interactions that can be brought into the digital world.

How
The SNIF starter kit includes a leash and collar as well as membership in the online community.

SNIF collars contain an LED display, an IR transceiver, and various sensors such as accelerometers and digital thermometers. They function as output devices that display personalized “collar tones” when the pet comes in proximity to another pet. They serve as input devices that sense activity levels, microclimate conditions, and other pets’ presence.

The SNIF leash contains a two-way RF device, such as the Ambient Devices platform, and serves multiple purposes in the SNIF system. When attached to a pet’s collar, it can upload information from the collar to the SNIF servers. When disconnected, the leash functions as an ambient device that displays real-time information, which is streamed from the SNIF servers, relevant to the pet and pet owner. For example, the leash displays the “collar tones” of frequently encountered pets that are going out for a walk. It may also give an indication of the general pet-walking index.

The online community portion of SNIF allows pet-owners to set privacy preferences, communicate with other pet owners, arrange pet outings, and customize the ambient information that their SNIF leashes display.

Extensions
Pet toys that serve as tangible interfaces for the pet. Degrees of separation between pets that changes as they interact.
Remote monitoring of pet’s activity.
Local RF detection to display degrees of separation from the other pets in the vicinity.
Aphorisms about Networks

- **Social Networks:**
  - Its not what you know, its who you know.

- **Cognitive Social Networks:**
  - Its not who you know, its who they think you know.

- **Knowledge Networks:**
  - Its not who you know, its what they think you know.
Cognitive Knowledge Networks

It’s not who you know.
It’s what who you know knows.

Source: Newsweek, December 2000
TECLab/SONIC Projects on Enabling Networks

- Networks to enable Cyberinfrastructure, NCSA/NSF
- Emergency Response Networks, NSF-ITR
- Transnational Immigrant Networks, Rockefeller Foundation
- Economic Justice Networks, Rockefeller Foundation
- Communities of Practice Networks, Procter & Gamble
- Food Safety Networks, UIUC Cross-Campus Initiative & John Deere
- Global Supply Chain Infrastructure, Vodafone
Science and Engineering Cyberinfrastructures

- GriPhyN
- NVO
- EUROGRID
- LCG
- iVDGL
- LIGO
- GridLab
- DataTAG
- Data Grid
- North Carolina BioGrid
- FusionGRID
- Condor
Geosciences Cyberinfrastructures

CUAHSI
Consortium of Universities for the Advancement of Hydrologic Science, Inc.

The Earth System Grid
ESG

Meteorological Assimilation Data Ingest System (MADIS)

NOMADS
The NOAA Operational Model Archive and Distribution System

The National Virtual Ocean Data System

DLIESE
A community-centered resource for anyone interested in learning more about the Earth.
Supported by the National Science Foundation

DESCOPE

SEEK: The Science Environment for Ecological Knowledge

NEESgrid
Building the National Virtual Collaboratory for Earthquake Engineering Research
Multidimensional Networks
Multiple Types of Nodes and Multiple Types of Relationships
Testbed Communities: Partners

- Collaborative for Large-scale Engineering Analysis Network for Environmental Research (CLEANER)
- Tobacco Systems Integration Grid (Tobacco SIG)
- Social Network Analysis Cyberinfrastructure (SNAC)
**Announcements**

Social Network Analysis Tool has been added to the CLEANER portal! (Jan, 05, 2006)

**New Group Members**

Three (3) new members join the CLEANER community since last time you logged in.

**Recent Forum Activities**

The following posts may be of interest to you:
- CLEANER Portal Design posted by Liu
- Most read thread: CLEANER Management Plan
- Most recommended solution: CLEANER Future
- Most active member: Barbara Minskor

**Recent Documents**

CLEANER Video Conference.pdf
CLEANER Management Plan.doc

**Recent Data Activities**

The following new data sets may be of interest to you:
- Real-time Hydrological Data Sets From Mississippi River
- Total data subscriptions available: 10
- Total models in the community: 130

**Sensor Status**

Up: 150 sensors have been up for 30 days.
Down: 3 sensors are down for 2 hours.
Advanced Search

Areas

Select the area of the system you would like to search:

- [x] My Space
- [ ] Collaboration
- [x] Data
- [ ] Analysis
- [ ] Library

Referrals

Select the categories for which you would like to receive referrals:

- [x] People
- [ ] Data
- [ ] Topics
- [ ] Documents
- [x] Tools
- [ ] Projects
Advanced Search

Displaying Results 1 through 20 of approximately 286 [Next 20 Results]

Draft Action Plan for Reducing Mitigating and Controlling Hypoxia in the Northern Gulf of ... HTML, Thursday September 04 2003 8:31 PM

Notice of Availability and Request for Comment on Draft Plan of Action for Reducing Mitigating ... HTML, Saturday October 14 2000 10:52 PM

ens HTML, Monday September 29 2003 1:13 PM

Chesapeake Research Consortium Publications HTML, Tuesday January 14 2003 6:28 PM

Stormwater | Nutrient Trading HTML, Friday September 26 2003 10:22 PM
Demo of multidimensional network
TECLab/SONIC Projects on Enabling Networks

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- Communities of Practice Networks, Procter & Gamble
- Food Safety Networks, UIUC Cross-Campus Initiative & John Deere
- Global Supply Chain Infrastructure, Vodafone
ICT Support in Emergency Management Networks

Drawing Analogies from Natural Systems
ENTOMOLOGY: Learning from natural robust societies.

Successful systems (evolution time)

Ant-based models have successfully been applied to solve optimization [Dorigo, 1996; Botee, 1999] and networking [Bonabeau, 2000] problems, among others.

Problem: Information Overload

- Hundreds or Thousands of first responders operate sharing couple of voice channels (radio, cell-phones) [Domel, 2001]

- If technology provides a mean to enhance delivery and media of information, we envision this problem would increase
Information Overload: Ants

Analogy (Ants’ alarm propagation)

Division of Labor; each ant “has” a threshold for each stimulus (pheromone).

When stimulus is greater than threshold the ant will be on “alarm” mode.

Cenels ants detects a hazard and release “alarm” pheromone (volatile).

Each pheromone release will last for a limited time; seconds or minutes.

The heterogeneous response to alarm pheromone avoids all ants react immediately (good or bad?).

Idea:

Actors will propagate information received only if the stimulus, i.e., “quality of information”, is greater than his/her threshold for that type of information.

Avoiding cascading effect; controlling information overload.
Natural System: Honey Bees

Honey Bees (*Apis melifera*)

Foraging Model [Seeley, 1991]

The system evaluates ALL the information, though individuals evaluate only partial information.
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INTERACTION NETWORKS

Human Agent to Human Agent Communication

Retrieving from knowledge repository

Publishing to knowledge repository

Human Agent (webbots, avatars, databases, “push” technologies) To Human Agent

Source: Contractor, 2001
COGNITIVE KNOWLEDGE NETWORKS

Non Human Agent’s Perception of Resources in a Non Human Agent

Human Agent’s Perception of Provision of Resources in a Non Human Agent

Non Human Agent’s Perception of what a Human Agent knows

Human Agent’s Perception of What Another Human Agent Knows

Source: Contractor, 2001
WHY DO WE CREATE, MAINTAIN, DISSOLVE, AND RECONSTITUTE OUR COMMUNICATION AND KNOWLEDGE NETWORKS?
Why do actors create, maintain, dissolve, and reconstitute network links?

- Theories of self-interest
- Theories of social and resource exchange
- Theories of mutual interest and collective action
- Theories of contagion
- Theories of balance
- Theories of homophily
- Theories of proximity
- Theories of co-evolution

Sources:

Co-evolution of knowledge networks and 21st century organizational forms

- Co-P.I.s: Monge, Fulk, Bar (USC), Levitt, Kunz (Stanford), Carley (CMU), Wasserman (Indiana), Hollingshead (Illinois).
- Three dozen industry partners (global, profit, non-profit):
  - Boeing, 3M, NASA, Fiat, U.S. Army, American Bar Association, European Union Project Team, Pew Internet Project, etc.
Public Goods / Transactive Memory
- Allocation to the Intranet
- Retrieval from the Intranet
- Perceived Quality and Quantity of Contribution to the Intranet

Transactive Memory
- Perception of Other’s Knowledge
- Communication to Allocate Information

Communication to Retrieve Information

Inertia Components
- Collaboration
- Co-authorship
- Communication

Social Exchange
- Retrieval by coworkers on other topics

Proximity
- Work in the same location
Motivation for Information Retrieval in Knowledge Networks

1. Social Communication 0.144

2. Perception of Knowledge & Communication to Allocate 0.995

3. Perception of Knowledge & Provision 0.972

4. Perception of Knowledge, Social Exchange, & Social Communication 0.851

5. Perception of Knowledge, Proximity, & Social Communication 0.882
3D Implications for Enhancing Networks

- **Discovery**: Effectively and efficiently foster network links from people to other people, knowledge, and artifacts (data setsstreams, analytic tools, visualization tools, documents, etc.). “If only CECCR knew what CECCR knew.”

- **Diagnosis**: Assess the “health” of knowledge networks - in terms of scanning, absorptive capacity, diffusion, robustness, and vulnerability to external environment.

- **Design or re-wire networks** using social and organizational incentives (based on social network research) and network referral systems to enhance evolving and mature communities.
Discovery - IKNOW Demo

http://iknow.spcomm.uiuc.edu
Use courtesy logins and passwords provided on the website
Diagnosis - Scanning

Scanning from many sources (such as countries)

Rest of Network

Country codes indicated in nodes

Internal  External
Absorbent star links external experts to internal network

Absorbent Star

Diagnosis - Absorbent Star

E1

I1

E2

I2

E3

I3

I4

I5

I6

Rest of Network

Internal

External
**Diagnosis - Diffusion**

*Internal cluster not connected to the rest of the internal network*

Diagram showing nodes labeled $I_1$, $I_2$, $I_3$, $I_4$, $I_5$, $I_6$, $I_7$, $I_8$, $E_1$, $E_2$, and $E_3$. The nodes $I_1$, $I_2$, $I_3$, and $I_4$ are within an isolated internal pocket. The nodes $I_5$, $I_6$, $I_7$, and $I_8$ are connected to the rest of the network, with $E_1$, $E_2$, and $E_3$ indicating external connections.
Diagnosis - Robustness

Internal network not robust to loss of $I_3$
Diagnosis - Vulnerability

Internal network vulnerable to external expert $E_1$
Design

- Design “small world” external networks for exploration of disruptive technologies
- Design “dense” external networks for exploitation of existing technologies
- Design “star” external networks for mobilization of incremental, non-disruptive technologies
The Lovegety and SNIF underscore 21st century aspirations for more effective networking.

Recent advances in cyberinfrastructure development provides the technological capability to more effectively leverage our networks.

Recent advances in communication networks research provides important insights into the social and organizational motivations that explain how we leverage our networks.

We are poised for the design, development, and deployment of large scale socio-technical network referral systems as part of the next generation public health cyberinfrastructures.
Science of Networks in Communities

nosh@uiuc.edu
www.uiuc.edu/ph/www/nosh