Dynamic Community

A New Approach to Supporting Knowledge Collaboration

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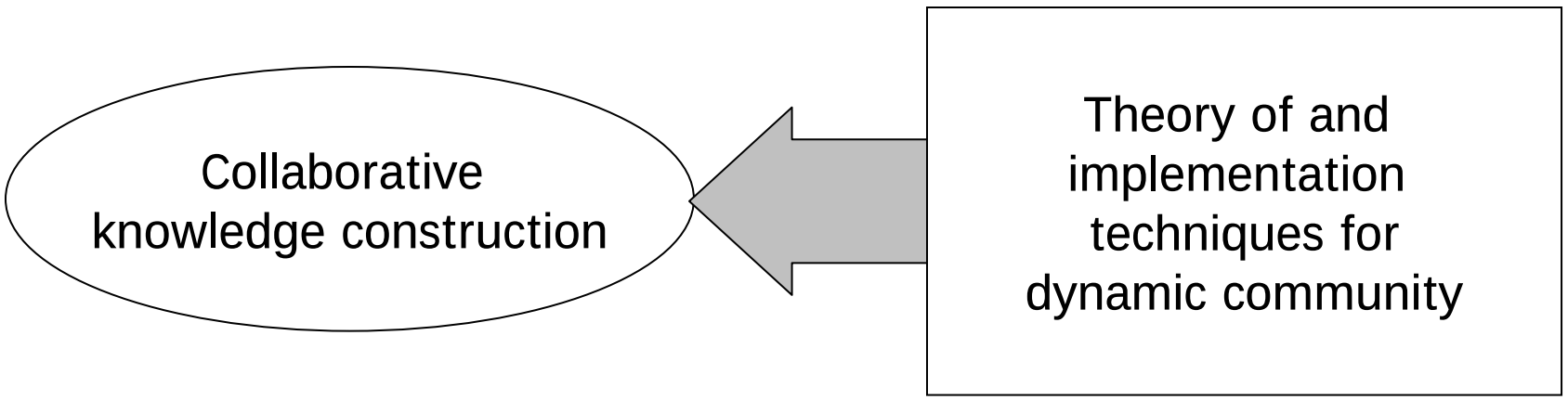
Outline

- The DynC (Dynamic Community) project
- What's dynamic community and why?
- A generic architecture for software systems in support of dynamic community
- Dynamic community theory applied to software reuse
- Summary

Background

- Funding agency
  - Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan
- Period
  - Oct. 2003 – Mar. 2006,
- Main Members
  - Principal Investigator
    - Kouichi Kishida, SRA-KTL
  - Co-PIs:
    - Yunwen Ye SRA-KTL & L3D, Univ. of Colorado
    - Katsuro Inoue Osaka University
    - Ken'ichi Matsumoto Nara Institute of Science and Technology
    - Kumiyo Nakakoji University of Tokyo

Overall research goal

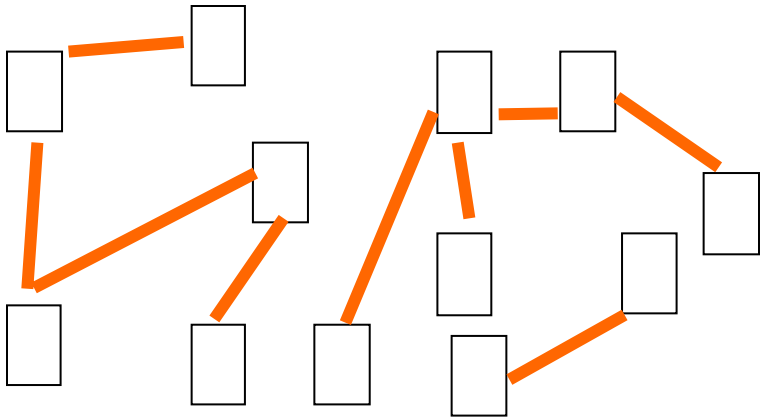


Socio-technical environments conducive to knowledge collaboration

- Cognitive proximity
  - Shared interest in the problem, the task or the knowledge involved as the bonding force
- Structural proximity
  - Timely communication channels exist among members
  - Social connection paths exist among participating members
- Relational proximity
  - The sense of closeness that members feel toward other members
    - obligations and expectations among the members
    - trust and motivation
- All proximities change dynamically
  - Support for situated and agile knowledge collaboration is needed

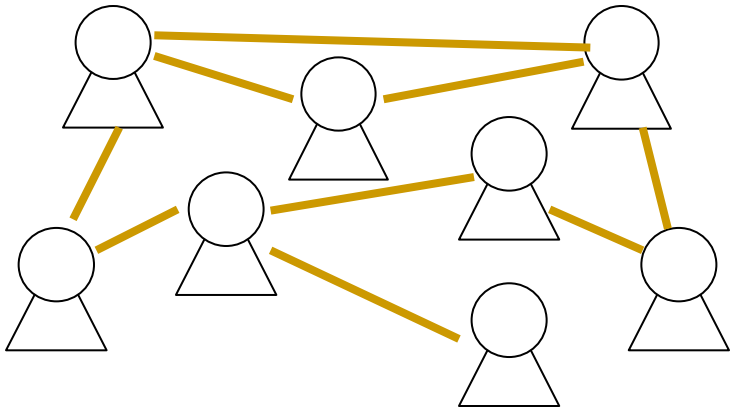
Current approaches to knowledge collaboration

Knowledge and knowledge-owners are separated



Knowledge repository

- Knowledge as commodity
- Achieving collaborative knowledge construction via collecting, managing, and sharing knowledge



Community

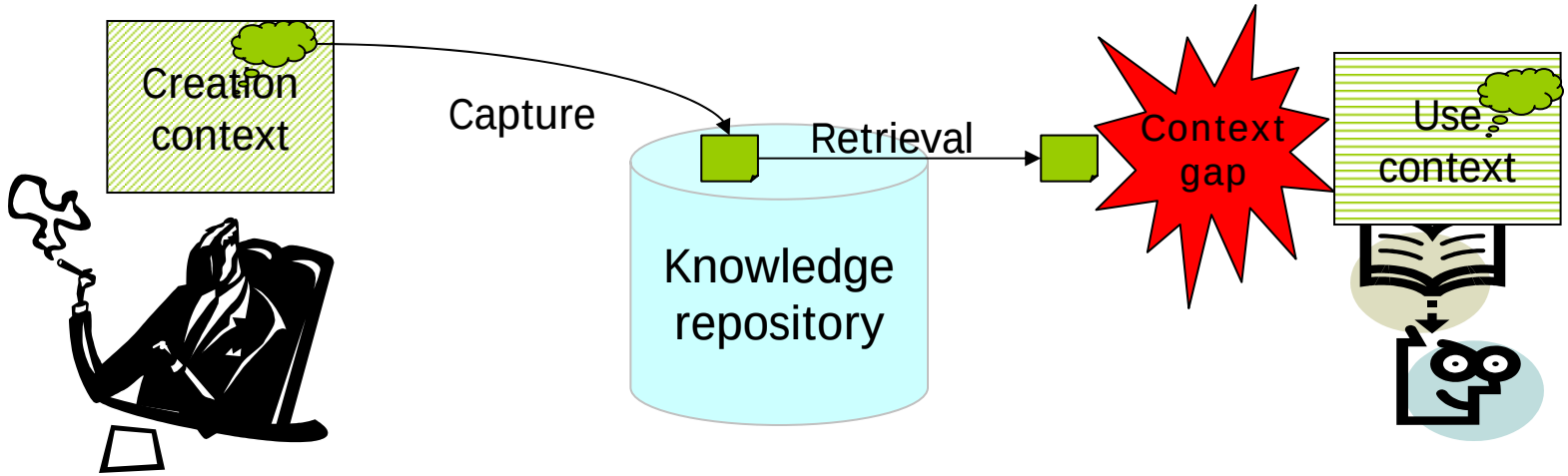
- Knowledge inseparable from the owner
- Achieving collaborative knowledge construction by supporting communications within a community

Knowledge repository

- Knowledge is a thing that is
  - Independent of context and knowledge owners
  - Specifiable
  - Transferrable
- The knowledge management cycle
  - Creation – Capture – Retrieval – Use
- Deeply rooted in traditional AI research

Problems with knowledge repository

- Unable to capture tacit knowledge
- The context gap
- Ignoring the structural and relational proximity completely

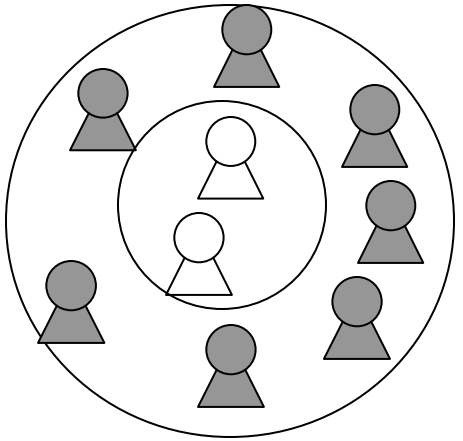


Community-based knowledge collaboration

- Knowledge is not a thing; it's
  - Fundamentally tacit
  - Highly contextualized and individualized to knowledge-owners
  - Always reconstructed in a new context
- Sharing in a community
  - Knowledge transfers along social networks
  - Knowledge gets transferred through social interactions among members with shared background

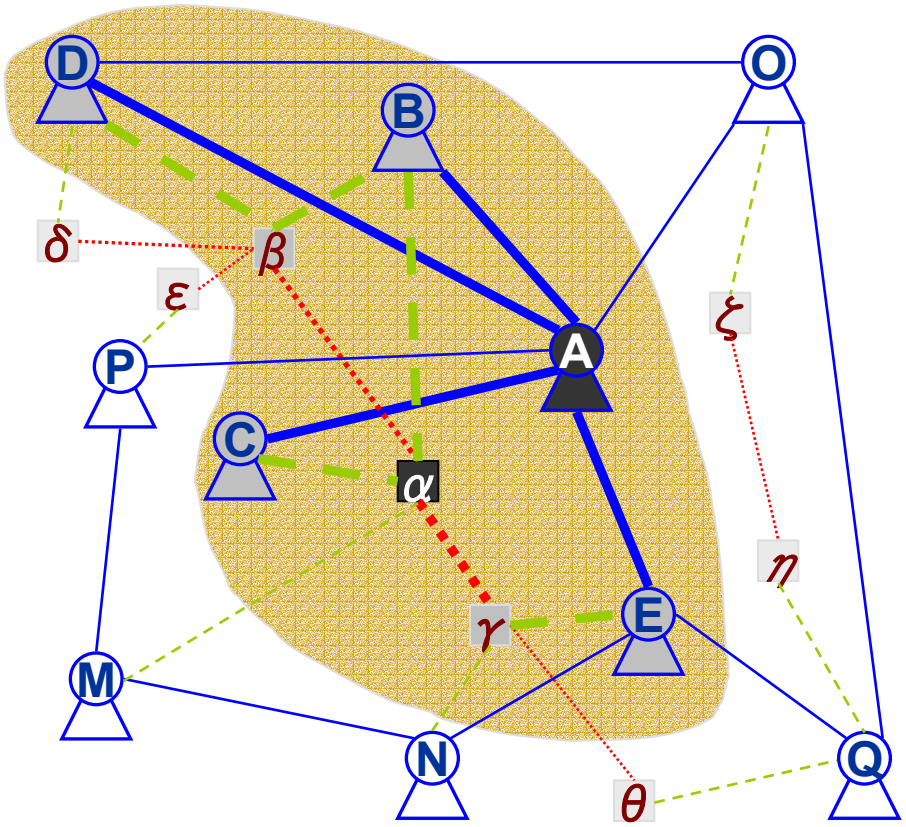
Problems with community

- Communities exist for a relative long time once formulated
- Experts and novices are regarded as personal attributes and their roles remain stable for a long time
  - One-direction information flow from experts to novices
  - Overload of experts
    - Easy task should not go to the experts
- No consideration for the difference of individual tasks
  - Not dependent on the diversity and situatedness of an individual's task and information needs
- Little consideration of social relationship between members
  - Member relationship is not differentiated
  - Member relationship outside of the community is not considered



Dynamic community: an integrated approach

Integrating knowledge and knowledge-owners



Technical factors:

- ❑ Knowledge repository
- ❑ Community support

Social factors:

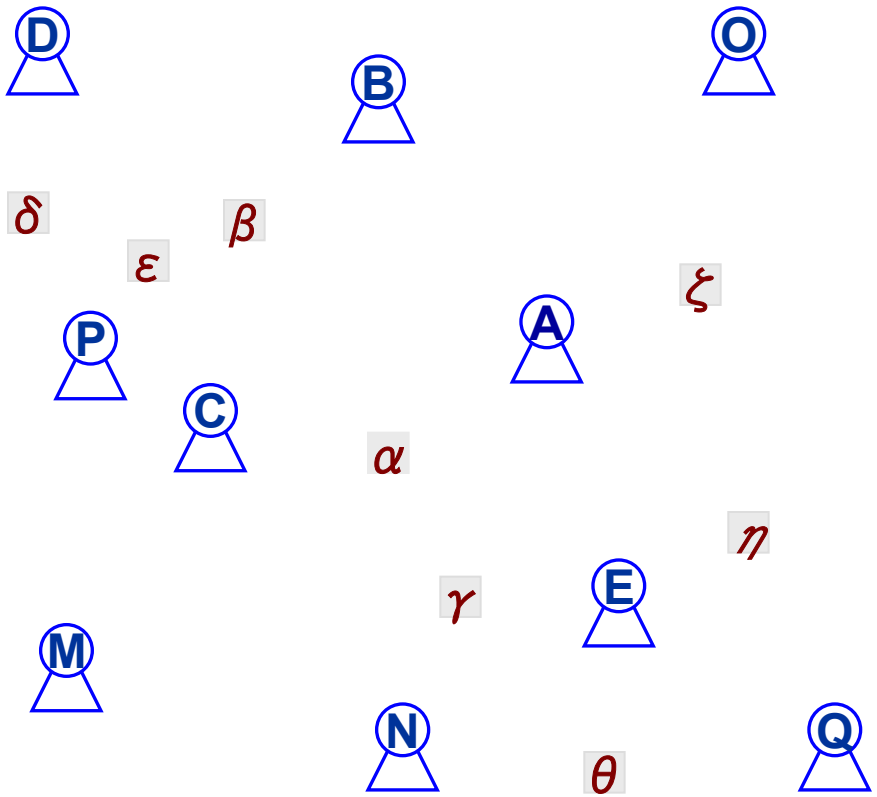
- ❑ Trust
- ❑ Motivation
- ❑ Relation

Defining dynamic community

- A dynamic community is a small group of people from a *knowledge work space*
- A dynamic community is formed for *a particular knowledge worker* who has *a particular task*
- Members in the dynamic community share interests in knowledge related to *the particular task*
- Members in the dynamic community have social connections with the *particular knowledge worker*

- *Knowledge worker*-specific and *task*-specific

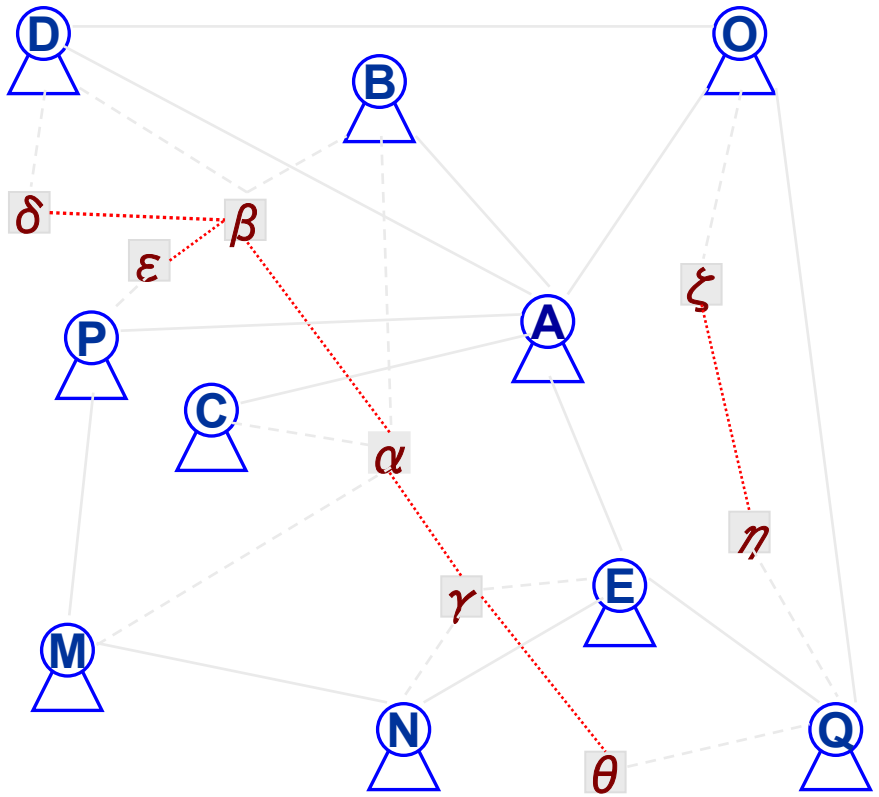
Knowledge Work Space



Set of people $\Psi = \{A, B, C, D, E, M, N, O, P, Q\}$

Set of information $\Phi = \{\alpha, \beta, \gamma, \delta, \varepsilon, \zeta, \eta, \theta\}$

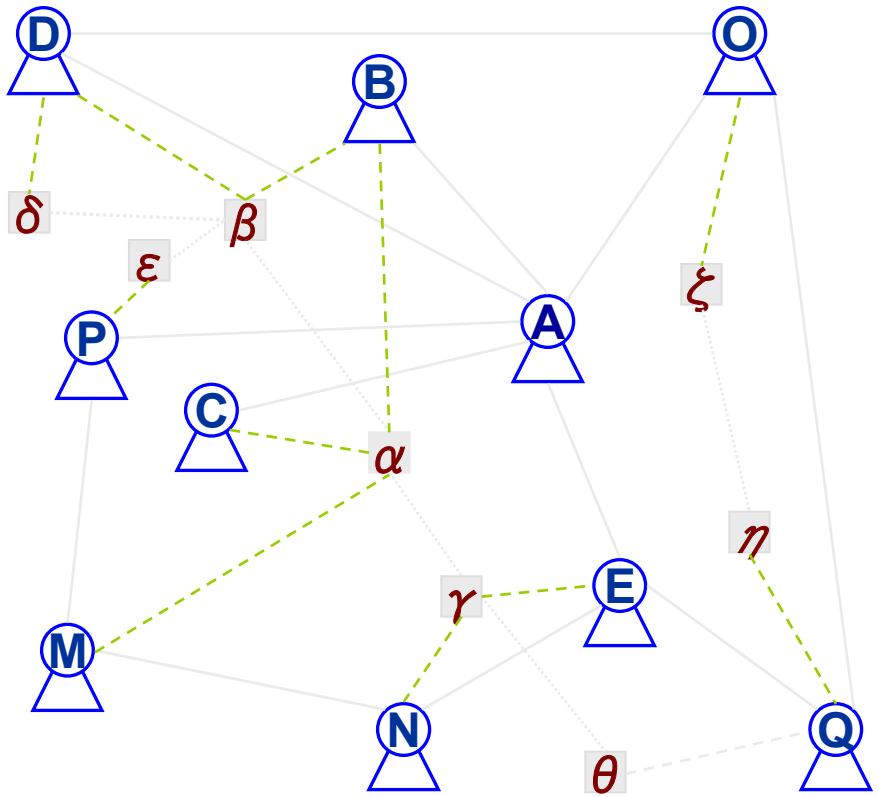
Knowledge Work Space



Relation between information

$\Pi = \{ (\alpha, \beta), (\alpha, \gamma), (\beta, \varepsilon), (\beta, \delta), (\gamma, \theta), (\zeta, \eta) \}$

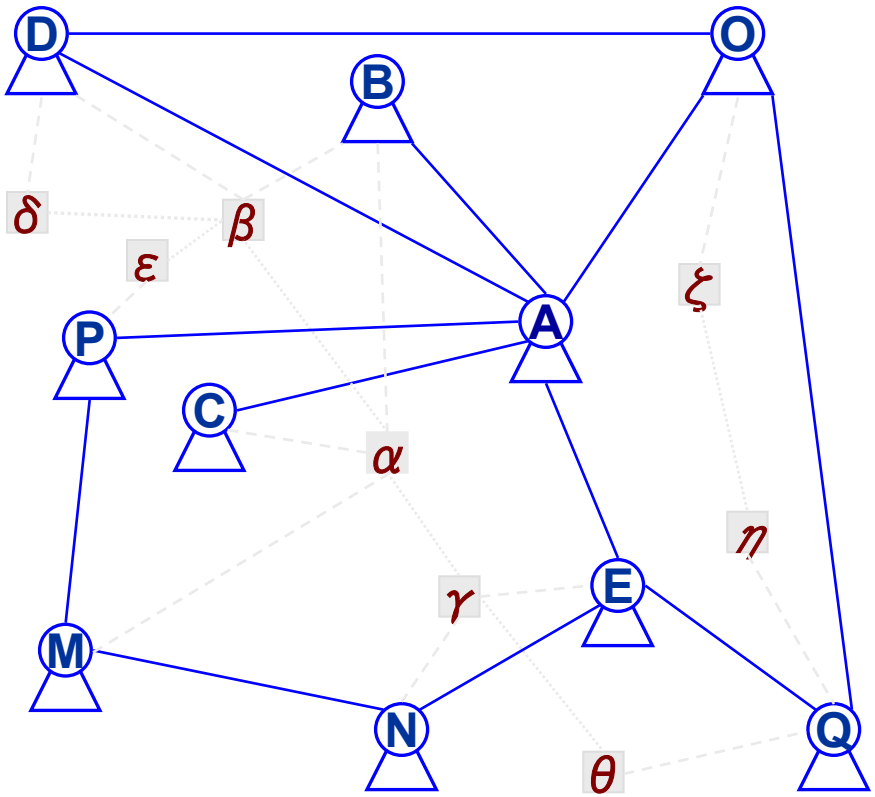
Knowledge Work Space



Relation between people and information

PI = { (B, α), (C, α), (M, α), (B, β), (D, β), (E, γ),
(N, γ), (D, δ), (P, ε), (O, ζ), (Q, η), (Q, θ)}

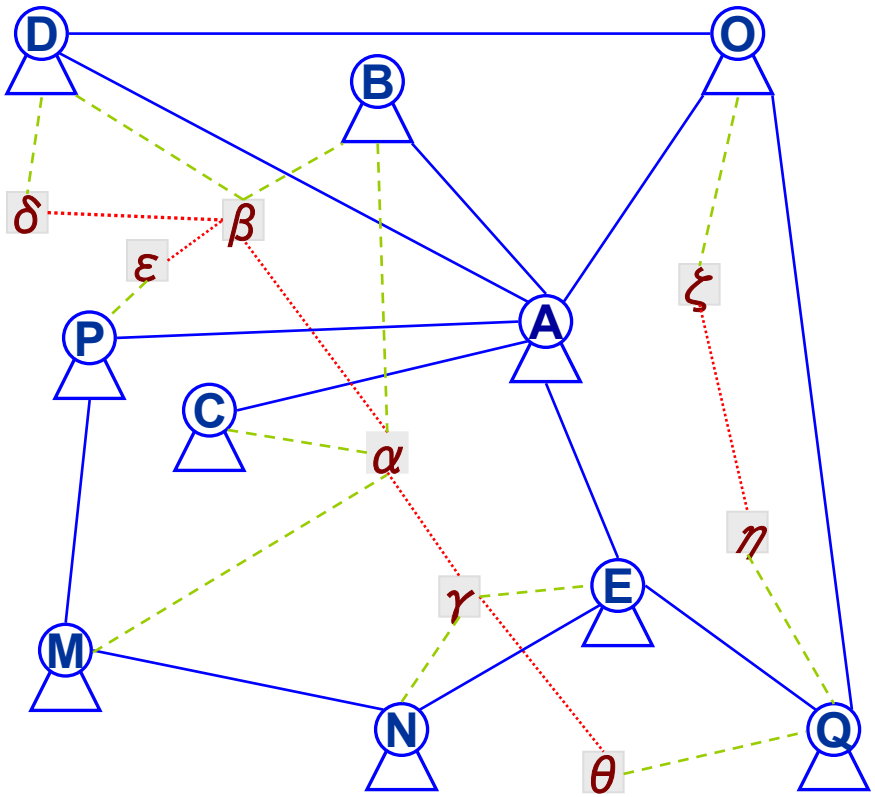
Knowledge Work Space



Relation between people

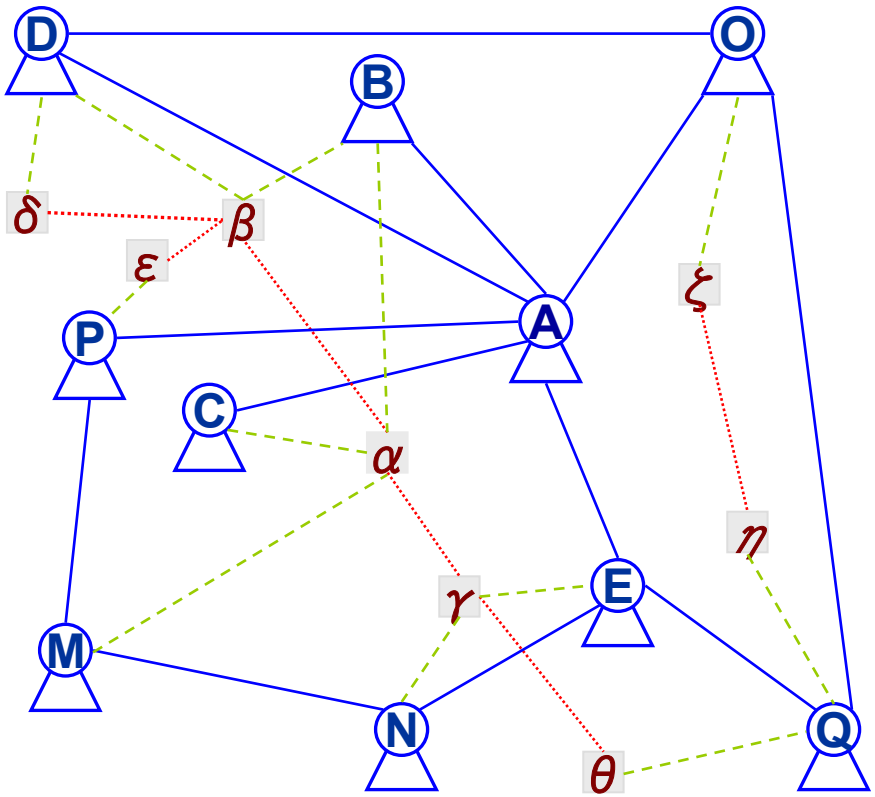
PP = { (A, B), (A, C), (A, D), (A, E), (A, O), (A, P),
(D, O), (E, N), (E, Q), (M, P), (M, N), (O, Q) }

Knowledge Work Space



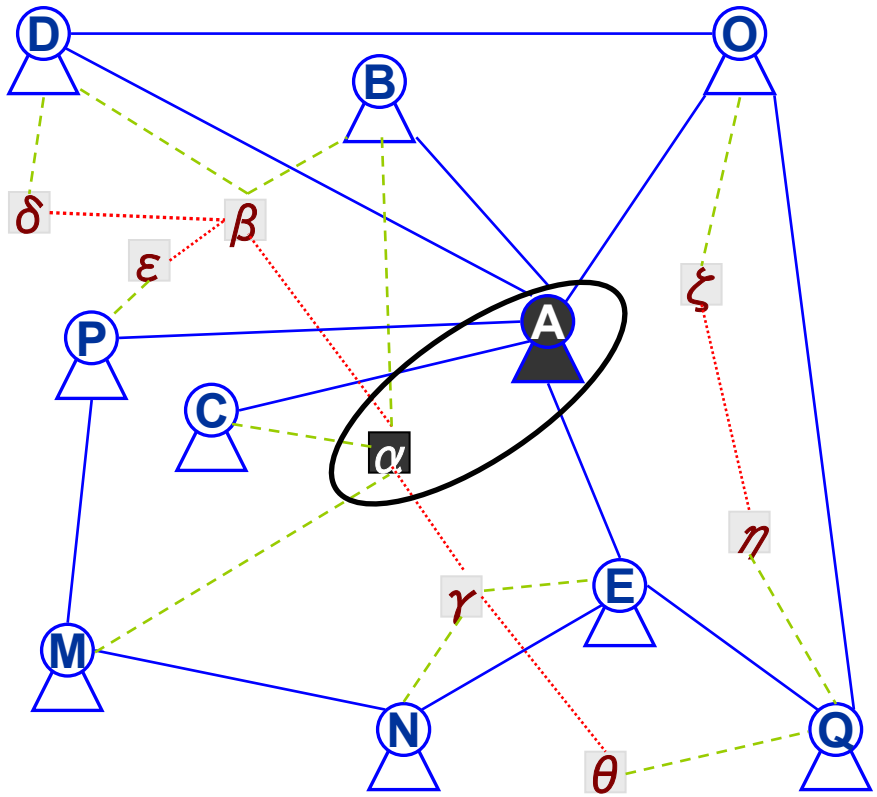
KWS= ({(α, β), (α, γ), (β, ε), (β, δ), (γ, θ), (ζ, η)},
{(B, α), (C, α), (M, α), (B, β), (D, β), (E, γ), (N, γ), (D, δ), (P, ε), (O, ζ), (Q, η), (Q, θ)},
{(A,B), (A,C), (A,D), (A,E), (A,O), (A,P), (D,O), (E,N), (E,Q), (M,P), (M,N), (O,Q)})

The forming process of a DynC



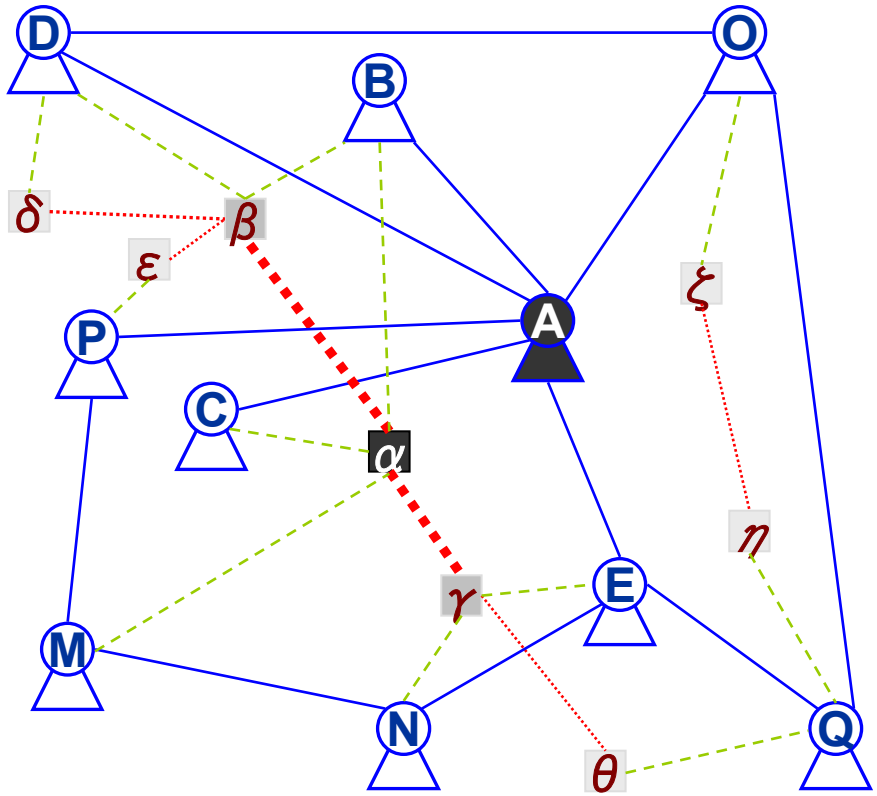
Forming *Dync(A, α)*

Triggering event



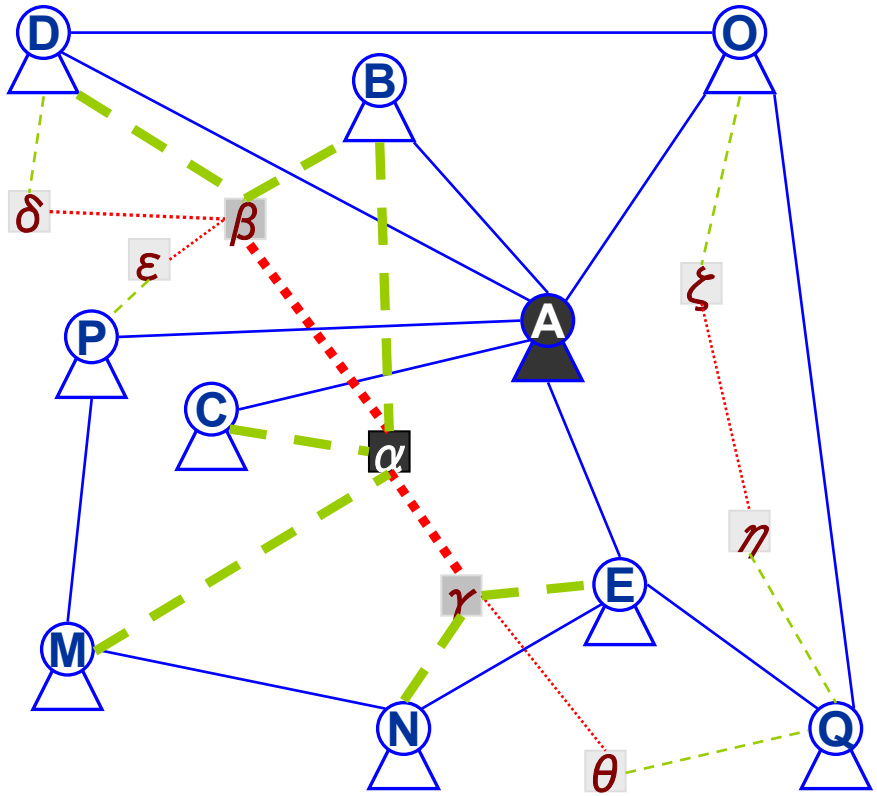
Forming *Dync(A, α)*

From information to information



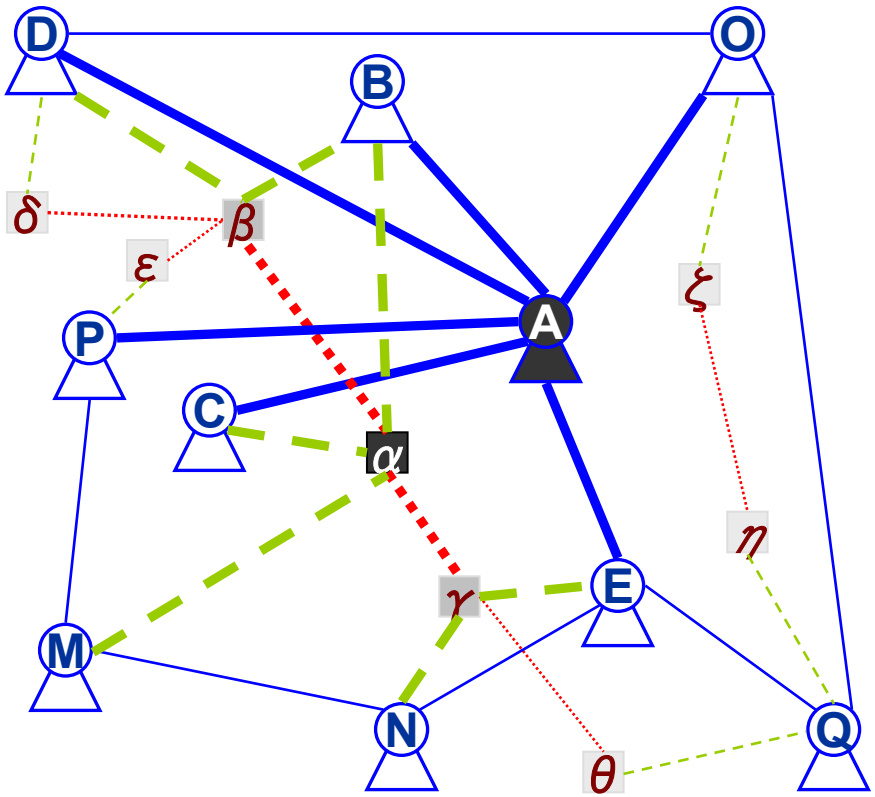
Forming *Dync(A, α)*

From information to experts



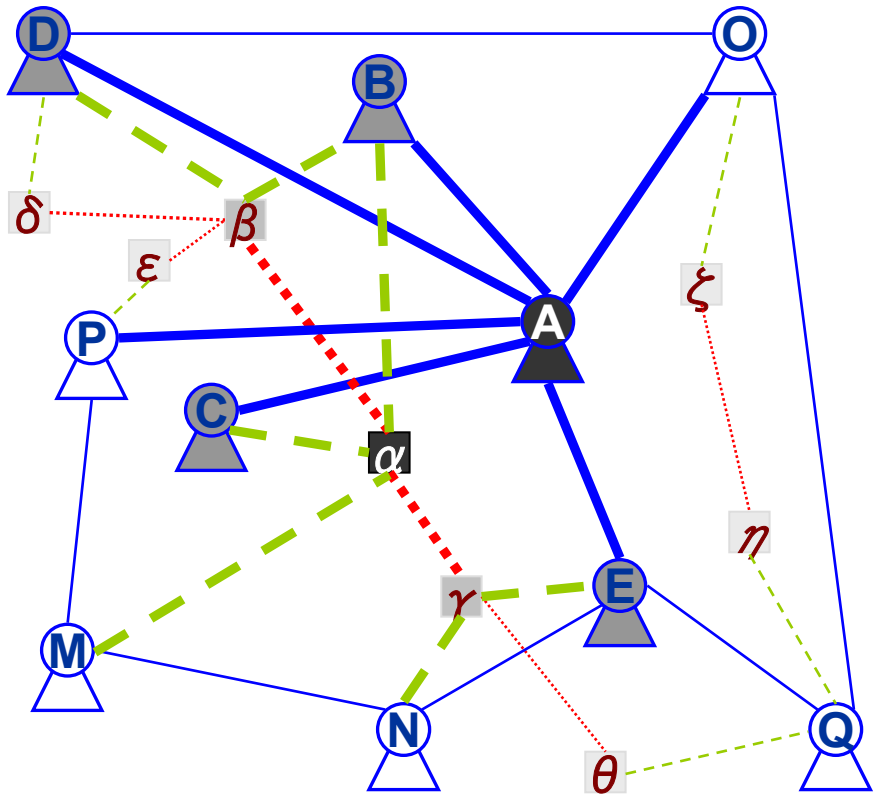
Forming *Dync(A, α)*

From people to people



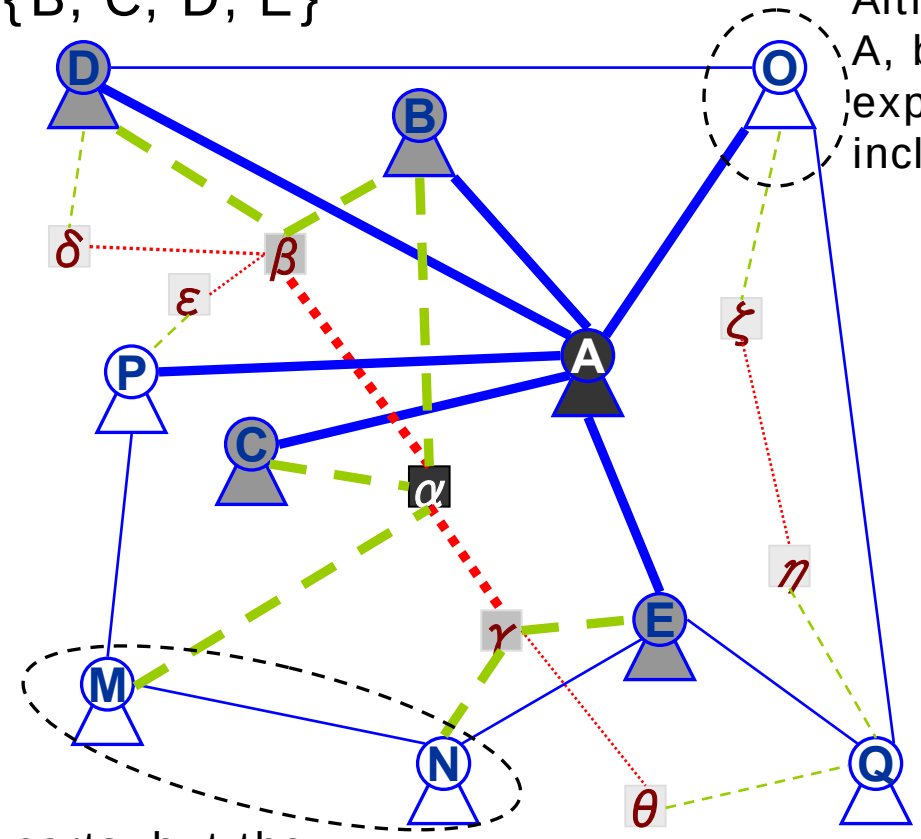
Forming *Dync(A, α)*

Dync(A, α) = {B, C, D, E}



Forming *Dync(A, α)*

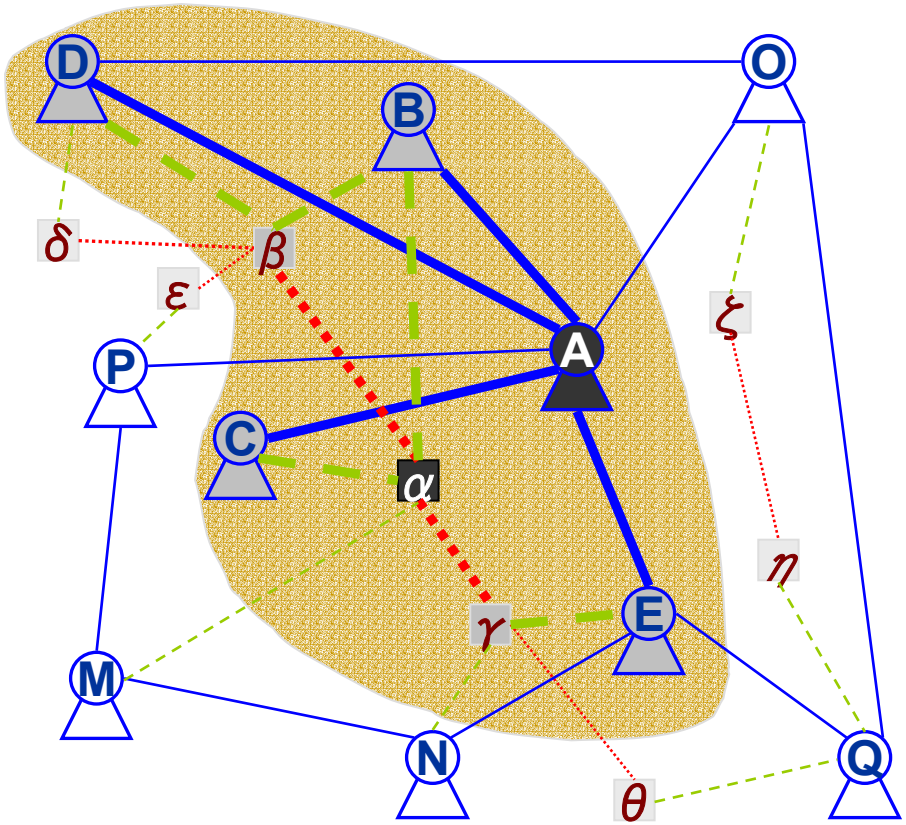
Dync(A, α) = {B, C, D, E}



Although O is related to A, because O is not an expert of A, he is not included in *Dync(A, α)*

M and N are experts, but they are not related to A; therefore, M and N are not included in *Dync(A, α)*

Forming *Dync(A, α)*



Why dynamic community

- Expertise is a relative attribute
  - Depends on the task
  - Asymmetry of knowledge
    - Two-way knowledge transfer
- Improve motivation to participate
  - Knowledge transfer through individual's social network

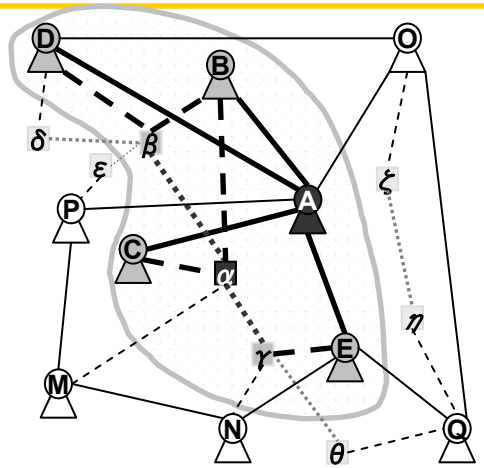
Characteristics of dynamic community

- Ad hoc and on-demand
  - It is formed dynamically when the needs arise
  - It dissembles when the needs disappear
- Task-specific
  - The network is formed for a specific task
  - Different dynamic communities for different tasks
- Member-specific
  - The network is formed for a specific member
  - Different dynamic communities for different member

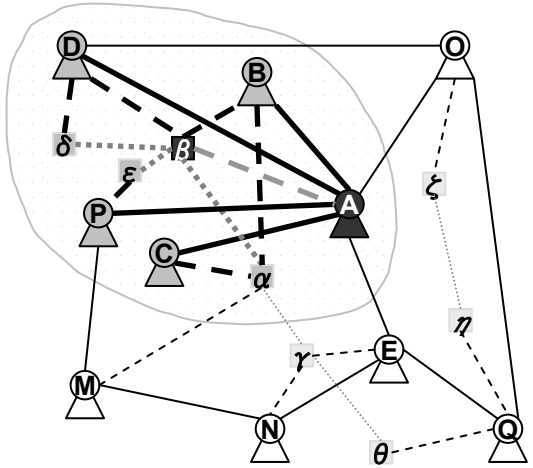
Task-specific and member-specific

Task-specific

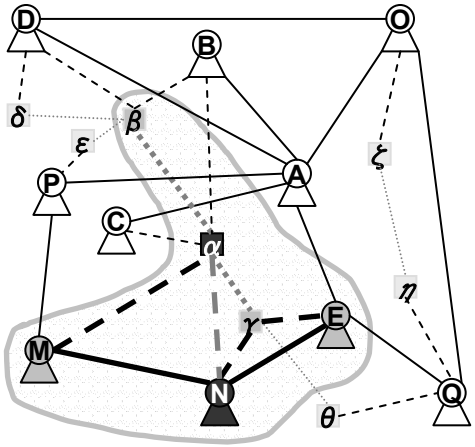
Member-specific



DynC(A, α) = {A, B, C, D, E}

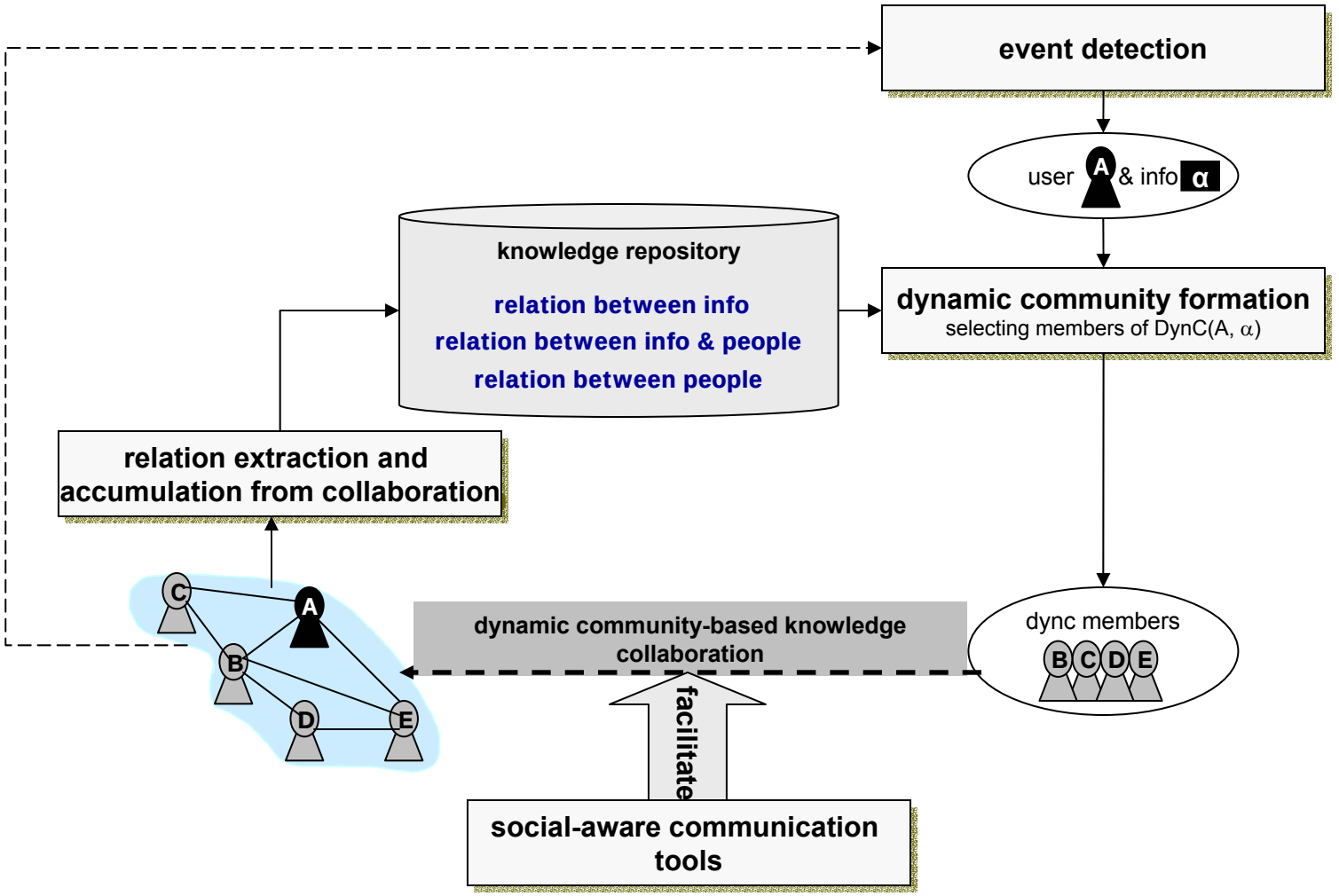


DynC(A, β) = {A, B, C, D, P}

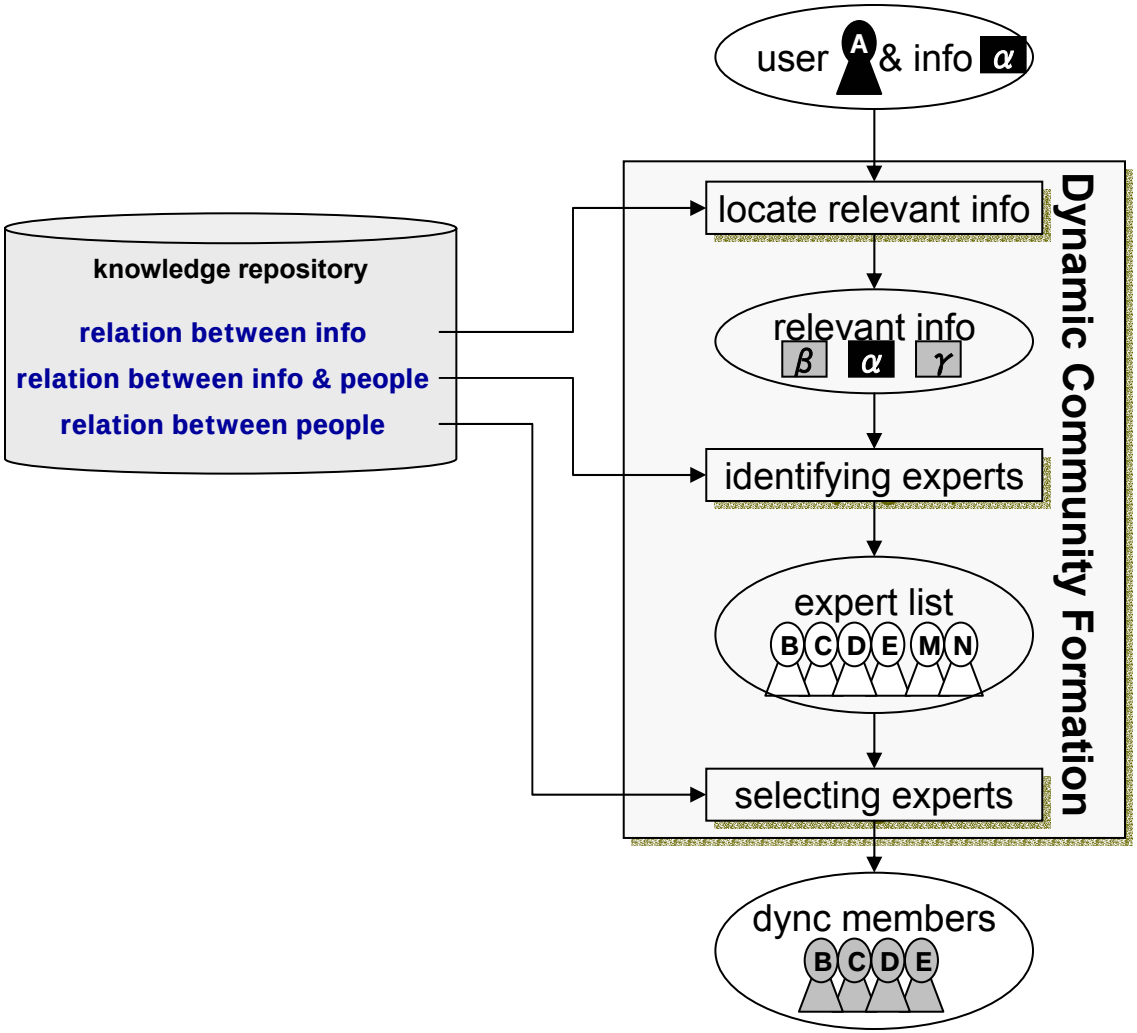


DynC(N, α) = {E, N, M}

General system architecture



DynC formation support subsystem



Social awareness mechanism

- Unobstrusive notification mechanism
- Respect experts' time and willingness
  - Give them excuse space
- Selecting experts based on interaction history
  - Capture and display social interaction
  - Social interaction outside of the domain should also be considered
- Load balance
  - Not overwhelming the same expert with requests for help
- For longer-term success
  - The **helper** should be the first priority

Creating dynamic communities that support software reuse

A concrete example in CodeBroker

Delivery of task-relevant components

Programmer Jack

emacs@partner.cs.colorado.edu

Buffers Files Tools Edit Search Mule JDE Java Help

```
import java.lang.*;

class Chi2Eng {
    /** constructor */
    void Chi2Eng (String initVal) {
    }
    /** just set the internal value */
    void setValue (String val) {
    }
    /** translate to the English format and return it */
```

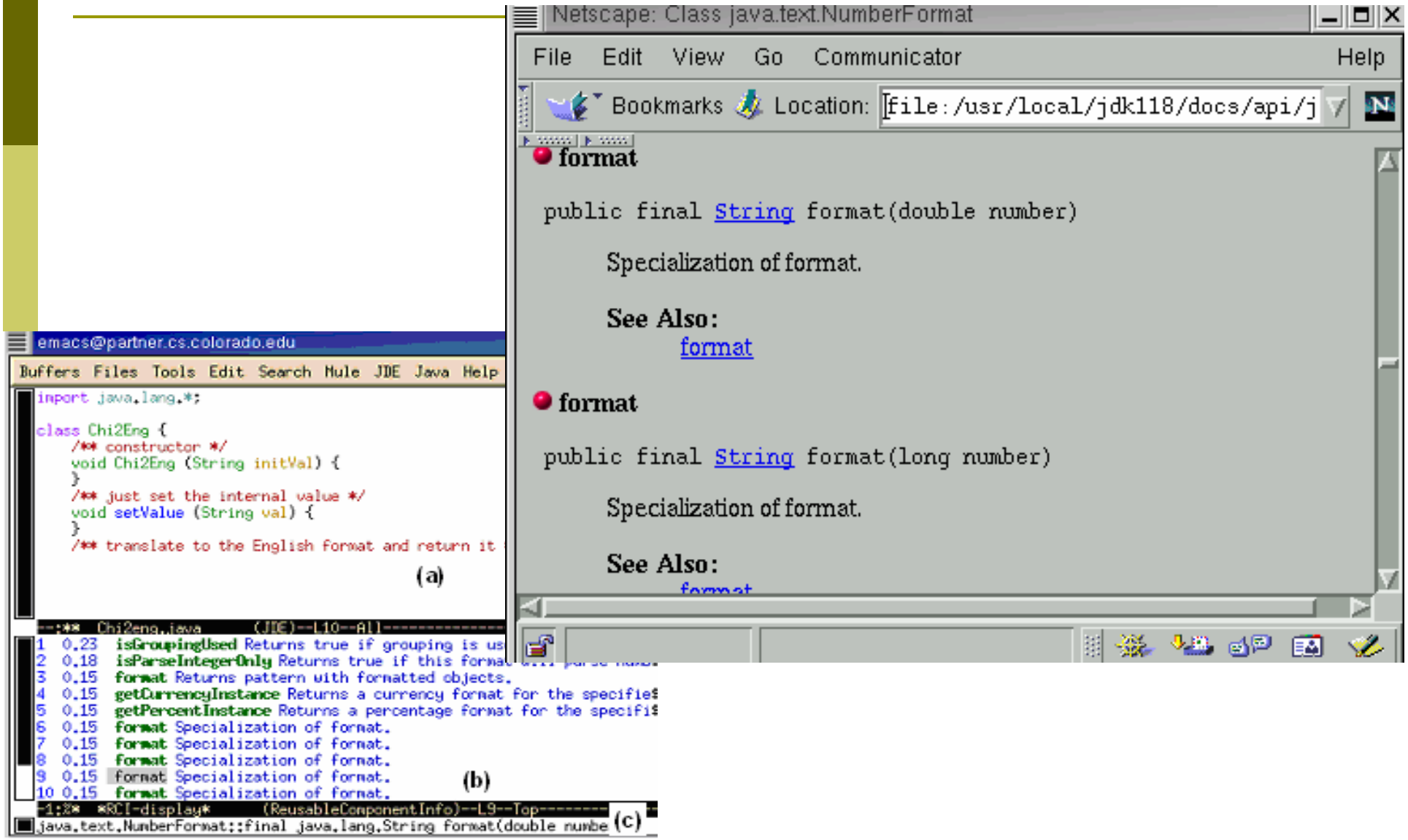
(a)

```
--:**  Chi2eng.java      (JDE)--L10--All----------------------------------
1  0.23  isGroupingUsed Returns true if grouping is used in this format$
2  0.18  isParseIntegerOnly Returns true if this format will parse numb$
3  0.15  format Returns pattern with formatted objects.
4  0.15  getCurrencyInstance Returns a currency format for the specifie$
5  0.15  getPercentInstance Returns a percentage format for the specifi$
6  0.15  format Specialization of format.
7  0.15  format Specialization of format.
8  0.15  format Specialization of format.
9  0.15  format Specialization of format.
10 0.15  format Specialization of format.
-1:%*  *RCI-display*      (ReusableComponentInfo)--L9--Top--------
java.text.NumberFormat::final java.lang.String format(double numbe
```

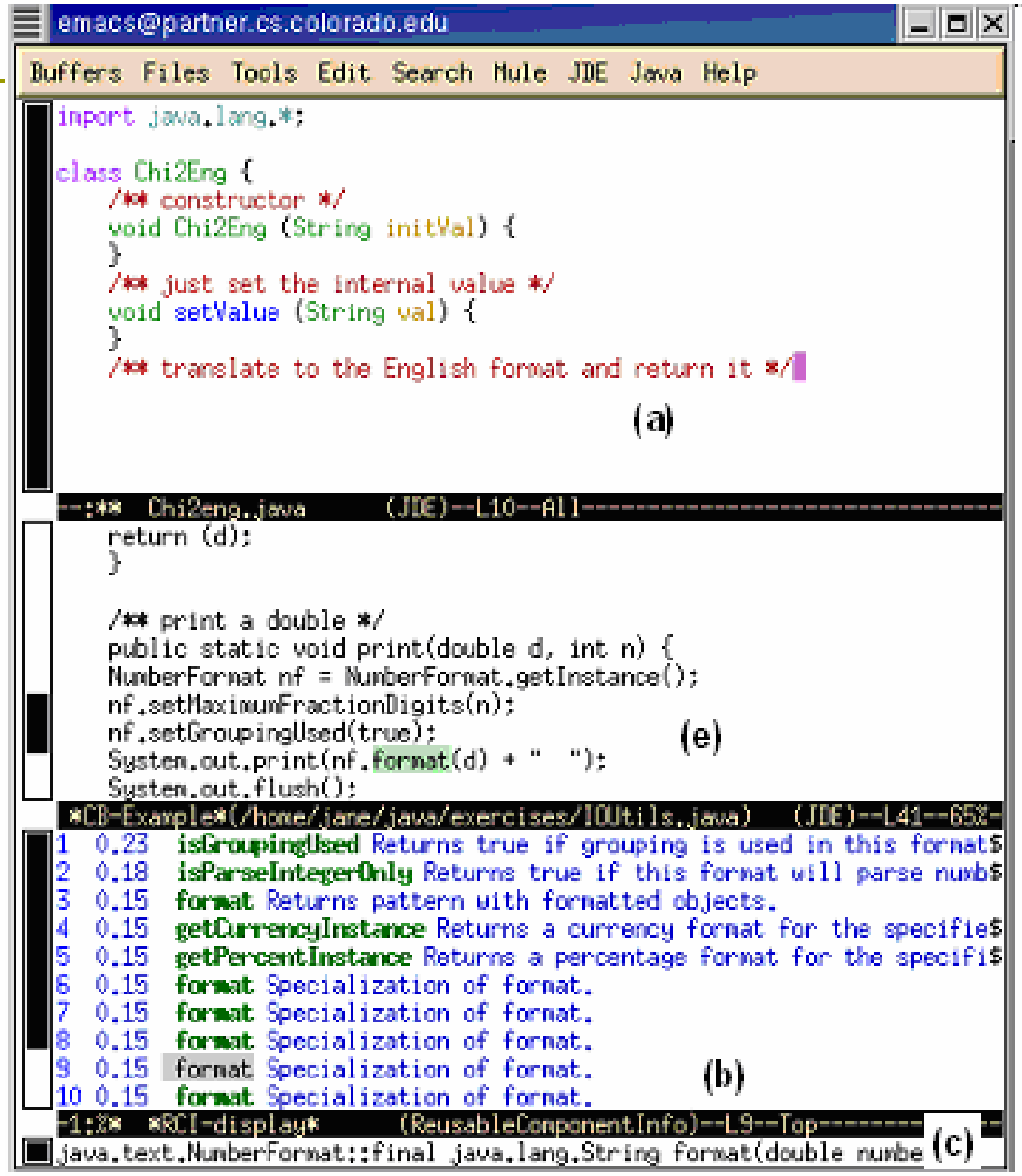
(b)

(c)

From component to the document



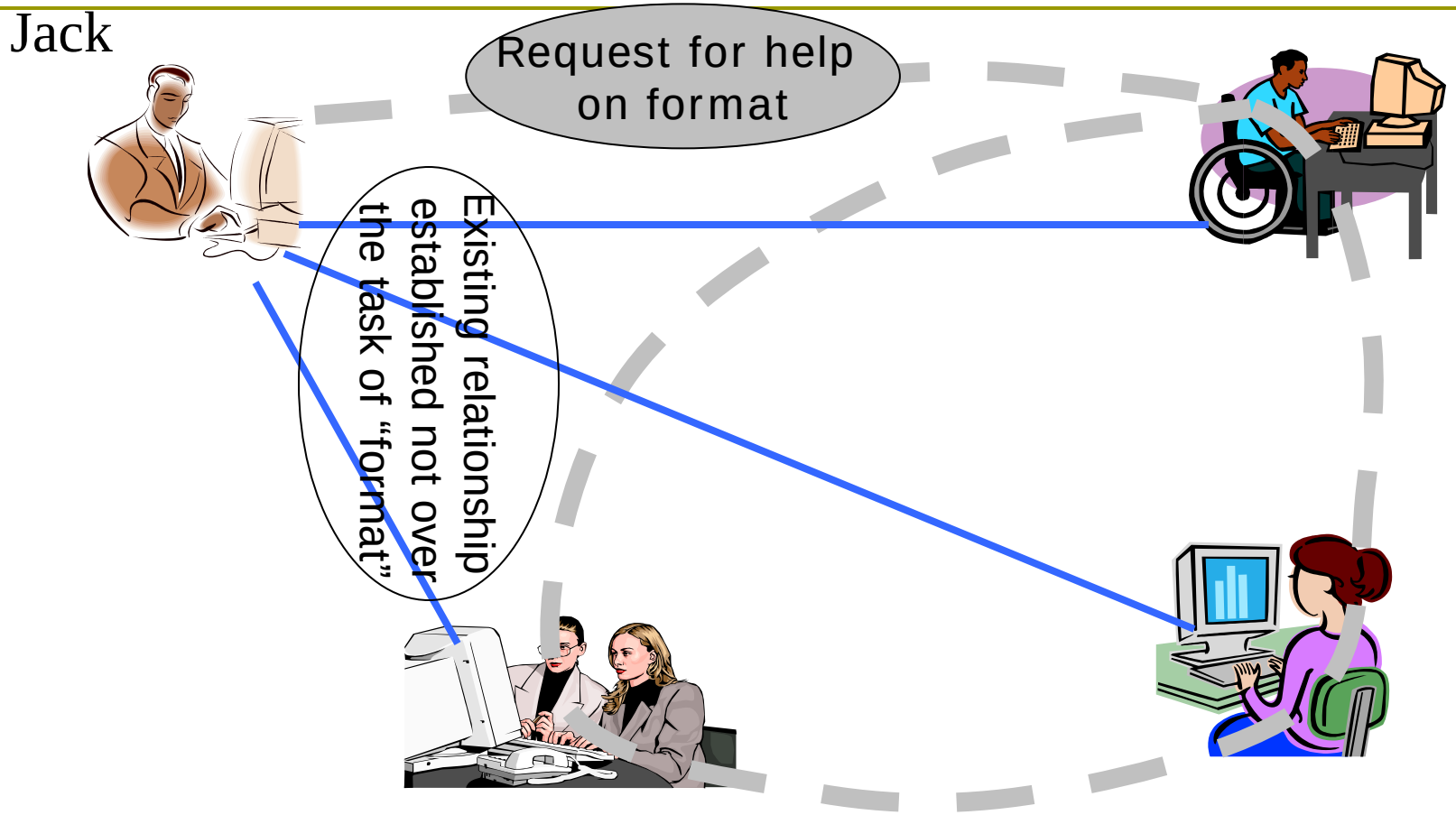
From component to example



Finding and selecting experts

- Looking for programs that use `format`
- Finding those programmers who wrote the programs
- Selecting those who have interacted with A before
  - not about the component `format`

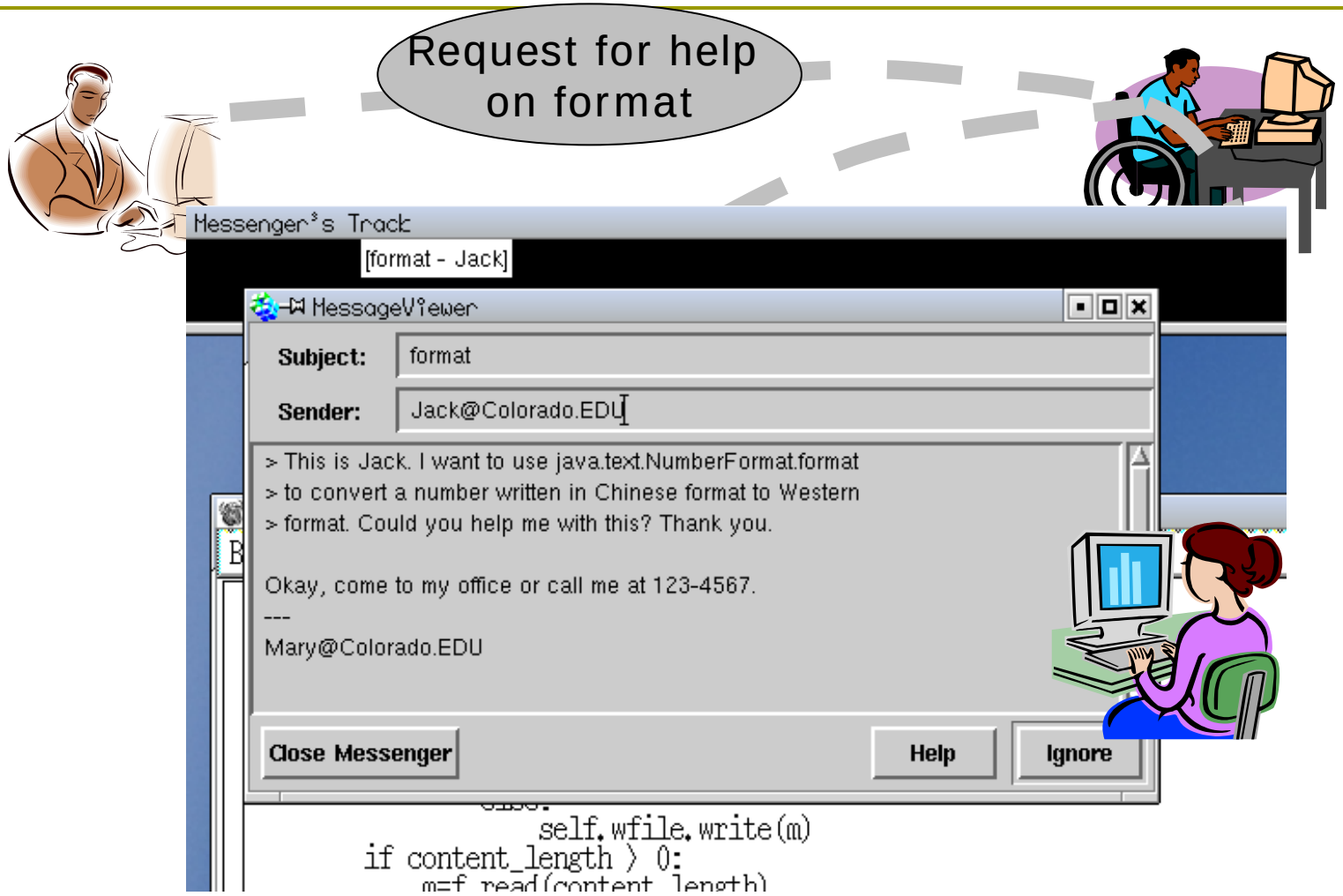
Asking for help with Choo-choo messenger



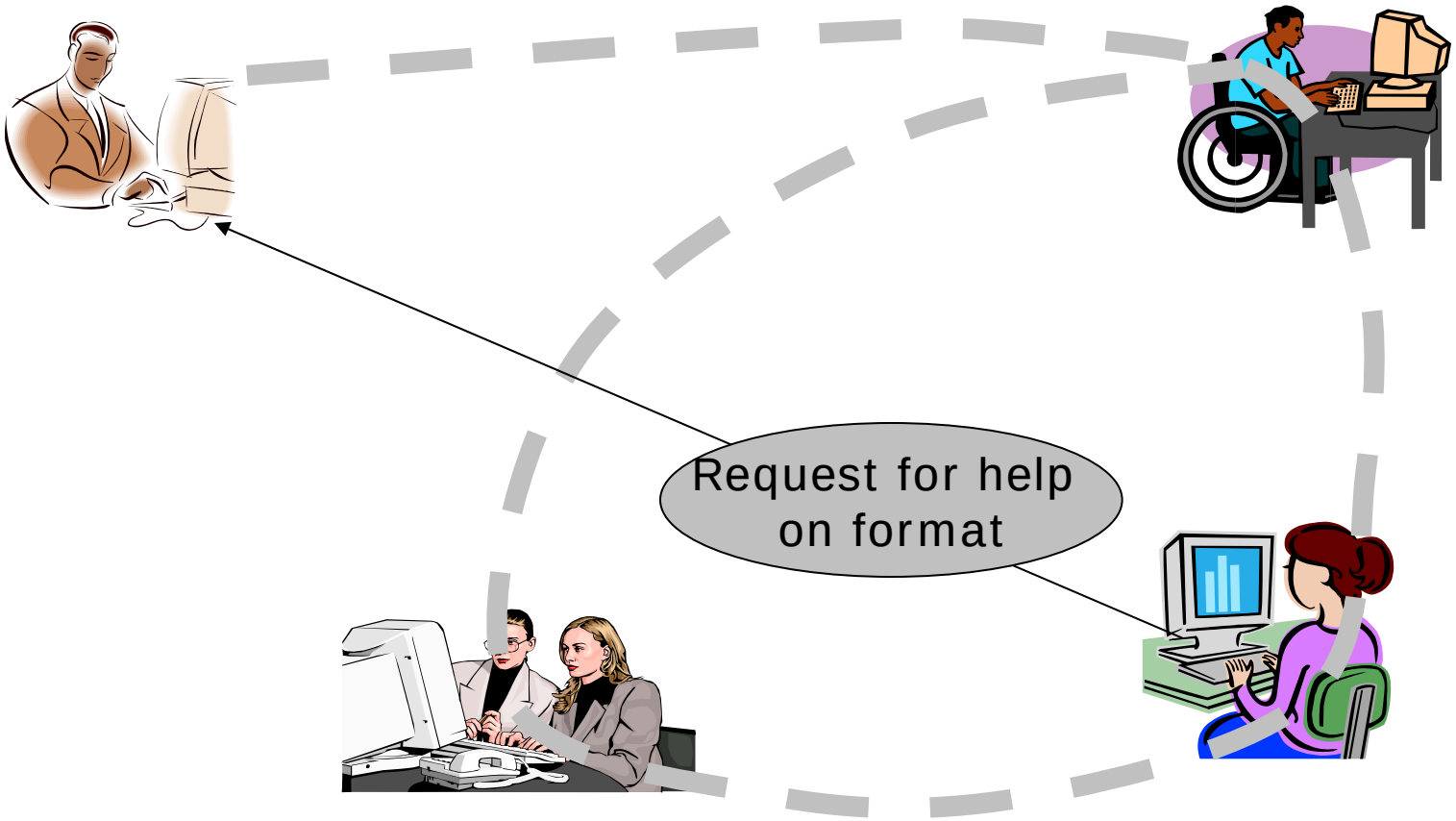
Why should I help?

- Make individual social capital explicit
- Individual social capital: social resources that can be drawn from others by an individual
  - SCj= Sum(favors to others by j) – Sum(favors owed by j)
  - Sum(SCj) = 0
- Social bonding force
  - SBFij = Sum(favors from i to j) + Sum(favors from j to i)
    = Sum(social captial tranaction between i and j)
- Gross community capital: a measurement of the strength and liveliness of a community
  - GCC = Sum(favors to others by j) + Sum(favor owed by j)
    = Sum(SBFij)
    = Sum(social capital exchanged in each transaction)

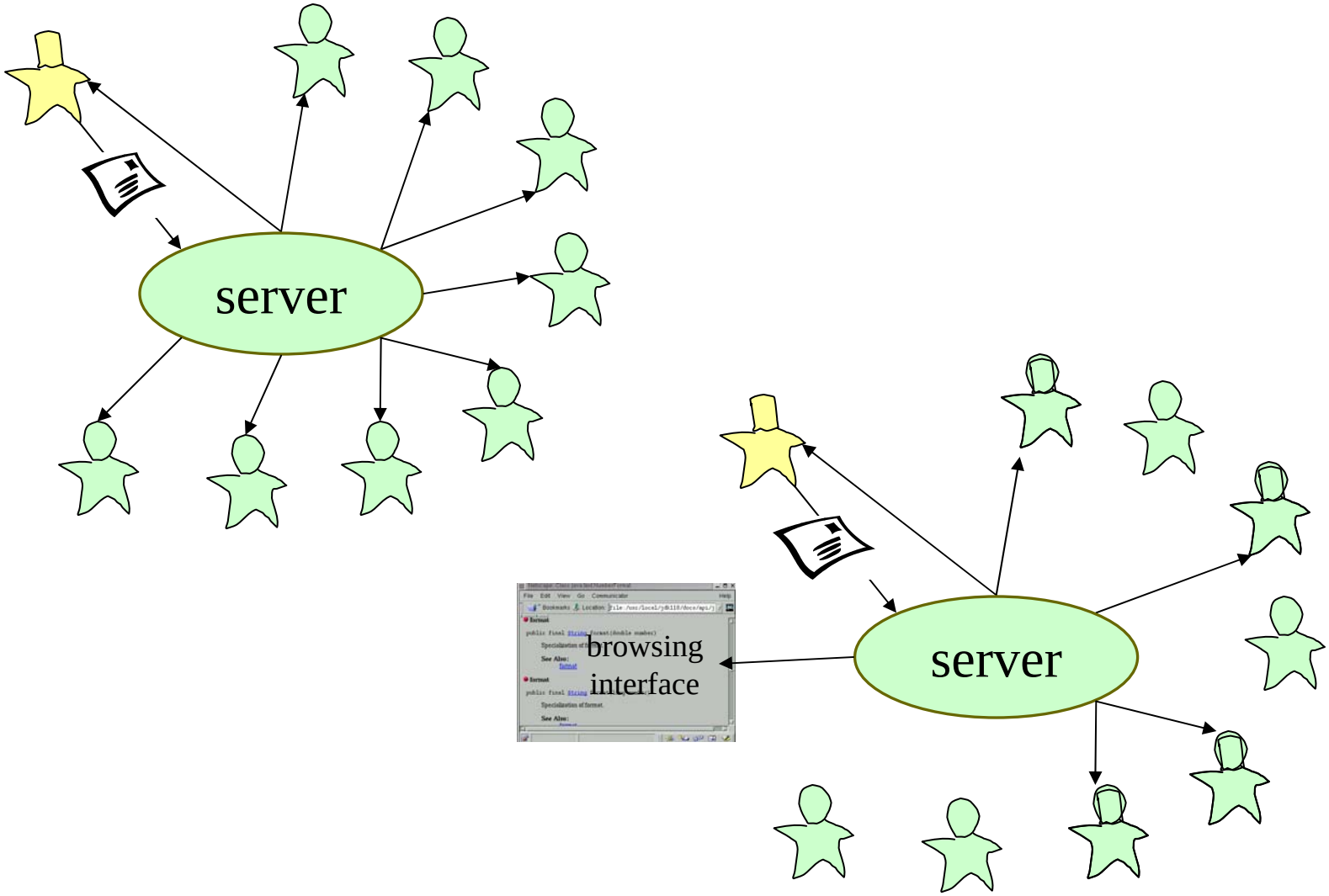
Offering help



Collaboration



Dynamic mailing list



Theoretical questions

- Relationship with community of practice, community of interest, intensional network and other similar theories

	Community of Practice	**Community of Interest**	**Intensional Network**	**Dynamic Community**
Granularity	Domain	Problem	Project	Task
Bonding factor	Shared identity	Shared problem	Shared work history	Generalized reciprocity
Focus of relationship	Individual to community	Individual to community	Individual to individual	Individual to individual
Motivation	Learning to be	Shared understanding	Divided labor and roles	Asynchronous mutual learning
Persistence	Long-term	Short-term	Long-term	Ephemeral

Summary

- Dynamic community is
  - Ad hoc
  - On-demand
  - Ephemeral
  - Task-specific
  - Member-specific

It's not "it's what you know; it's who you know"; it's both.