

Trust Networks

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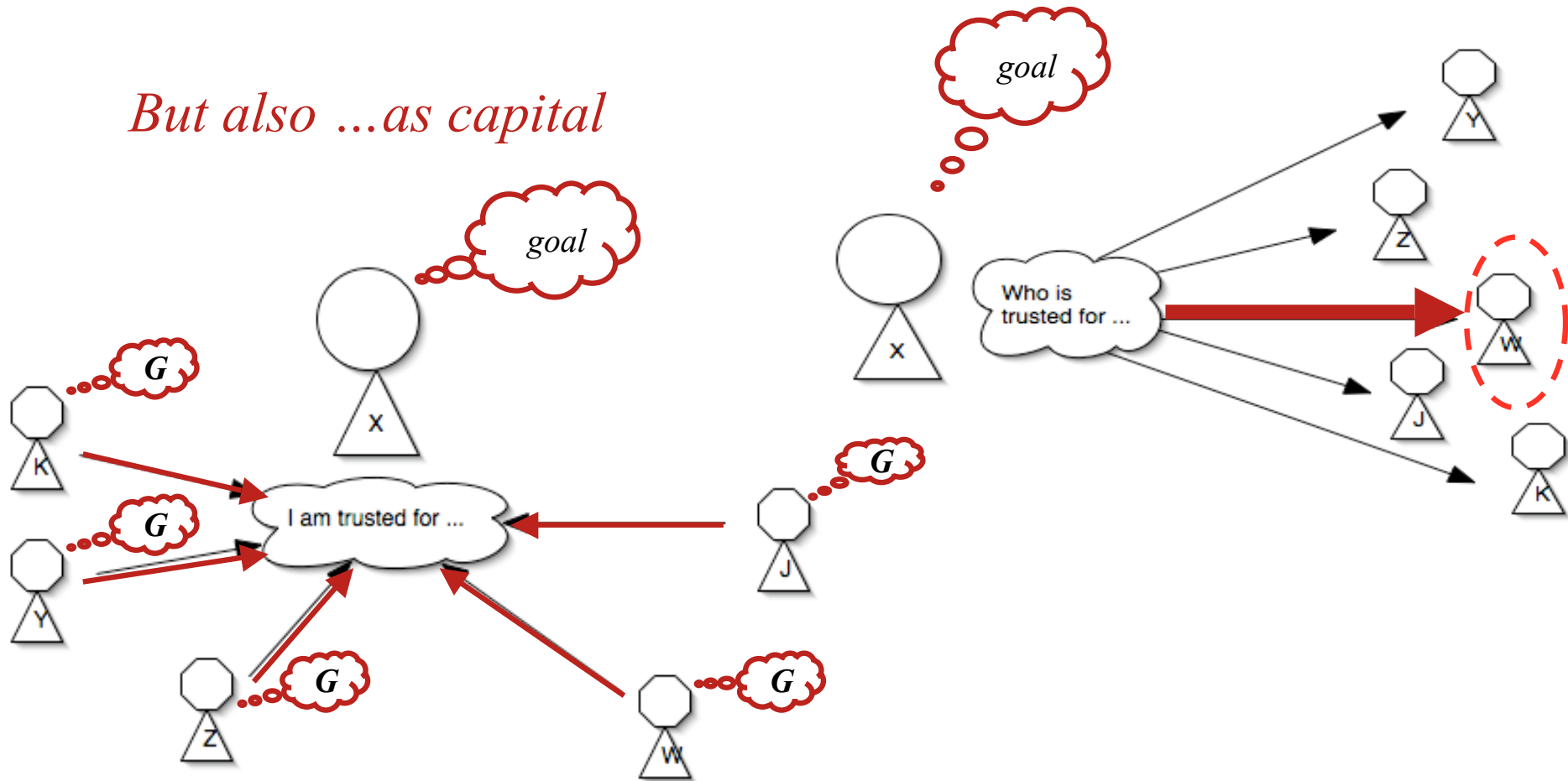
Thessaloniki, October 9, 2009



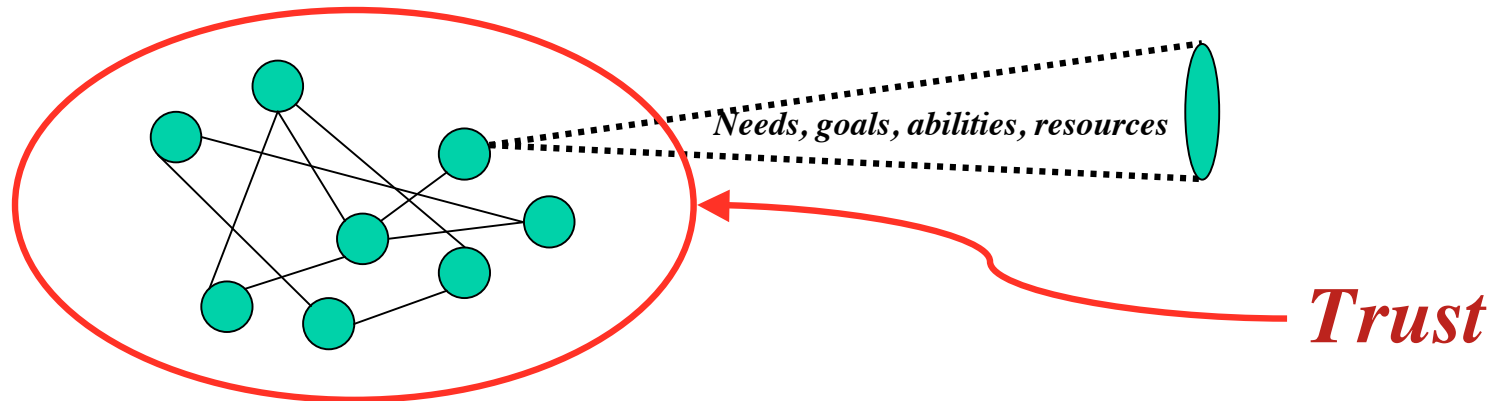
The Trust Role

Trust can be viewed

But also ...as capital



Trust and Dependence Network



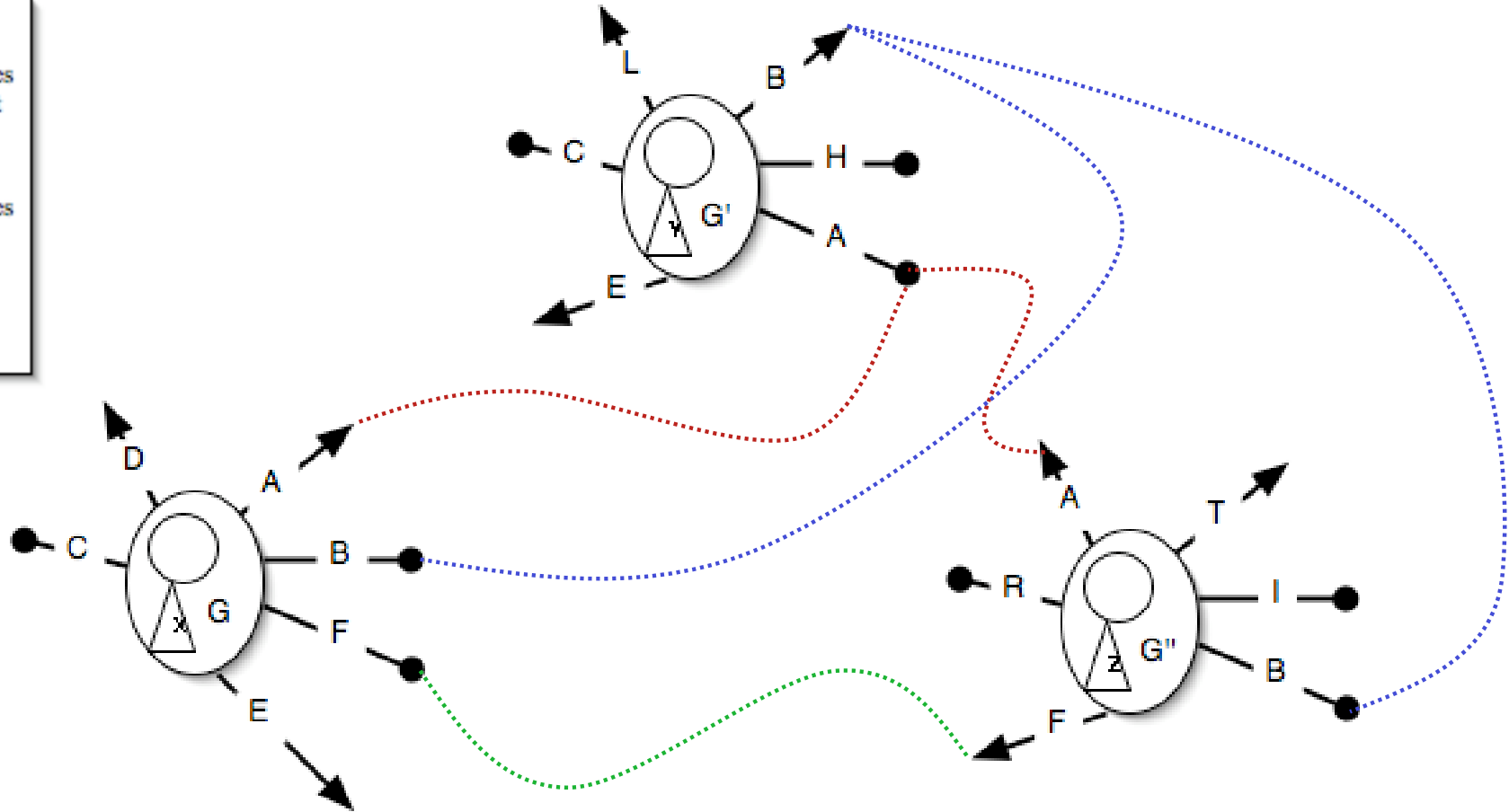
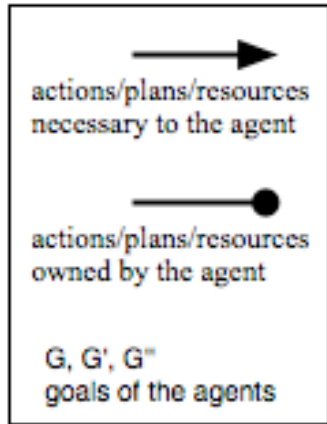
Classical Dependence Network

In order to better *understand dynamics of social networks*, now we propose a study of the trust relationship, focusing on the trustee, in particular on a *cognitive trustee*

In fact agent's *trustworthiness* directly affects:

- i) *the chance* to be requested or accepted as a partner for exchange or cooperation;
- ii) *the 'price'*, the contract that the trustee can obtain

Objective Dependence

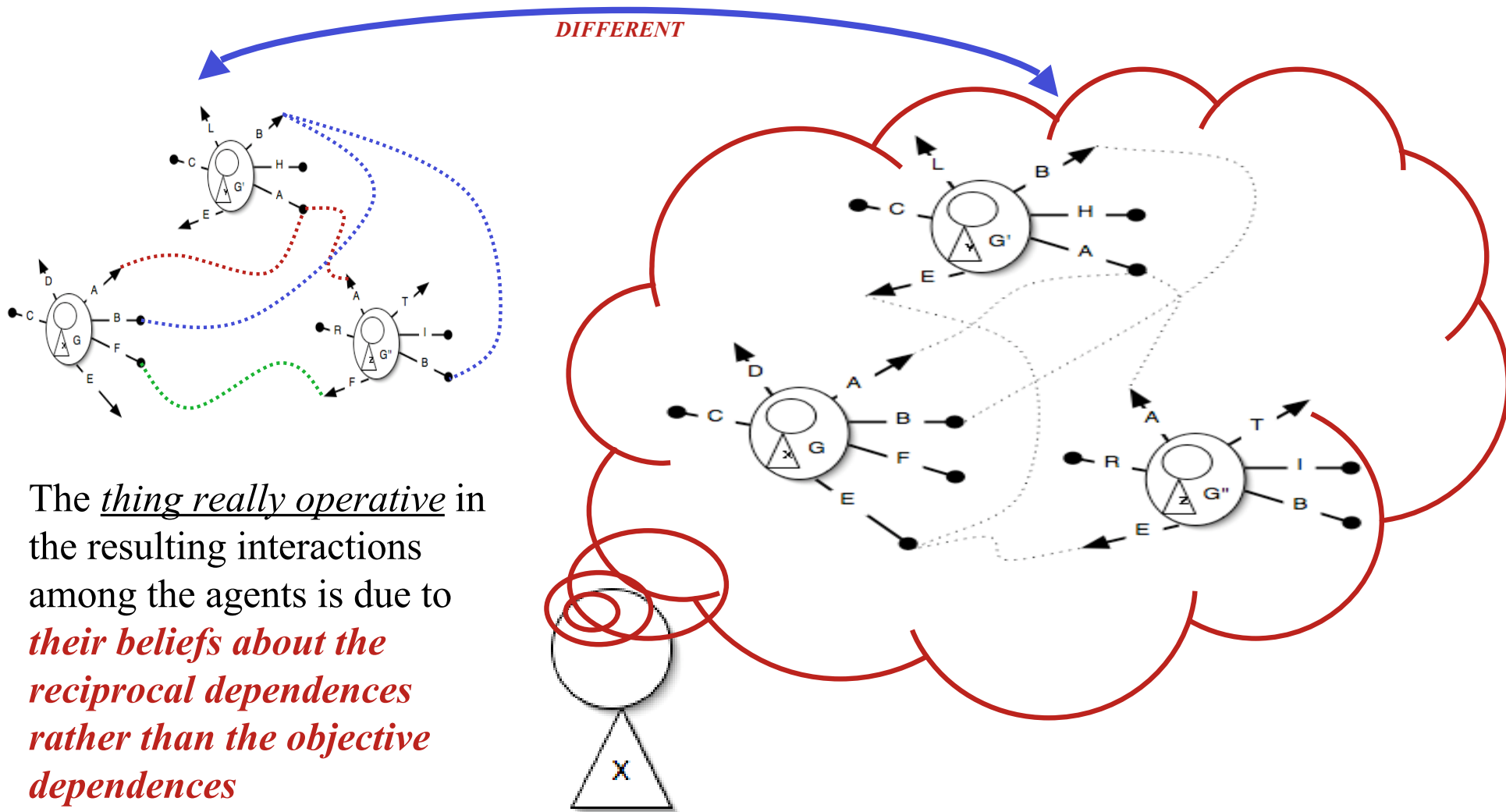


Who needs whom for what in a given social network

This *dependence* has already the power of establishing certain *asymmetric relationships* in a potential market, and it determines the actual success or failure of the reliance and transaction

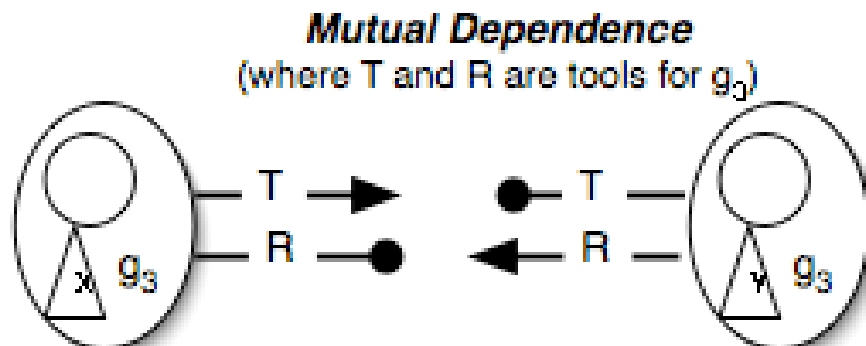
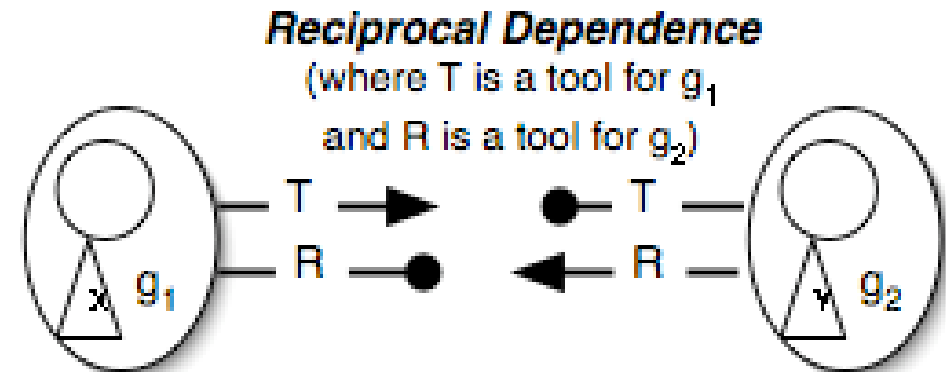
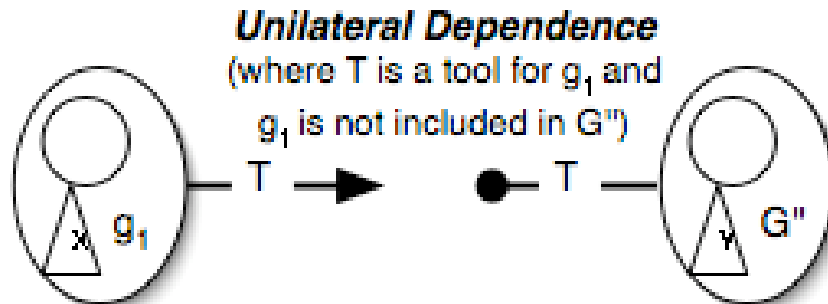
Subjective Dependence

Who is believed to be needed (useful) by who for what in a given social network
This Dependence is what determines relationships in real market and settles on the negotiation power



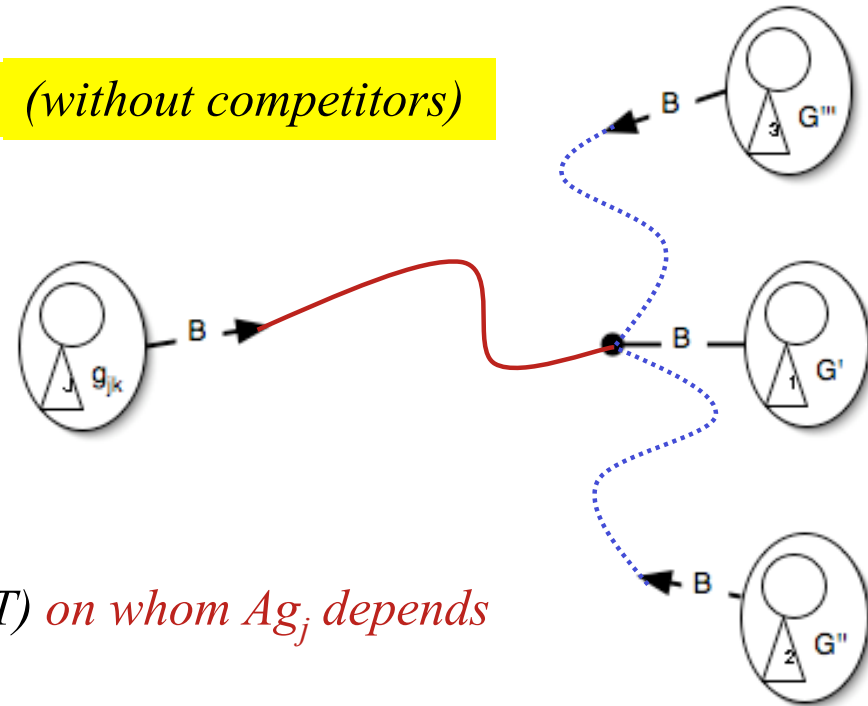
The thing really operative in the resulting interactions among the agents is due to *their beliefs about the reciprocal dependences rather than the objective dependences*

Types of Dependence



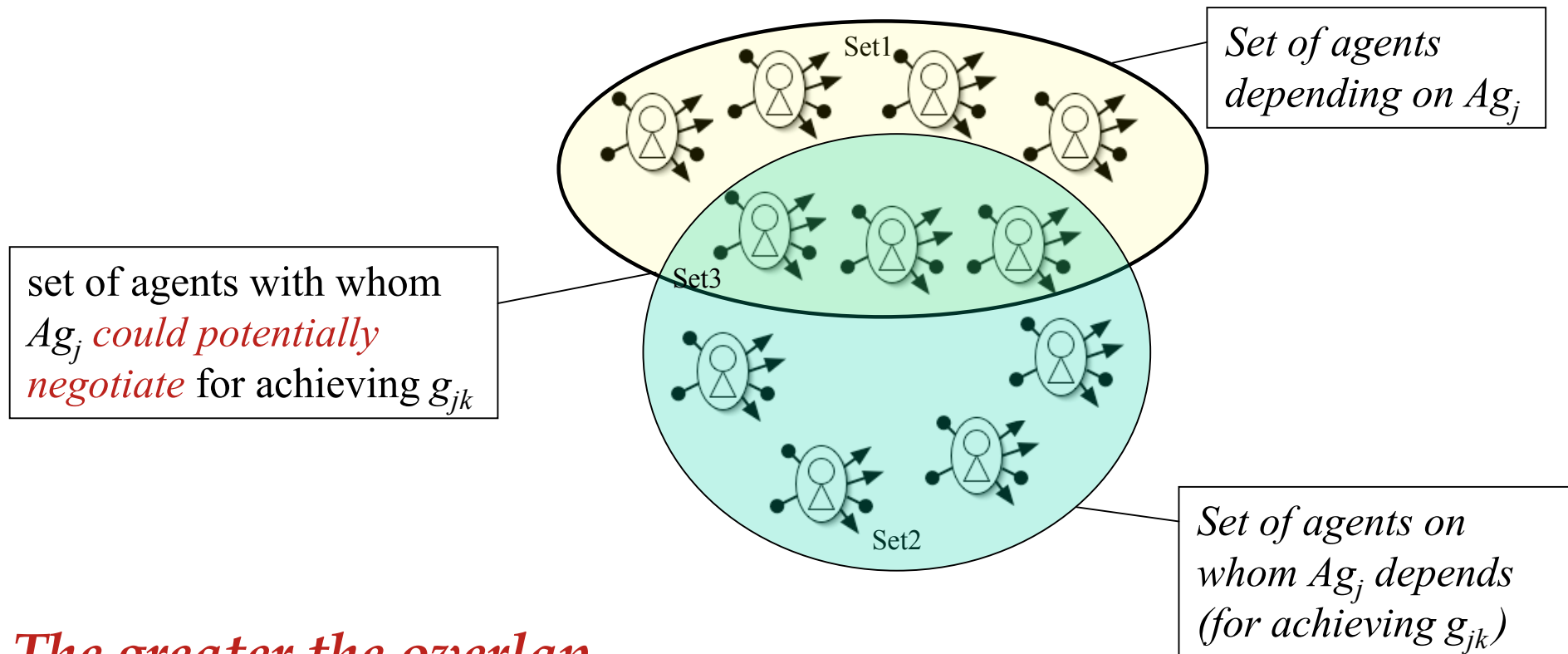
Potential of Negotiation in the Dependence Networks

$$OPN(Ag_j, g_{jk}) = \sum_{i=1}^l \frac{1}{1 + p_{ki}} = l \text{ (without competitors)}$$



- *OPN = Objective Potential for Negotiation*
- *l* represents the number of agents (in the set *AGT*) *on whom Ag_j depends* with respect to *g_{jk}*
- *p_{ki}* is the number of agents in *Agt* that are *objectively requiring the same actions/plans/resources* (as useful for *g_{jk}*) to *Ag_i* on which is based the dependence relation between *Ag_j* and *Ag_i* and that in consequence are *competitors* with *Ag_j* on that *actions/plans/resources in a not compatible way*

Negotiation Power without Trust

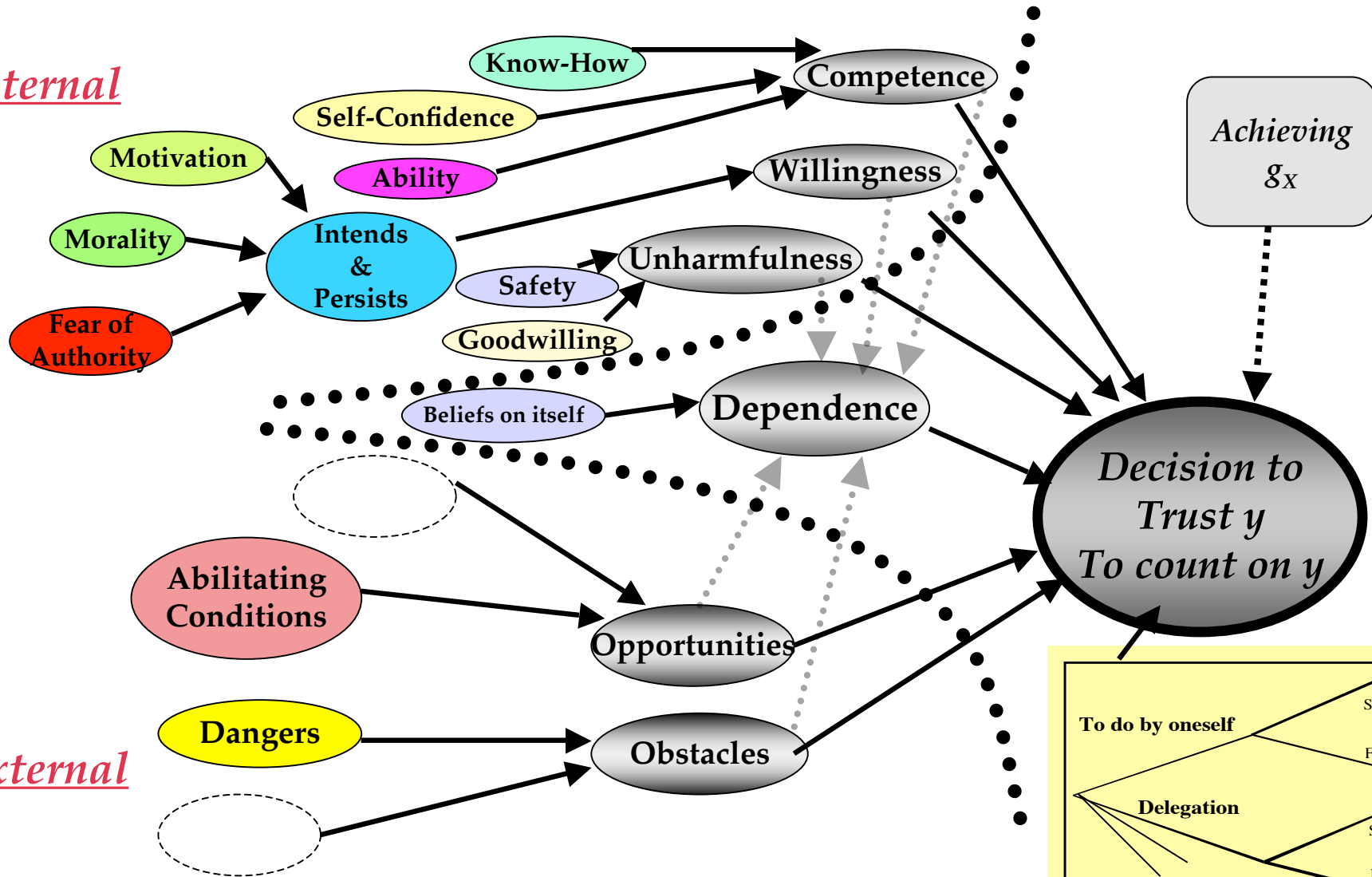


The greater the overlap the greater the negotiation power of Ag_j in that context

$$SPN(Ag_j, g_{jk}) = \sum_{i=1}^{l^{Bj}} \frac{1}{1 + p_{ki}^{Bj}}$$

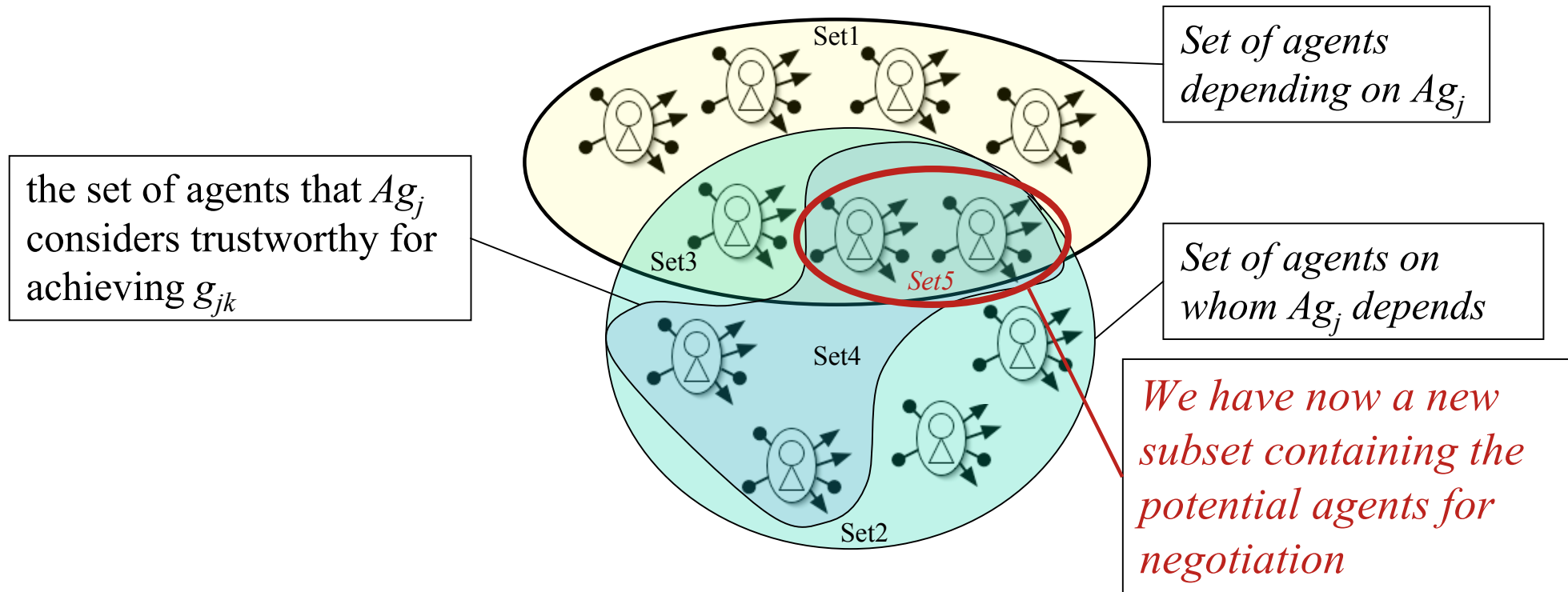
Socio-Cognitive model of Trust

Internal



External

Introducing Trust in the Negotiation



$$SPN^T(Ag_j, g_{jk}) = \sum_{i=1}^{l^{Bj}} \frac{DoA_{ik}^{Bj} * DoW_{ik}^{Bj}}{1 + p_{ki}^{Bj}}$$

Subjective Potential for Negotiation with Trust (by the trustor)

$$OPN^T(Ag_j, g_{jk}) = \sum_{i=1}^l \frac{DoA_{ik} * DoW_{ik}}{1 + p_{ki}}$$

Objective Potential for Negotiation with Trust (by the trustor)

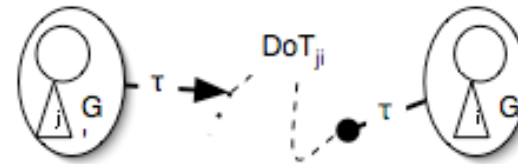
$$0 \leq DoA_{ik}^{Bj}, DoW_{ik}^{Bj} \leq 1$$

Objective and Subjective Trust Capital

We take now the point of view of the trustee in the dependence network: so we present a cognitive theory of trust as a capital.

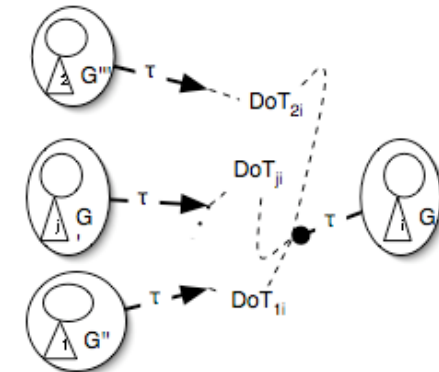
Degree of Trust of the Agent Ag_j on the agent Ag_i about the task τ_k :

$$DoT(Ag_j, Ag_i, \tau_k)^{Bj} = DoA_{ik}^{Bj} * DoW_{ik}^{Bj}$$



Objective Trust Capital of Ag_i about a potential delegable task τ_k :

$$OTC(Ag_i, \tau_k) = \sum_{j=1}^l DoA_{ik}^{Bj} * DoW_{ik}^{Bj} = \sum_{j=1}^l DoT(Ag_j, Ag_i, \tau_k)^{Bj}$$

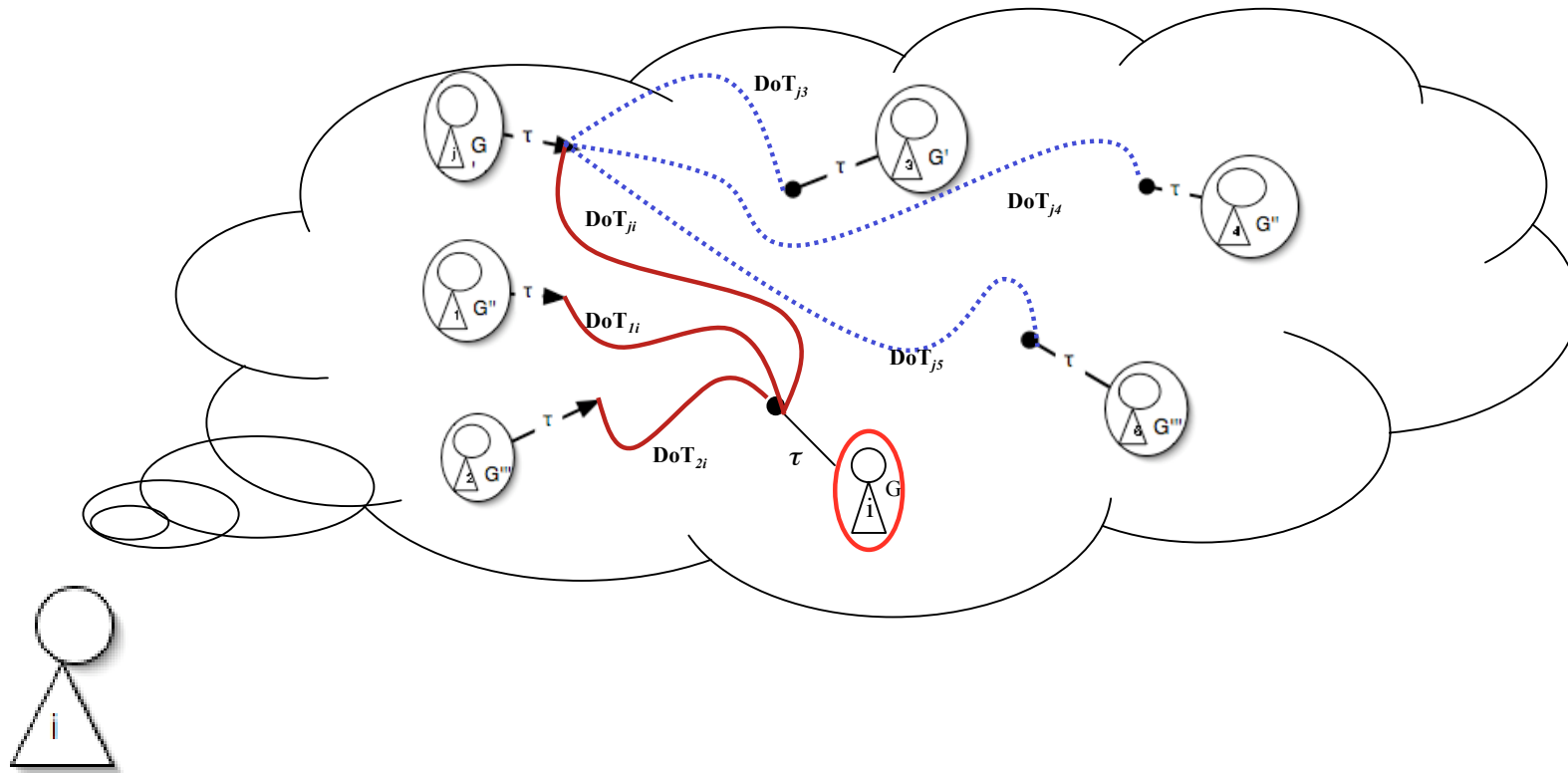


l is the number of agents (included in the dependence network) who have need of the task τ_k

Subjective Trust Capital of Ag_i about a potential delegable task τ_k

$$STC(Ag_i, \tau_k) = \sum_{j=1}^{l^{Bi}} DoA_{ik}^{BiBj} * DoW_{ik}^{BiBj} = \sum_{j=1}^{l^{Bi}} DoT(Ag_j, Ag_i, \tau_k)^{BiBj}$$

Usable Trust Capital

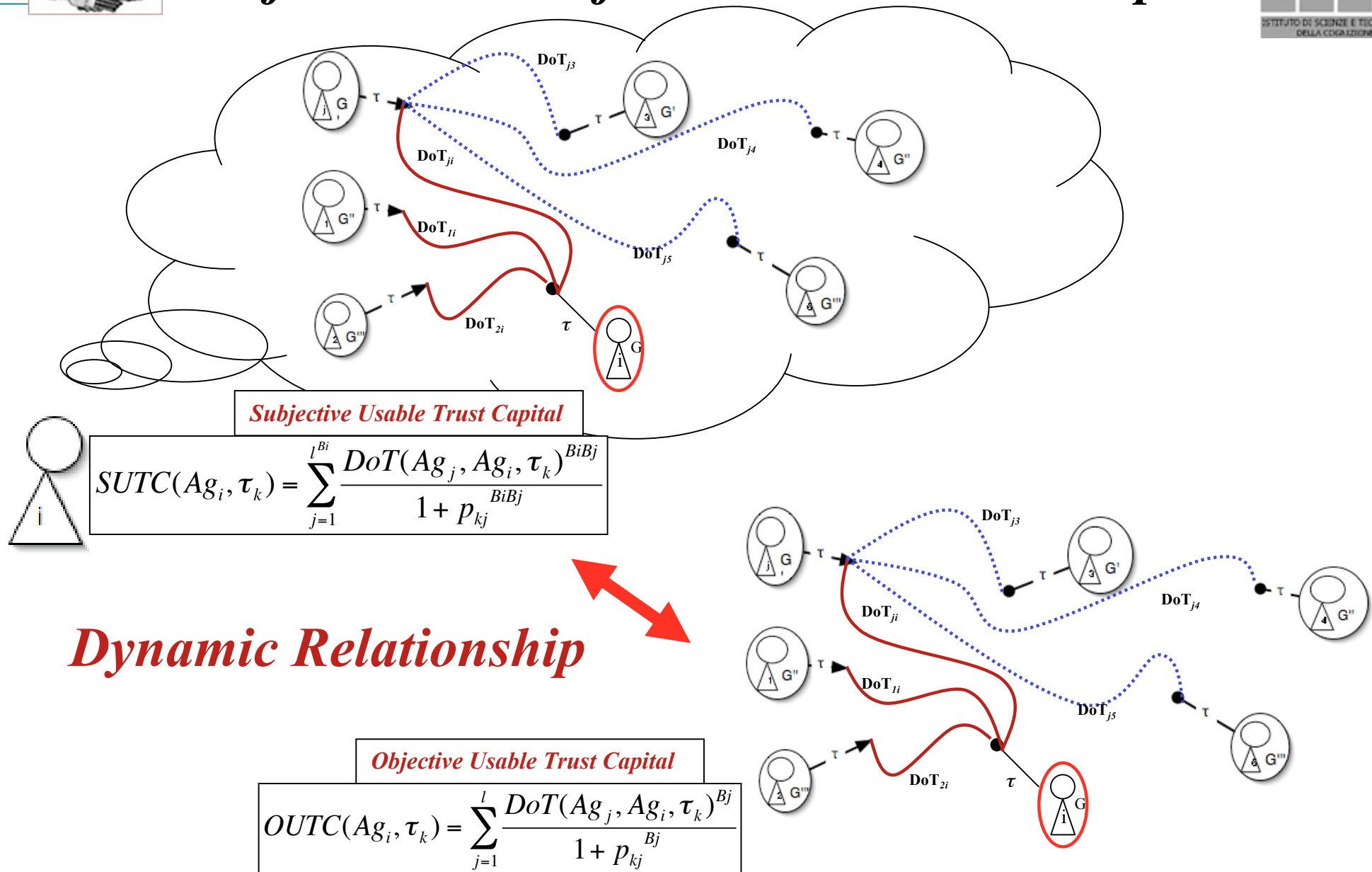


Subjective Usable Trust Capital
of Ag_i about a potential delegable
task τ_k

$$SUTC(Ag_i, \tau_k) = \sum_{j=1}^{l^{Bi}} \frac{DoT(Ag_j, Ag_i, \tau_k)^{BiBj}}{1 + \sum_{c=1}^{p_{kj}} DoT(Ag_j, Ag_c, \tau_k)^{BiBj}}$$

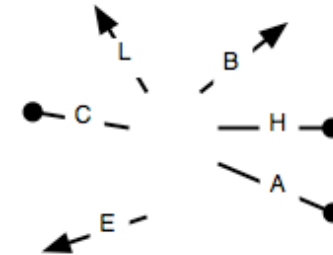
p_{kj}^{Bi} is (following the Ag_i 's belief) the number of other agents in the dependence network that can realize and achieve the same task to whom Ag_j can delegate the task τ_k

Subjective and Objective Usable Trust Capital



How the Trust Capital changes

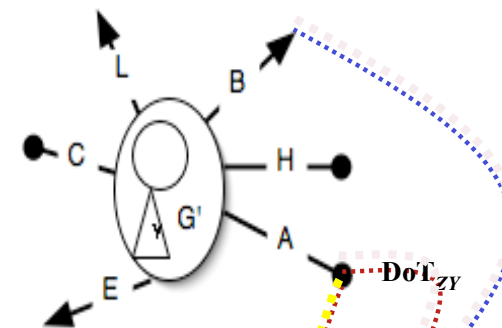
It can change the set of *know-hows/tools/abilities/powers*:



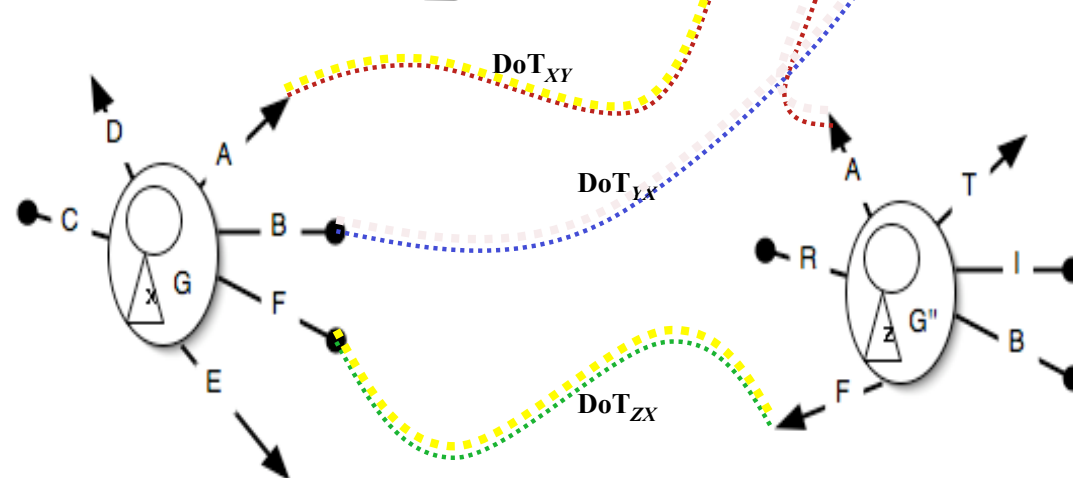
It can change the set of *goals/needs/interests*:



So we have a different *dependence structure*:



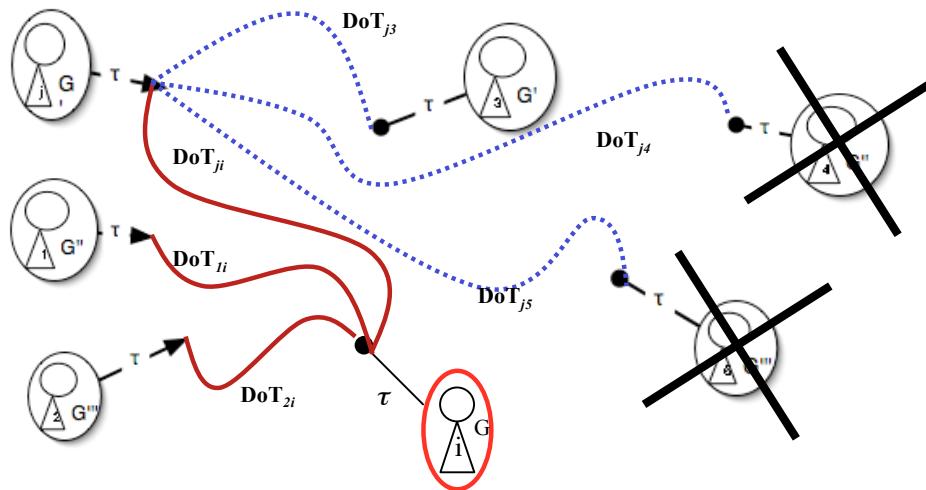
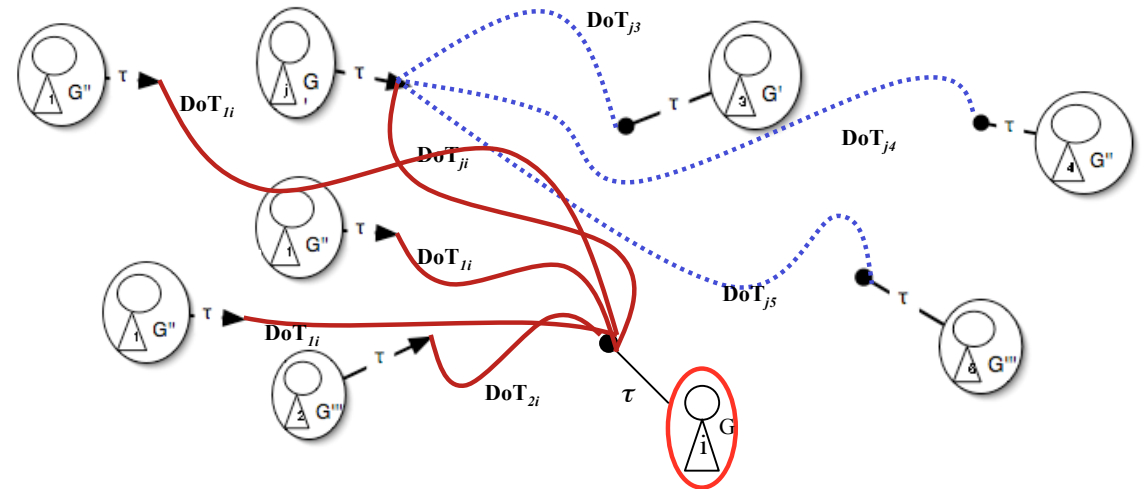
But, can also change the *trust relationships* among the agents:



Changing Trust Capital

The trust capital of an agent (say Ag_i) increases when:

i) *increases the number of agents (delegators/clients) in the DTN requiring the solution to the given task (and/or his trustworthiness in that task)*



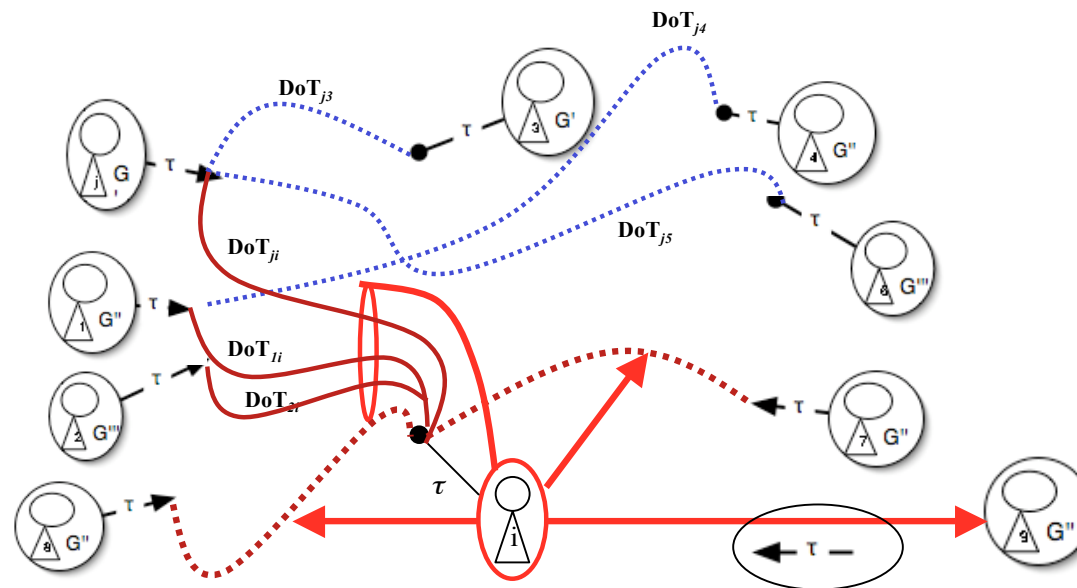
ii) *decreases the number of other agents (competitors) in the DTN offering the solution to the given task (or classes of tasks); and/or*

Changing Trust Capital (2)

i) **increases** the number of agents (**delegators/clients**) in the DTN requiring the solution to the given task (and/or his trustworthiness in that task).

For this the agent could:

- maintaining and enforcing the already established DoT (operating in its specific components) with it (as trustee)
- connecting new potential trustors to it (as trustee) on the specialized task
- soliciting new needs, goals, tasks
- and so on ...

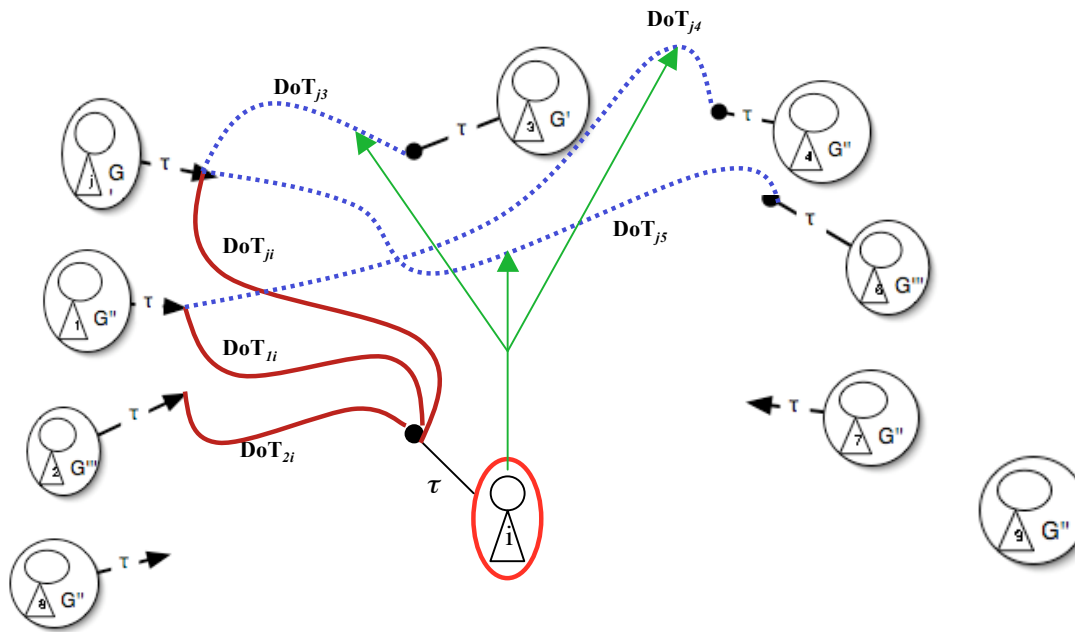


Changing Trust Capital (3)

ii) decreases the number of competitors in the DTN offering the solution to the given task (or classes of tasks).

For this the agent could:

- *disconnect the links in the network*
- *diffuse low reputation of its competitors*
- *and so on ...*



CONCLUSIONS

- **Relational capital is based on beliefs:** in addition to the dependence network (who sees whom and how clearly) it is relevant characterizes the *levels of trust* of the links in the network (who trusts whom and how much). **Trust is based on beliefs. Relational capital can be manipulated by manipulating beliefs**
- **The dependence network is modified by the dynamics of the agents' goals:** the dependence network is mainly based on the set of actions, plans and resources owned by the agents and necessary for achieving the agents' goals. In fact there could be variations of goals (as they *evolve* in time), the *emergency* of new ones, the *disappearance* of old ones, the *increasing* request of a subset of them, and so on. On this basis, *changing the role* of each agent in the dependence network, *changes* in fact *the trust capital* of the involved agents
- **Difference between individual trust capital and collective trust capital:** since the individual is in competition with the other individuals, he has a better position when trust is not uniformly distributed (everybody trusts everybody), but when he enjoys some form of concentration of trust (an oligopoly position in the trust network); while the collective social capital could do better with a more equilibrated distribution of the trust capital among the members of the collectivity