Towards **Trustworthy Information Sharing** by Creating Cyber Security Alliances

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Motivation

Cyber attacks are **human** activities executed to achieve certain results. An effective **defense strategy** against such attacks require **organizations** next to **technical measures**, therefore:

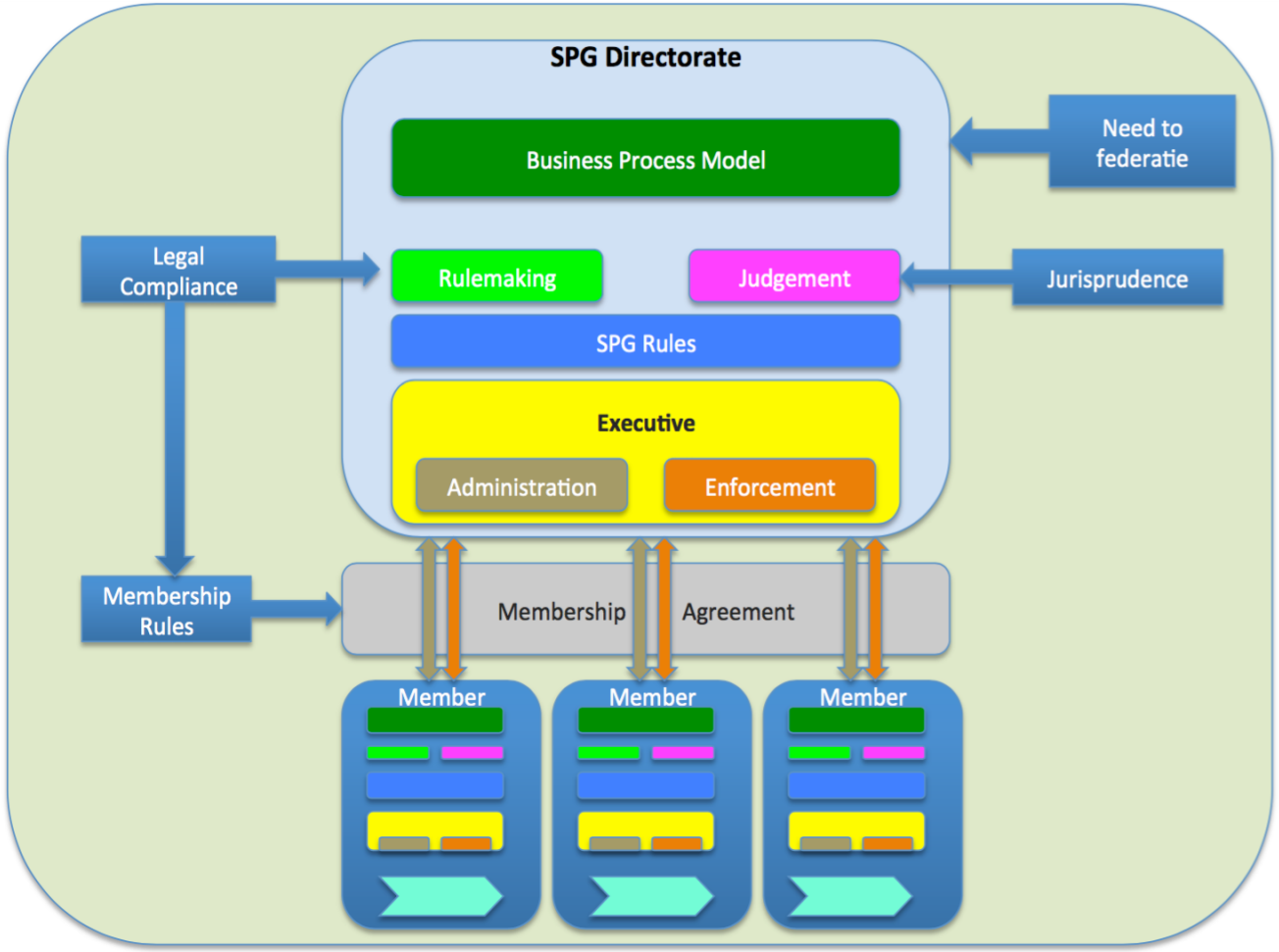
- Cybersecurity needs **principles** that involve not only **IT** representations and architectures, but also the **organizations** and **environments** in which they are realized.
- Despite progress in cybersecurity on the **technical** aspects, big gaps remain, especially at the **social** and **human** levels.
- The social level **evolves** over time.
- Collaboration with the **right** partners to work **on joint tasks** is essential**.**
- Sharing with these partners that may be **competitors** in other aspects requires organizing **Trust**.

Goal

- Service Provider Group (SPG) framework as a common framework to arrange trust by defining a set of rules for the members.

- Social computational trust model and its antecedents.

Service Provider Group (SPG)



Alliance Lifecycle

1,2,3 arrange by SPG

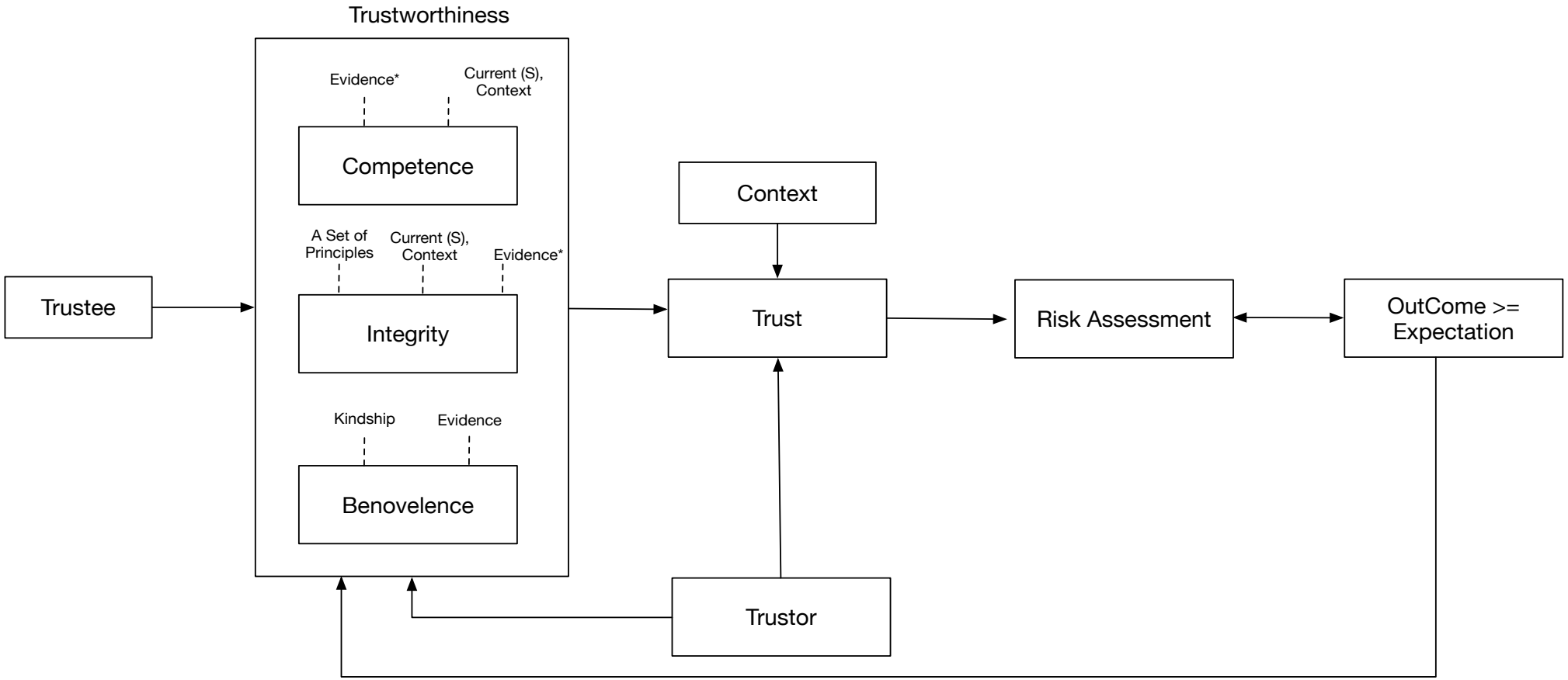
Trust as a key word..

- Trust reflects an **expectation** and, therefore, cannot be expressed **objectively**. It is influenced by subjective perceptions of the involved **actors**.

- Trust is **context** dependent and is basically valid within a **particular scope only**, such as the type of an activity and the organizational structure.

- Trust relies on **previous interactions**, i.e., from well-proven previous behavior a **prediction of the future** is inferred.

Trust Framework

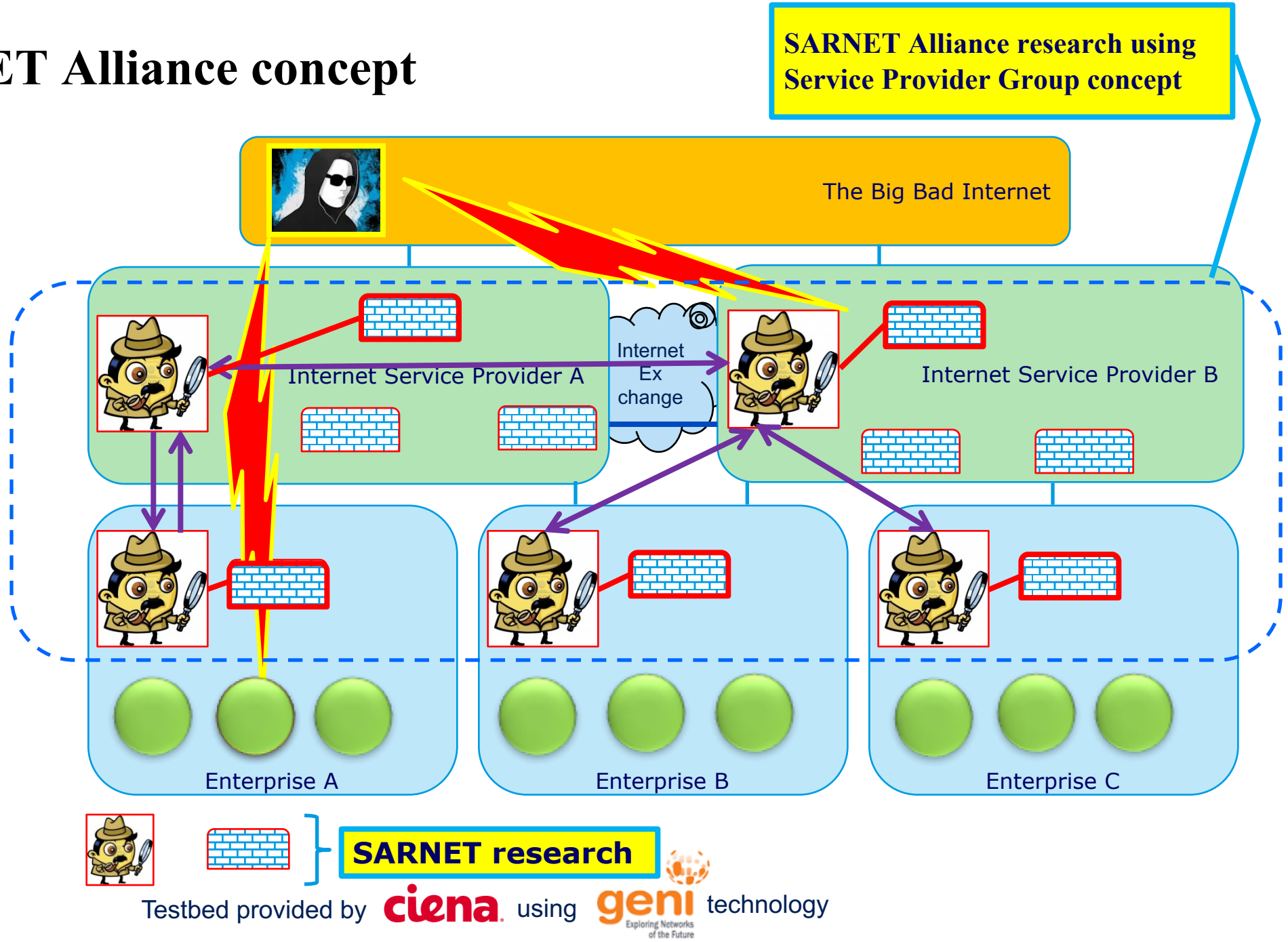


Adopted: Mayer et al. (1995)

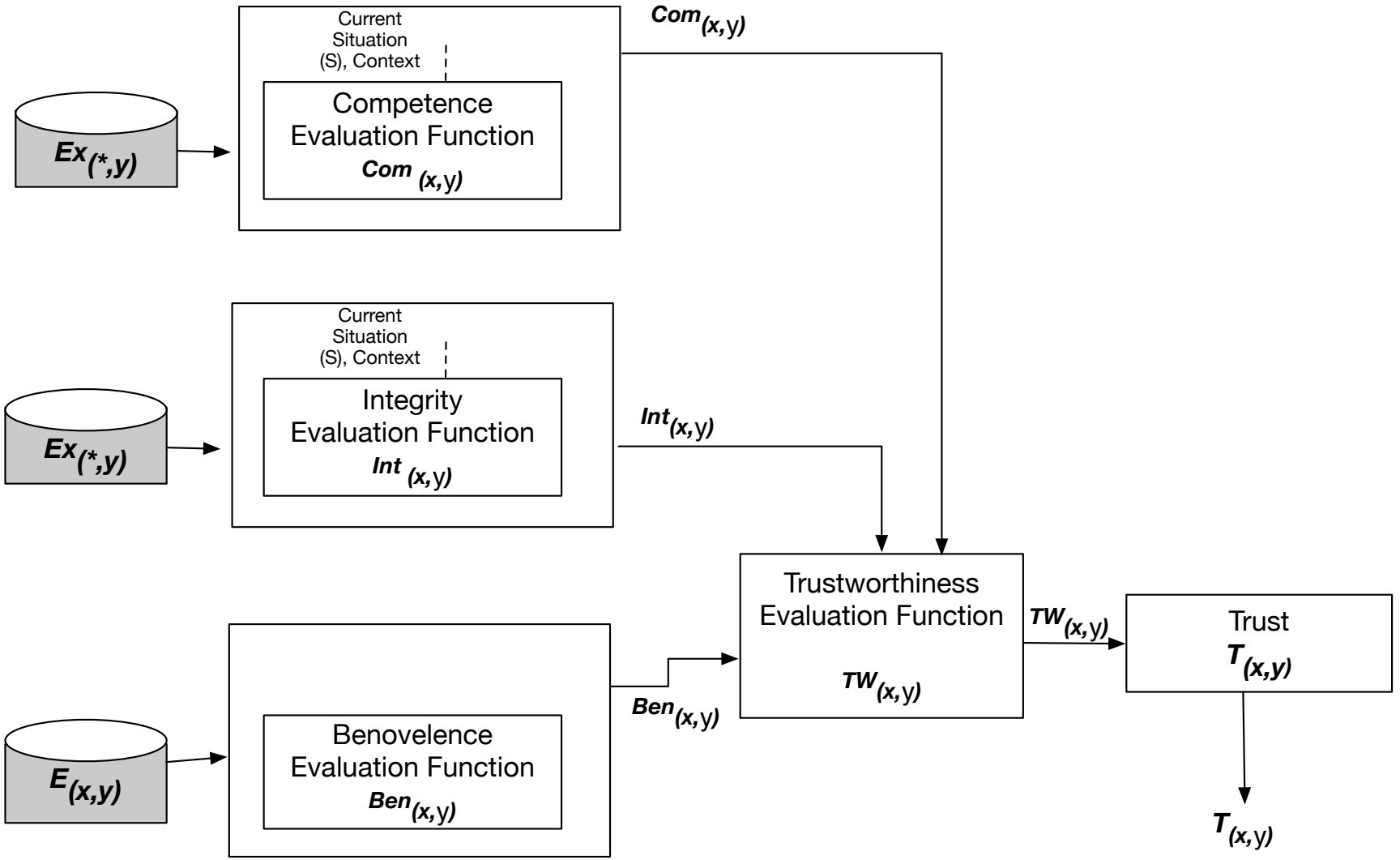
Trustworthiness Components

- **Competence:** Potential **ability** of the evaluated entity to perform a **given task**.
- **Integrity:** Act accordingly to fulfil the **commitments** even when acting on them is **not in self interest** and accept the **consequences**.
- **Benevolence:** A disposition to do **good** and an act of **kindness** even if unforeseen contingencies arise.

SARNET Alliance concept



Social Computational Trust Model (SCTM)



Notation

- X, Y are two members (agents) of the alliance (A).
- Given two agents, x, y member's of A, to notate "x trusts y in the situation α" $Tr\ x(y, \alpha)$.
- $E_x(x, y)$ denotes as the set of past interactions between x, y.
- $E_x(*, y)$[1] as the set of **All** the evidence on Y by others.
- Situations represent as a set of $\{S_1 S_2 \ldots S_n\} \subset \alpha$
- The experience of an interaction is valuated by a function O mapping the fulfilment of the agreement between the two agents to a value $[0,1]$:

$$O = \begin{cases} Fd = 1 \\ Fdd = 0.5 \\ V = 0 \end{cases} \quad F = \text{fulfilment},\ Fd = \text{fulfilment } with\ delay,\ V = violation\ of\ the\ agreement$$

[1] $E_x(x, y) \not\subset E_x(*, y)$

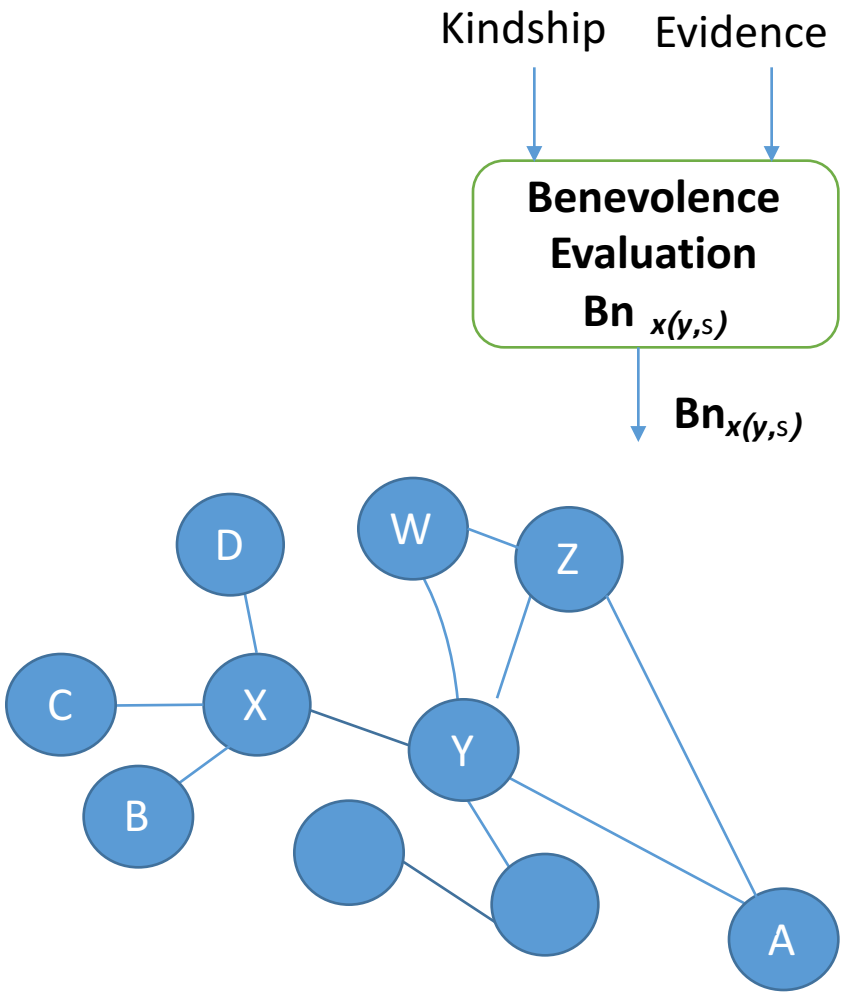
Advantages of Our SCTM

- Consider three trustworthiness components: **Benevolence, Competence and integrity**.
- Consider **different stages** of relationships between each pair (trustee and trustor).
- Estimate trustworthiness in a **dynamic** way by taking into consideration the **situation** and of the **relationship**.
- Use the **available evidence** to the trustee by considering different situations to estimate the trustee's benevolence and competence.

Benevolence Evaluation

- Based on the **Direct** interactions between X and Y (in the situation α).
- At least two past interactions between X and Y.

$$Ben_{(x,y)} = \frac{1}{|S|}\sum(val(E_{(x,y)}))$$



Competence Function

- There is no evidence available from the trustee.

$$Risk = \frac{Cost * (1 - Pr)}{Benefit * Pr}$$

- Situation β: there are some evidence but not for the considered context.

$$Com = \frac{1}{|N|} \sum_{\beta \in N} \text{val (E(*,y))} \times \widehat{Tx(y, \beta)}$$

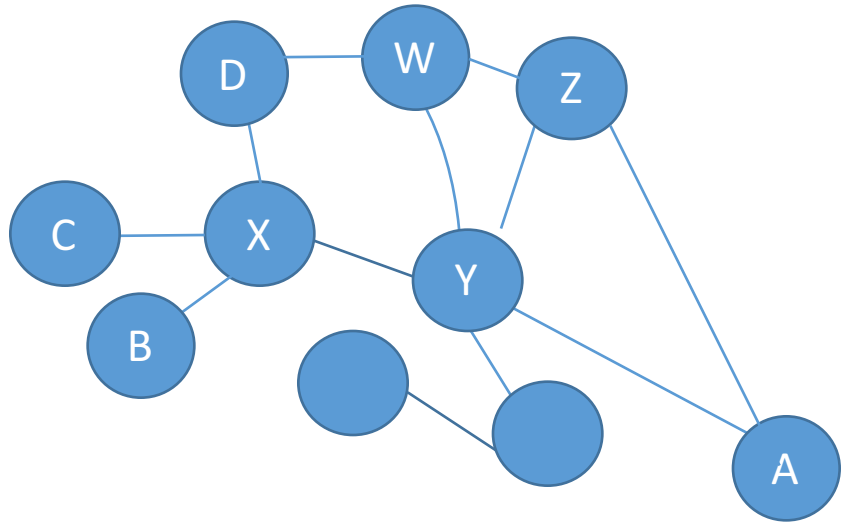
$\widehat{Tx(y, \beta)}$ denotes the basic trust and β is the set of all situations. $\widehat{Tx(y, \beta)} = \frac{1}{|N|} \sum_{\beta \in n} \text{T(x,y)}$, T(x,y) ∈ [0,1]

- Situation α : there is related evidence about the agent in this context.

$$Com = \frac{1}{|N|} \sum_{\alpha \in N} \text{val (E(*,y))}$$

$N \in S$

Preliminary Result



Assumption:

- Agents are honest
- No conflicts on the agents' opinion
- 4 different situations
- 4 different agents

$$Com = \frac{1}{|N|} \sum_{\alpha \in N} \text{val (E(*,y))}$$

$Competence\ of\ Z\ from\ X\ point\ of\ view = 0.5$
$Competence\ of\ A from\ X\ point\ of\ view = 0.87$

Agent's opinion in Situation S1		
Agents	z	A
Y	FD	F
A	FD	F
W	FD	F
D	FD	F

Agent's opinion in Situation S2		
Agents	z	A
Y	F	F
A	F	F
W	F	F
D	F	F

Agent's opinion in Situation S3		
Agents	z	A
Y	FD	F
A	FD	F
W	FD	F
D	FD	F

Agent's opinion in Situation S4		
Agents	z	A
Y	FD	FD
A	FD	FD
W	FD	FD
D	FD	FD

$S1, S2, S3, S4 \in S$

Conclusion

- To better estimate this trustworthiness, it is important to estimate, **competence, integrity** and **benevolence separately**, and to combine them taking into consideration the particular **situation** and **relationship.**
- Any individual can estimate the **competence, integrity** and **benevolence** of trustees and combines these estimations in a dynamic way at any given **moment** and **situation**.
- We define different stages of **relationships** between the agents.
- We proposed a **general framework** that can be used in different **case studies**.

future Work

- Apply trust framework in other case studies
- Employ an evidential reasoning methods for the conflict situations.
- Evaluate integrity of Agents

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"Trust is a social good to be protected just as much as the air we breathe or the water we drink. When it is damaged, the community as a whole suffers; and when it is destroyed, societies falter and collapse. (Bok, 1978, pp 26 and 27)"