Some Trust Issues in Social Networks and Sensor Networks

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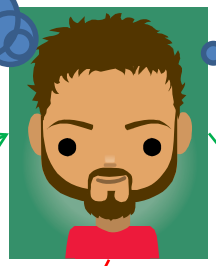
Bob has experience with cars

Anna's car is in terrible shape

Dick is a certified mechanic

Ben



Bob

Dick

Anna

Presentation Outline

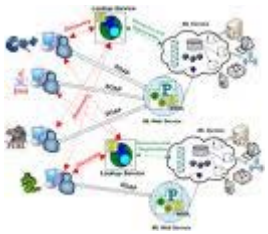
- Goal
- Why Trust Evaluation?
- Research Issues
- Trust Model
- Semantic Web and Trust
- Gleaning Trust Information
- Challenges
- Conclusions

Goal

Study semantic issues relevant to trust in

- Social Media - Data and Networks

- Sensor - Data and Networks



Web Services

Why Trust Evaluation ?

As Nobel prize winner Herbert Simon noted in 1971,

"a wealth of information creates a poverty of attention and a need to allocate that attention efficiently."

Why Trust Evaluation ?

Problem:

- Reducing Data overload in Social and Sensor networks.
- Increasing Data quality.

Two step process for tackling the problem:

- Reducing Data overload
  - Relevant – *spatial(geo-location), temporal(time) and thematic(type/topic).*
- Increasing Data quality.
  - Trustworthy – *Reliability of information/observations.*

Research Issues

- Upper level model of trust.
- Role of online interactions in trust.
- Tracking online entities.
- Robust methods of trust assessment.
- Can we integrate social and sensor networks?

Trust Model

6-tuple representing the trust relationship:

{type, value, process, scope}

Type – Represents the semantics of trust relationship.

Value – A quantification of trust relationship for comparison.

Scope – Domain where the trust relationship is applicable Eg: cars.

Process –Represents the process by which the *Trust Value* is created and maintained.

Trust Model

Trust Type, Scope and Value

- Trust Type[1] – E.g., Referral Trust, Functional Trust and Non-Functional Trust.(Each of these definitions are in a particular context)
  - Referral Trust – Agent a1 trusts agent a2's ability to recommend another agent.
  - Functional Trust – Agent a1 trusts agent a2's ability.
  - Non-Functional Trust – Agent a1 distrusts agent a2's ability.

- Trust Value – E.g., Star rating, numeric value or partial ordering.

- Trust Scope[1] – E.g., recommendation for a Car Mechanic, Baby sitter or a movie.

[1] K. Thirunarayan, Dharan K. Althuru, Cory A. Henson, and Amit P. Sheth, 'A Local Qualitative Approach to Referral and Functional Trust,' In: Proceedings of the The 4th Indian International Conference on Artificial Intelligence (IICAI-09), pp. 574-588, December 2009.

Trust Model

Trust Process

- Represents the process by which the Trust value is computed and maintained.

Reputation – based on past behavior.

Policy – based on explicitly stated constraints.

Evidence – based on seeking/verifying evidence.

Provenance – based on lineage information.

Bob has experience with cars

Anna's car is in terrible shape

Dick is a certified mechanic

Ben

type: referral
process: reputation
scope: car mechanic
value: 8

Bob

type: functional
process: policy
trust scope: car mechanic
value: 10

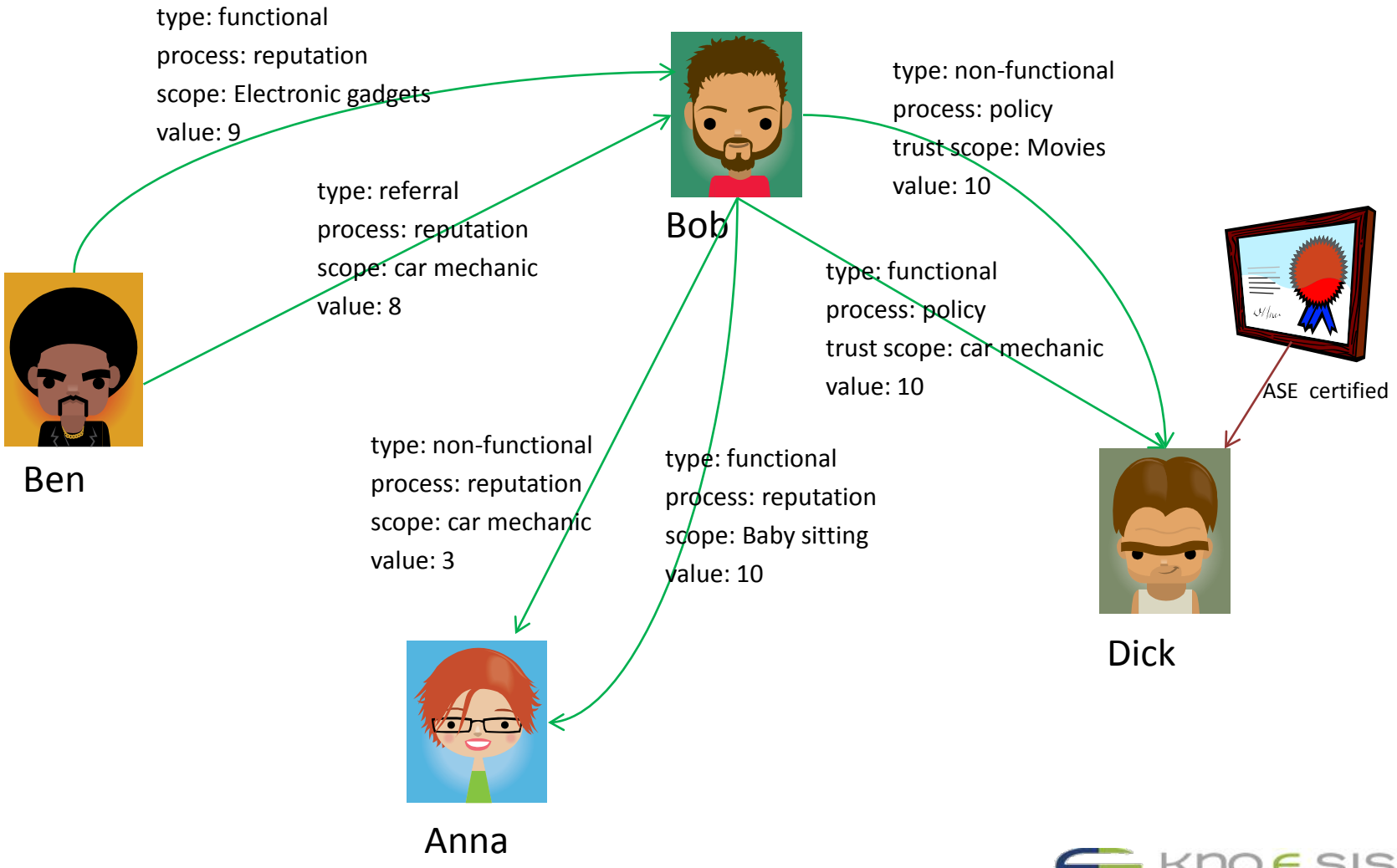
ASE certified

type: non-functional
process: reputation
scope: car mechanic
value: 3

Anna

Dick

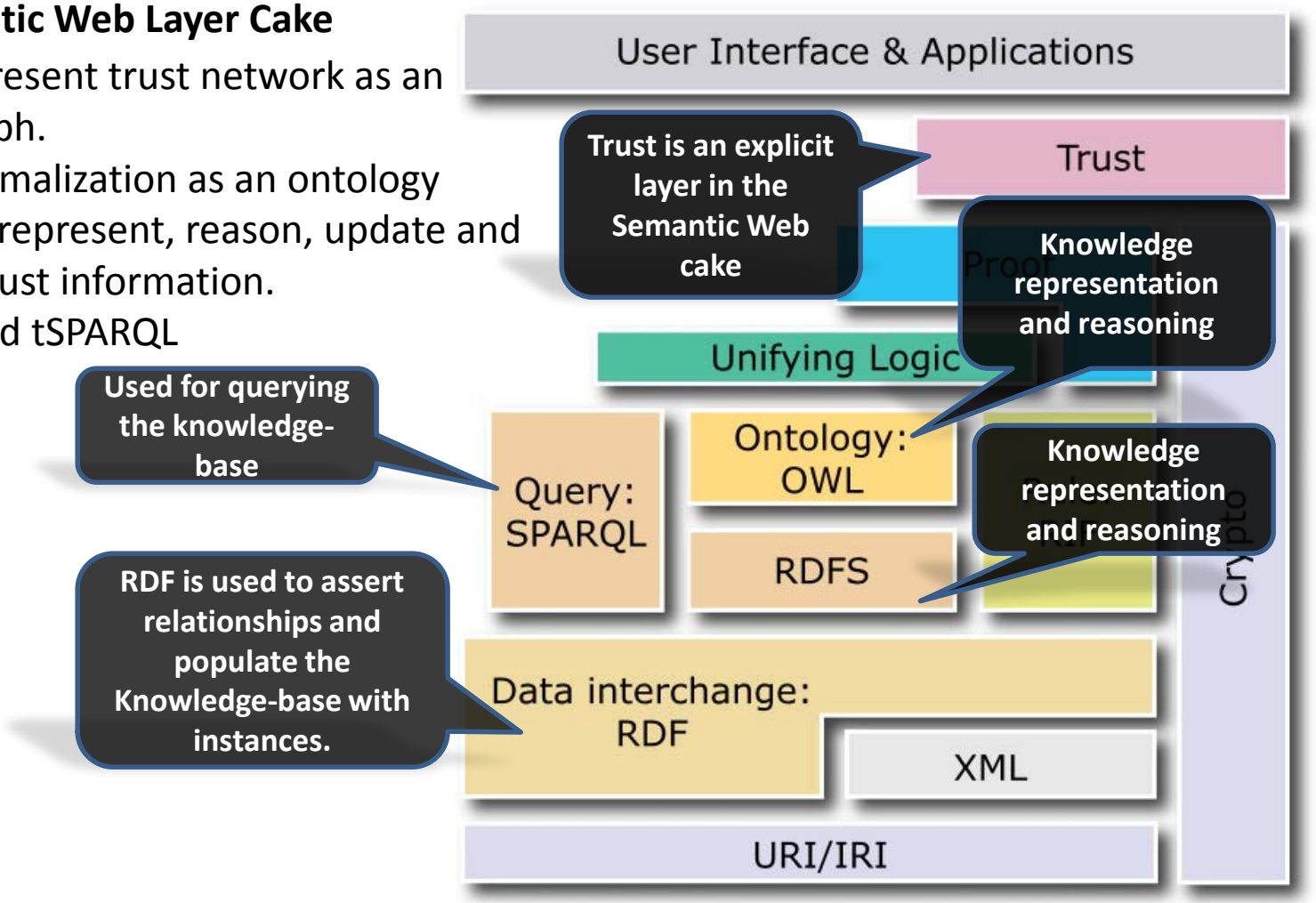
Trust relationships with multiple scopes



Semantic Web and Trust

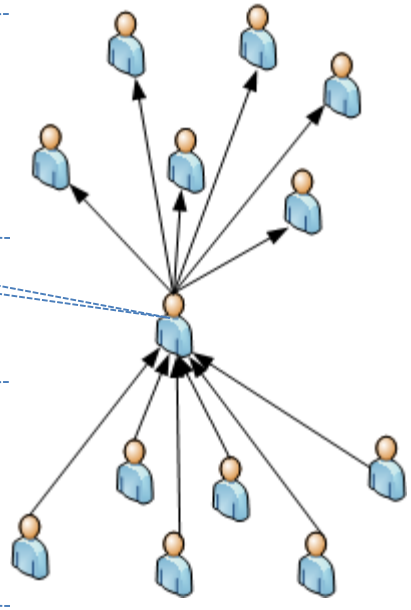
Semantic Web Layer Cake

- We represent trust network as an RDF graph.
- Trust formalization as an ontology used to represent, reason, update and query trust information.
- tRDF and tSPARQL

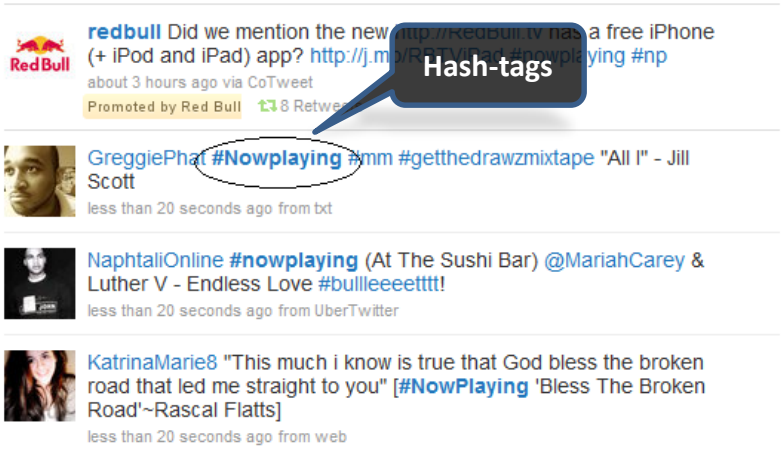


Gleaning Trust Information

Twitter domain concepts



A simple twitter network [Direction of arrow indicates Flow of tweets]



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Gleaning Trust Information

Trust Model Revisited – Twitter Data

Trust Type

- *Referral*: user introduced to another user's tweets (e.g., re-tweet)
- *Functional*: user likes tweets of another user (e.g., follow)
- *Non-Functional*: not-applicable

Trust Process

- *Policy-based*: user follows another based on some criteria (e.g., suggested user, affiliation)
- *Reputation-based*: users follow others based on past behavior (whose tweets are often re-tweeted – Influential twitterer)

Trust Value

- Value associated with each Trust link.

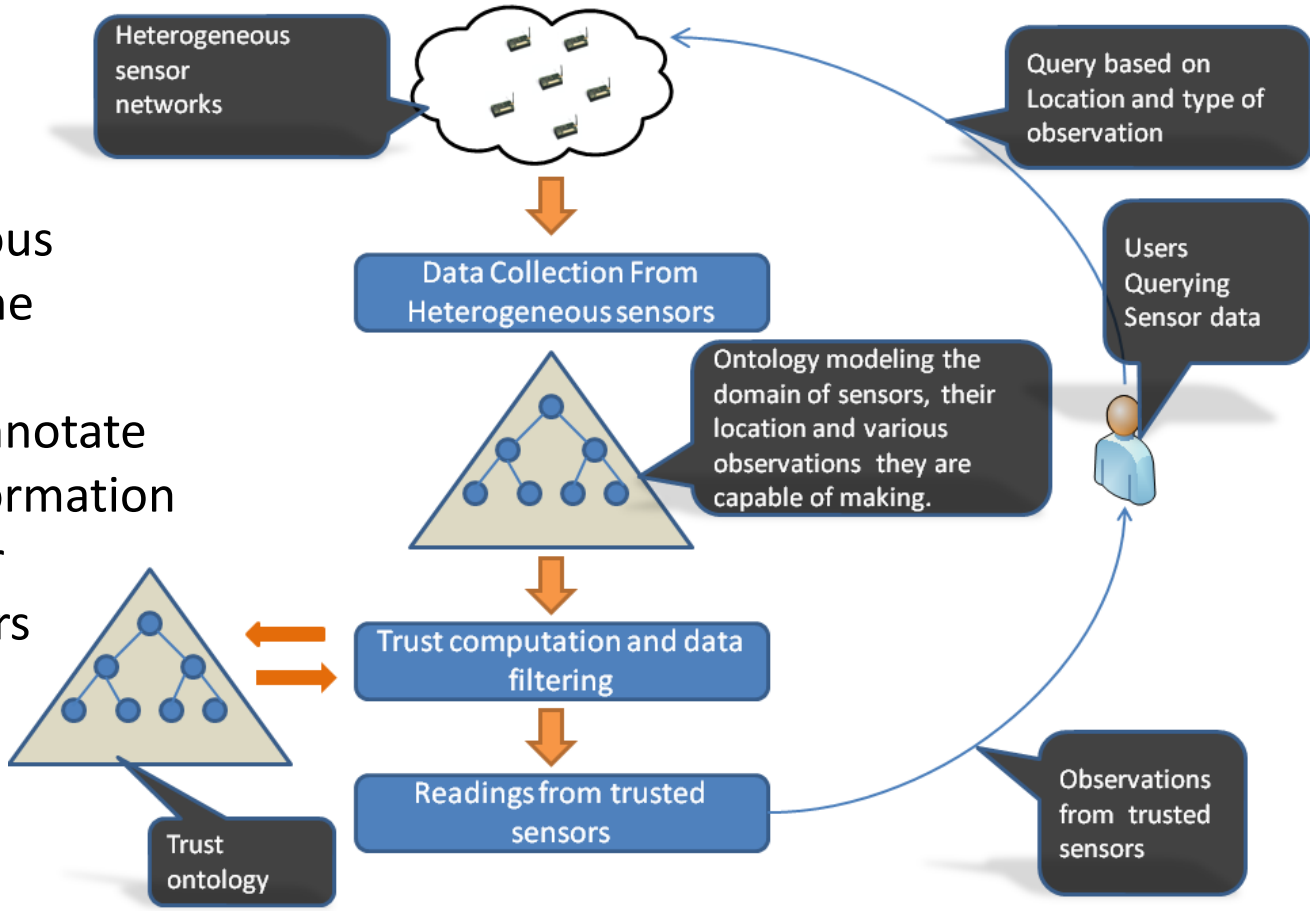
Trust Scope

- what tweets are about (e.g., hashtag topics, twitter lists)

Gleaning Trust Information

Semantic Sensor Web

- Heterogeneous sensors often used in real world deployment of sensors.
- Semantics of heterogeneous sensors are captured in the sensor ontology.
- Trust ontology helps us annotate sensor data with trust information
- Relying on middleware for aggregating trusted sensors and their observations.



Observations by Trusted sensors

Gleaning Trust Information

Trust Model Revisited – Sensor Data

Trust Type

- *Referral*: Packet routing happens through trusted sensors.
- *Functional*: belief that an observation generated by a sensor is valid.
- *Non-Functional*: belief that a sensor is malfunctioning or malicious.

Trust Process

- *Policy-based*: sensors of high quality, precision and wide operating range.
- *Reputation-based*: sensors reporting proper readings consistently over a period of time.

Trust Value

- Value associated with each Trust link.

Trust Scope

- Type of observation that the sensor makes.(e.g., temperature, wind speed)

Conclusions

- Approach that blends both theory and practice is required for trust assessment.
- Nature of trust demands rich semantics for formalization.
- Having a trust model will help us define trust in various domains.

Thank you.. ☺