



Telecooperation Lab
Prof. Dr. Max Mühlhäuser

TK3: Ubiquitous (& Mobile) Computing

Chapter: Trust

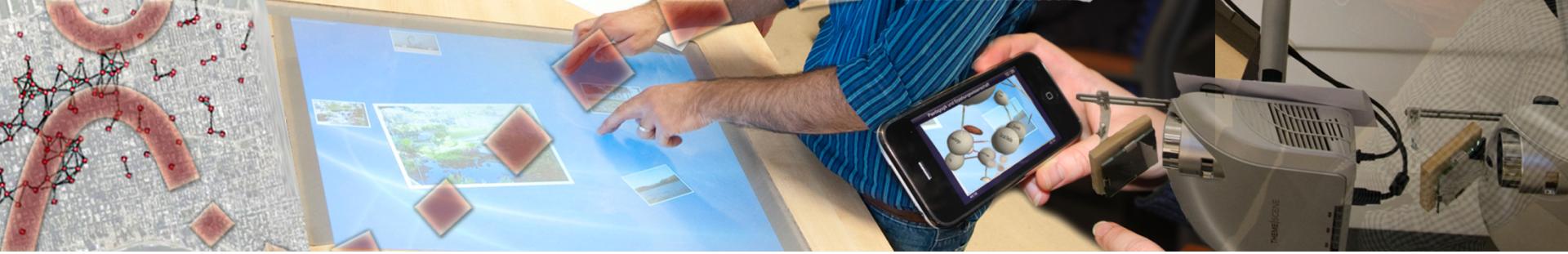
Lecturer: Sascha Hauke
(Sheikh M. Habib, Sebastian Ries)



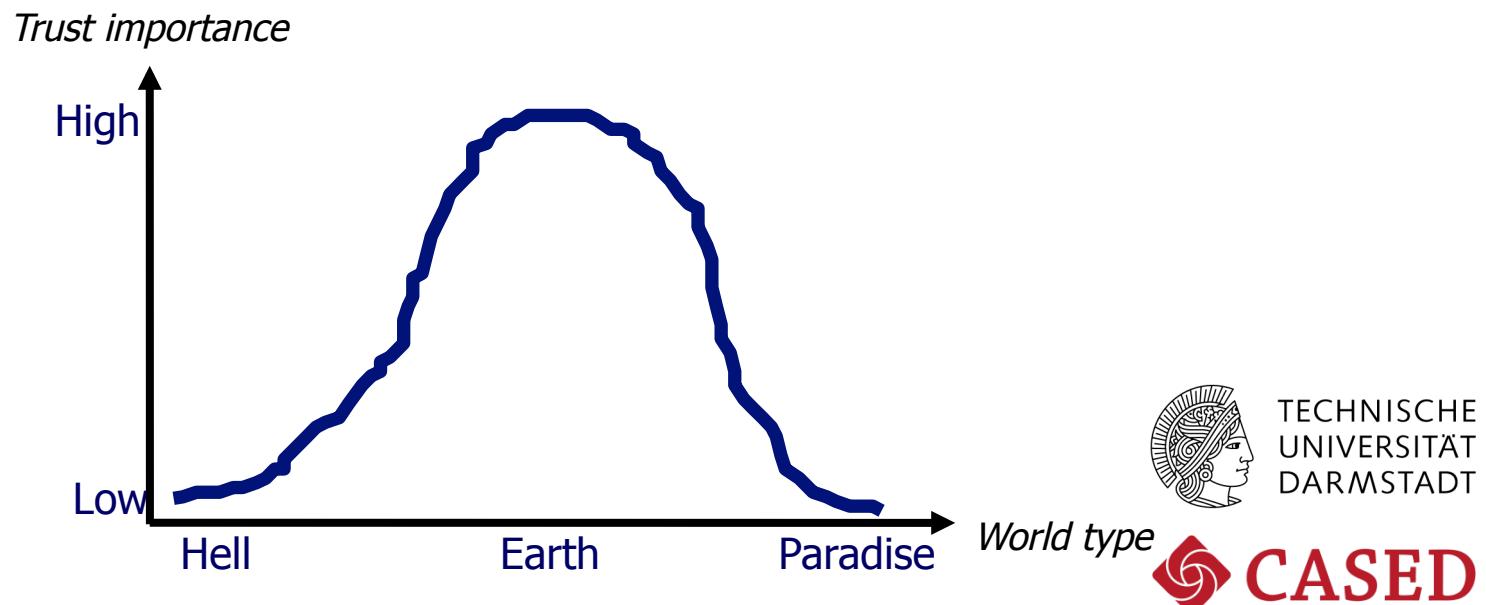
TRUST

Outline:

- Part I 45 mins
 - Introduction to trust
 - Trust modeling
- Part II 45 mins
 - Computational trust methods
 - Computational trust evaluation



Introduction





Trust: What is it... and why do we need it?



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Me
Truster

Some act of reliance
Engagement



Something at stake



Someone/something else
Trustee

Risk

Our definition:

Trust /trʌst/
noun

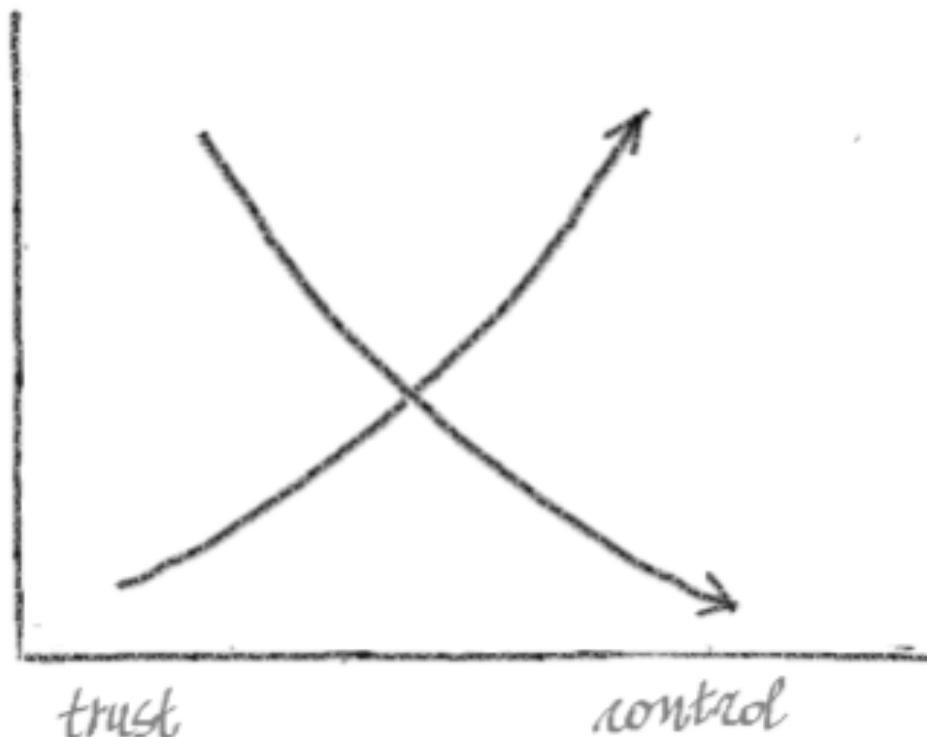
the **justified willingness** to **engage** with an **entity** in the presence of **risk**



Trust: What is it... and why do we need it?



Trust ← → Control



Our definition:

Trust /trʌst/
noun

the **justified** willingness to **engage** with an **entity** in the presence of **risk**
(without being able to control its actions)



Trust: What is it... and why do we need it?



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What does that mean?

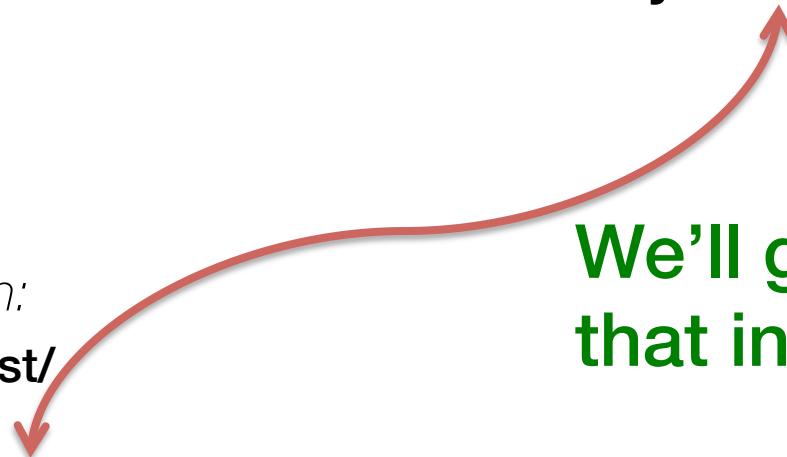
How do we measure “justified willingness”?

Our definition:

Trust /trʌst/
noun

the **justified** willingness to **engage** with an **entity** in the presence of **risk**
(without being able to control its actions)

We'll get back to
that in a bit!





Trust: What is it... and why do we need it?



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2011: Compromised CAs in PKI



AP PHOTO/SCOTT
HEPELL

2013: Mislabeling meat

NSA Prism scandal could cost US cloud computing industry \$35bn

NEWS | RENE MILLMAN AUG 6, 2013

80



European and Asian competitors could cash in on US misfortune, claims Washington-based think tank

2013: NSA Prism scandal



Now that we know what trust is (kinda), some more terminology:

- **Untrust:** (a measure of) how little a trustee is trusted
- **Distrust:** (a measure of) how much the truster believes that the trustee will actively work against them in a given situation
- **Mistrust:** misplaced trust (so, you trusted the trustee, but shouldn't have)

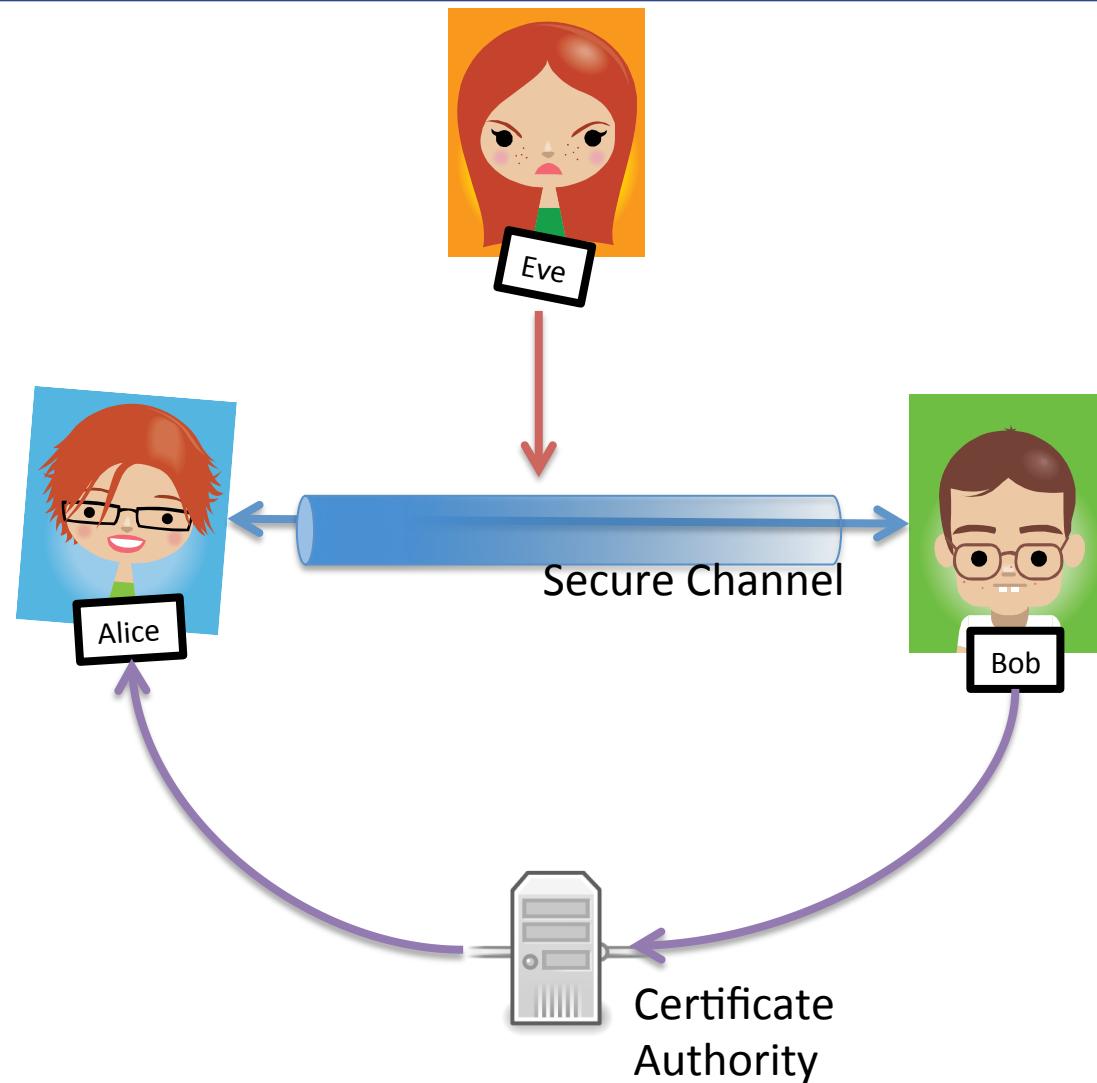
Stephen Marsh and Mark R. Dibben: Trust, Untrust, Distrust and Mistrust – An Exploration of the Dark(er) Side, iTrust 2005



Why trust when we have security?



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Why trust when we have security?

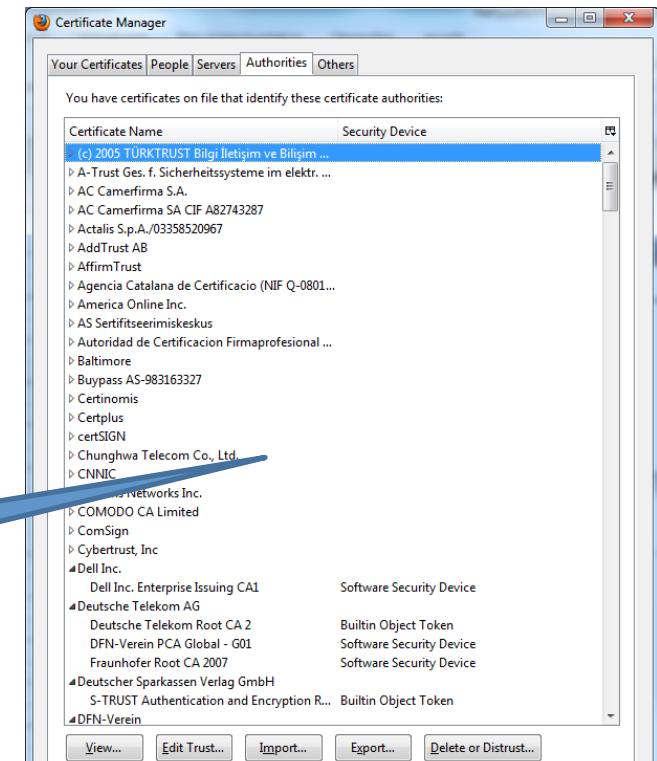


- IT security provides Confidentiality/Integrity/Authenticity for transport of data over space & time
 - + authorization, authentication, non-repudiation
- that is, IT security „secures“ path to Bob**

However, you still have to put trust in quite a few things:

- Bob is who he says he is and is trustworthy*,
- the CA issues correct certificates,
- the secure channel is implemented correctly,
- the cryptographic assumptions actually hold,
- ...

Did you ever have a look at the Certificate Mgr. of your browser?



* he is willing and capable to do what he promises



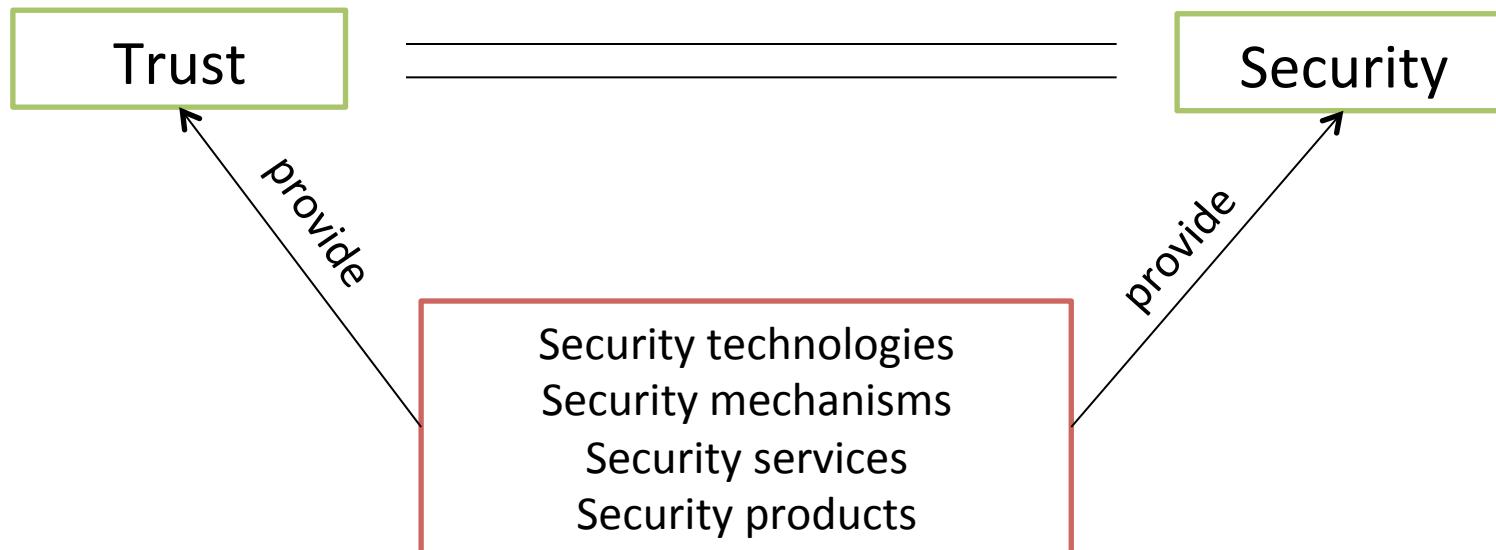
Trust in Security: Babylon reigns



(?) “Trust is **synonymous** to Security” [Chang, Dillon, Hussain (2006)]

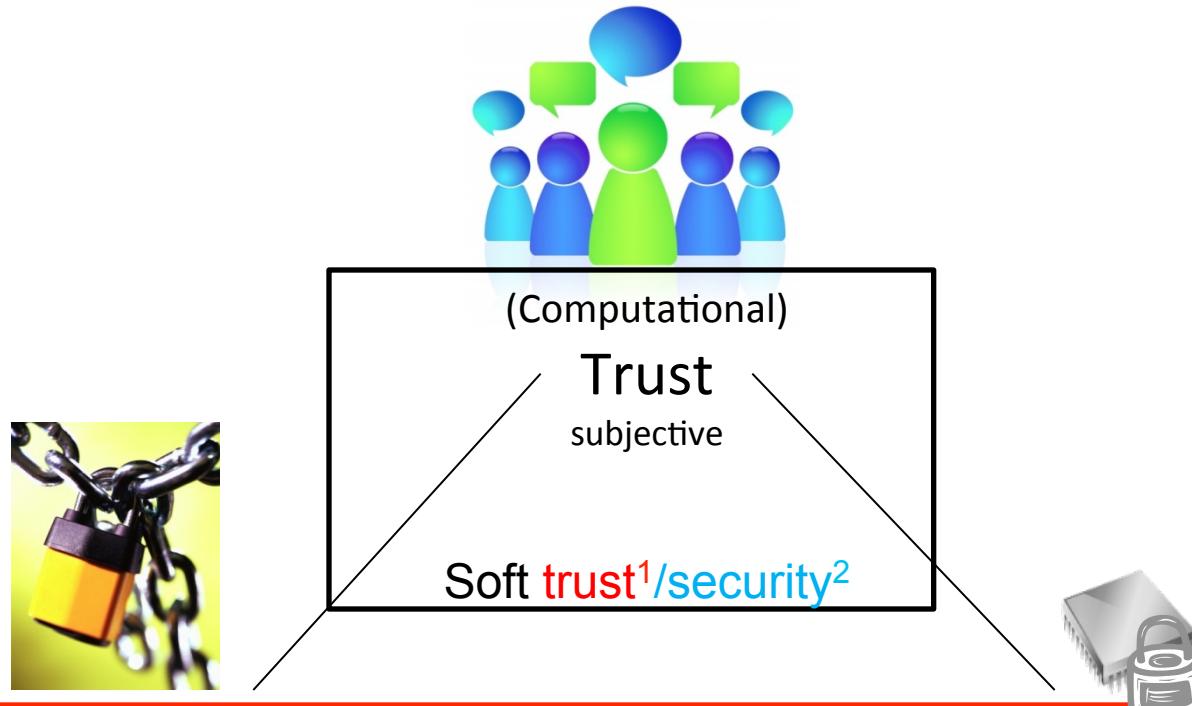
Trusted environment
Trusted network
Trusted computing
.....

Secure environment
Secure network
Secure computing
.....





Terminologies



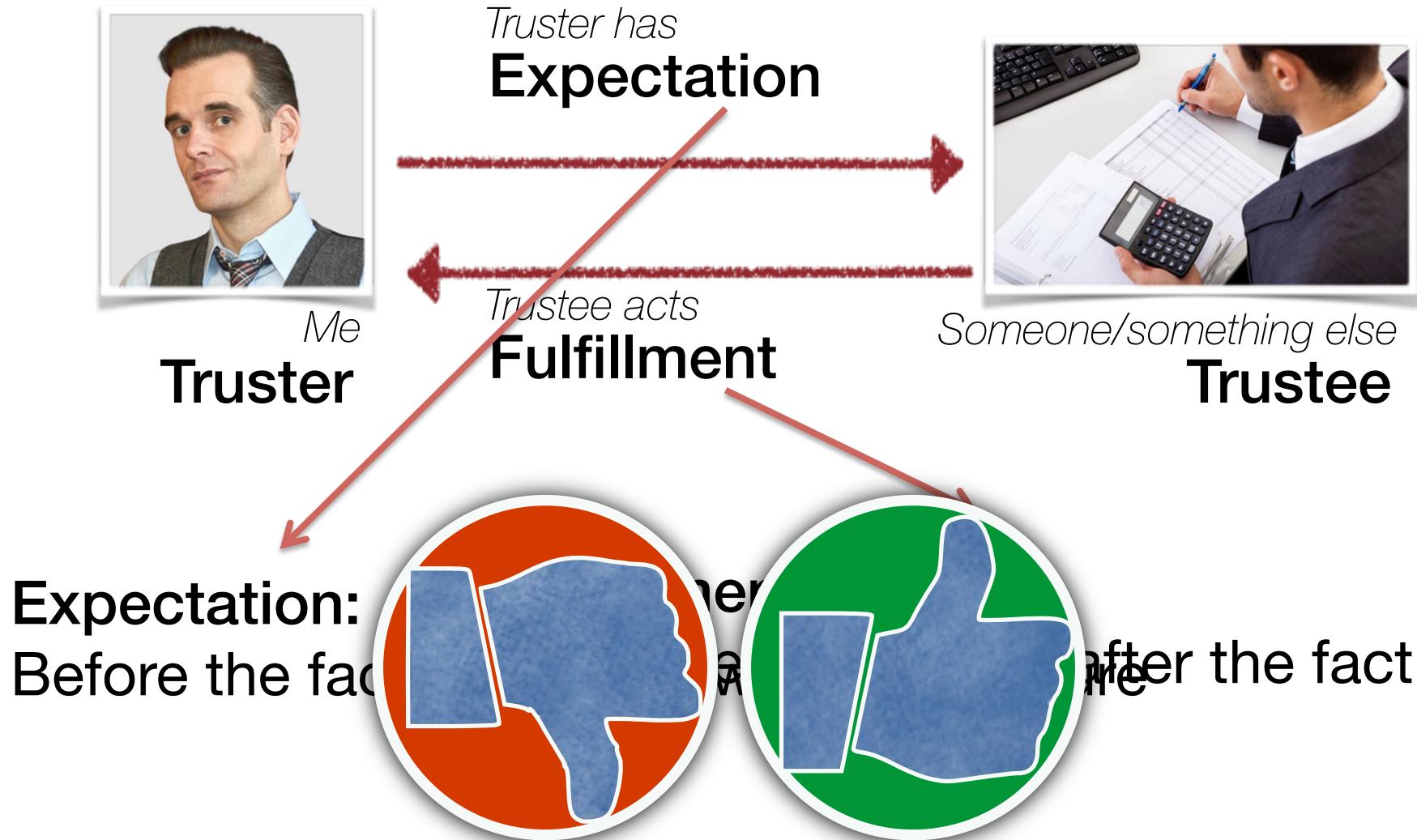
¹ [V2009] ² [RJ96]



Trust: How to compute the darn thing



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Trust: How to compute the darn thing



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Me
Truster

Truster has
Expectation



Someone/something else
Trustee



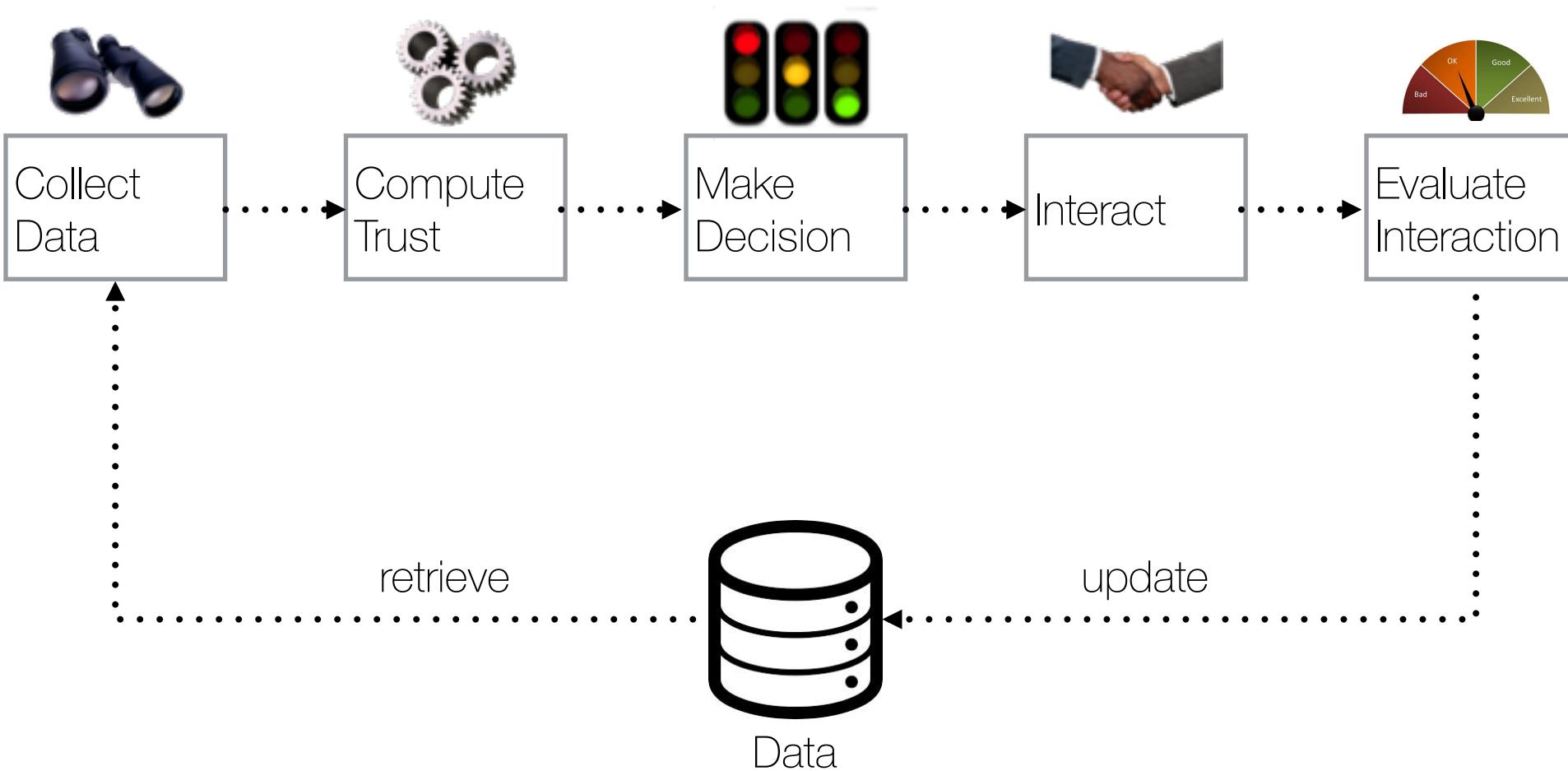
Trustee acts
Fulfillment

Jøsang's definition:
Reliability Trust

Reliability trust is defined as the trusting party's **probability estimate** p of success of the transaction.



Trust: How to compute the darn thing





Trust: How to compute the darn thing



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Experiences



Me
Truster



Recommenders

Question:
How much can I trust?*



Tax Advisor
Trustee

Dominik's recommendation

3x  0x 

Florian's recommendation

* 5x Context: 2x

... my tax advisor to file my taxes correctly?



middle-aged
Frankfurt-based
since 1987
family business

Attributes/ Features



Trust: How to compute the darn thing



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No or little
experience



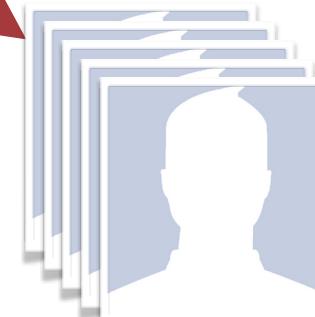
Me
Truster

Many but little known

Recommenders

ONLINE?

Question:
How much can I **trust**?*



"Friends"

Trustworthiness
(inherent quality)



Tax Advisor
Trustee

Online recommendation 1

3x 0x

•

Online recommendation n

15x 2x

"Strange"
attributes



**Attributes/
Features**



Trust: How to compute the darn thing



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TRUST:

Reliability trust is defined as the trusting party's **probability estimate** p of **success of the transaction**.

trust value = estimate of the probability of 



binomial
model

$$\omega := (t, c)$$



certainty value = estimate of the reliability of $t = \tilde{p}$

Data base for inference: repeated interactions





Trust: How to compute the darn thing



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A simple version of the *CertainTrust* computation

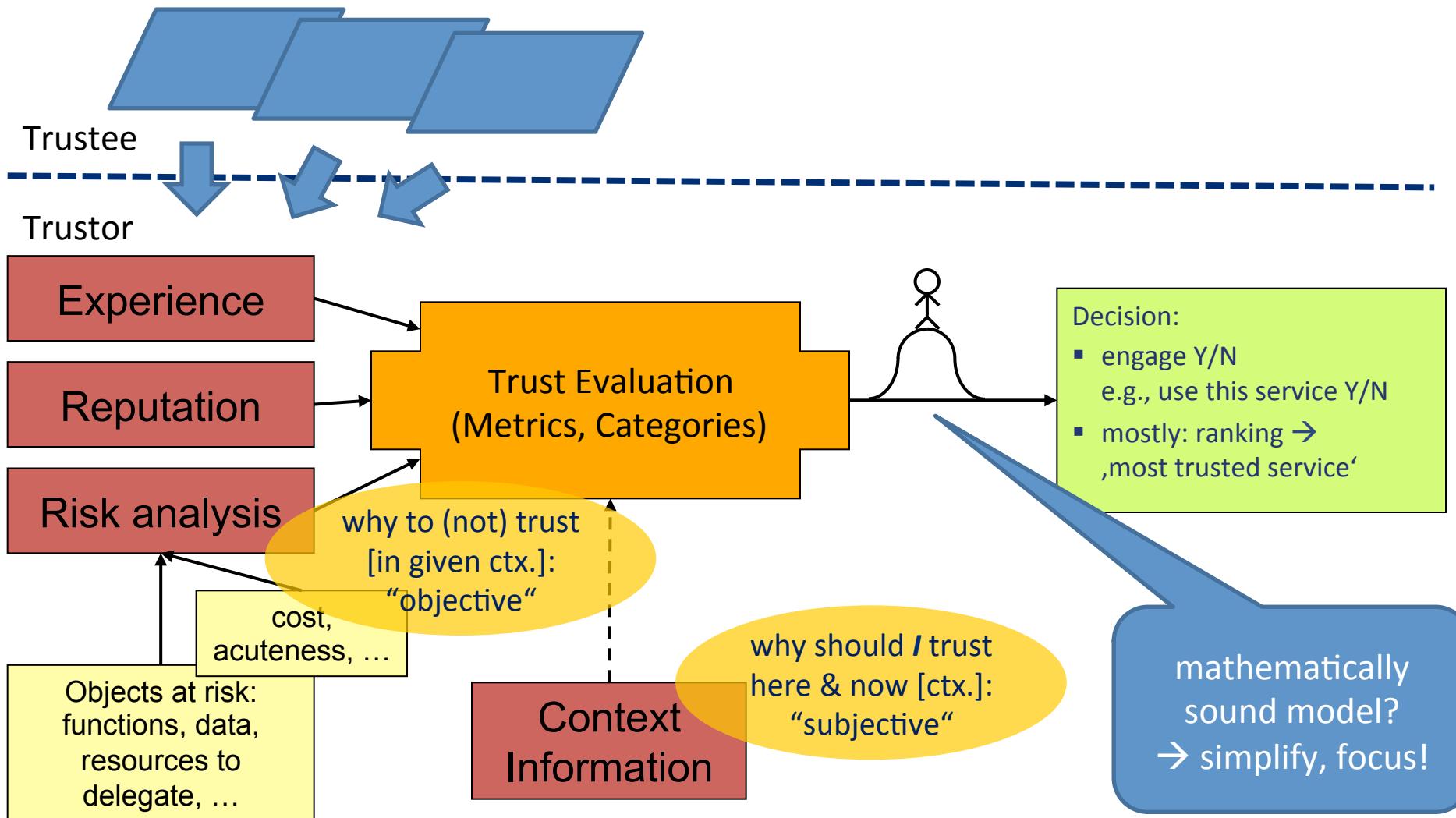
$$\omega := (t, c)$$

Data base for inference: repeated interactions





Preliminary Model





Summary



- Bayesian trust models provide sound **mathematical basis** for trust computation
- Belief approach provides **intuitive representation** of trust
- Operators explicitly deal with **uncertainty** and **conflict** within the computation of probabilities



Concluding remarks



- Computational trust are applicable to situations where
 - risk and uncertainty matters
 - security primitives are not sufficient
- Computational trust operators enable
 - trustworthiness evaluation in distributed environments under uncertainty
 - human-system/service , system/service-human, system/service-system/service
- Belief approach is a good choice for trust evaluation
 - explicitly deals with uncertainty associated with probabilities
 - estimate the future behaviour based on past evidence



References



- [CDH06] Elizabeth Chang, Tharam Dillon, Farookh K. Hussain, **Trust and Reputation for Service-Oriented Environments**, John Wiley & Sons Inc., 2006
- [HHRM12] Sheikh M. Habib, Sascha Hauke, Sebastian Ries, and Max Mühlhäuser, **Trust as a Facilitator in Cloud Computing: A Survey**, Journal of Cloud Computing: Advances, Systems and Applications, SpringerOpen, June 2012.
- [RJ96] Lars Rasmusson, Sverker Jansson, **Simulated social control for secure internet commerce**, NSPW 2006, 1996.
- [Ries09] Sebastian Ries, **Trust in Ubiquitous Computing**, PhD thesis, Technische Universität Darmstadt, 2009.
- [KSG-M03] Sepandar D. Kamvar, Mario T. Schlosser, Hector GarciaMolina, **The EigenTrust Algorithm for Reputation Management in P2P Networks**, WWW 2003.
- [Sab03] Jordi Sabater, **Trust and reputation for agent societies**, PhD thesis, Universitat Autnoma de Barcelona, Spain, 2003.
- [TPJL06] W. T. Luke Teacy, Jigar Patel, Nicholas R. Jennings, and Michael Luck. **TRAVOS: Trust and Reputation in the Context of Inaccurate Information Sources**, AAMAS 2006.
- [BLB04] Sonja Buchegger and Jean-Yves Le Boudec. **A Robust Reputation System for Peer-to-Peer and Mobile Ad-hoc Networks**, P2PEcon 2004.
- [MMH02] Lik Mui, Mojdeh Mohtashemi, and Ari Halberstadt. **A Computational Model of Trust and Reputation for E-businesses**, HICSS, 2002.
- [JI02] Audun Jøsang and Roslan Ismail, **The Beta Reputation System**, 15th Bled Conference on Electronic Commerce, 2002.
- [QHC06] Daniele Quercia, Stephen Hailes, and Licia Capra. **B-Trust: Bayesian Trust Framework for Pervasive Computing**, iTrust, 2006.
- [WJI05] Andrew Whitby, Audun Jøsang, and Jadwiga Indulska, **Filtering out Unfair Ratings in Bayesian Reputation Systems**, The ICFAIN Journal of Management Research, 4(2):48-64, 2005.
- [Bol04] William M. Bolstad. **Introduction to Bayesian Statistics**, John Wiley & Sons Inc., 2004.
- [WS10] Yonghong Wang and Munindar P. Singh. 2010. **Evidence-based trust: A mathematical model geared for multiagent systems**. ACM Trans. Auton. Adapt. Syst. 5, 4, Article 14, November 2010.
- [Lev04] Raphael Levien, **Attack resistant trust metrics**, PhD thesis, University of California at Berkeley, 2002.
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- [HRHM12] Sheikh M. Habib, Sebastian Ries, Sascha Hauke, and Max Mühlhäuser, "Fusion of Opinions under Uncertainty and Conflict – Application to Trust Assessment for Cloud Marketplaces", IEEE TrustCom 2012, June 2012.
- [HVHM12] Sascha Hauke, Florian Volk, **Sheikh M. Habib** and Max Mühlhäuser, "Integrating Indicators of Trustworthiness into Reputation-based Trust Models: Insurance, Certification, and Coalitions", IFIPTM 2012.

[Additional materials]

*Tutorial on Subjective Logic: <http://folk.uio.no/josang/sl/SubLog-FUSION2011.pdf>

*Demos on Subjective Logic: <http://folk.uio.no/josang/sl/>

*Tutorial on CertainLogic: <http://www.netsys2013.de/documents/Tutorial-Habib.pdf>

*Demos on CertainTrust and CertainLogic:

<http://www.tk.informatik.tu-darmstadt.de/de/research/smart-security-and-trust/demonstrators-certaintrust/>

*CertainTrust (including CertainLogic operators) SDK:

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