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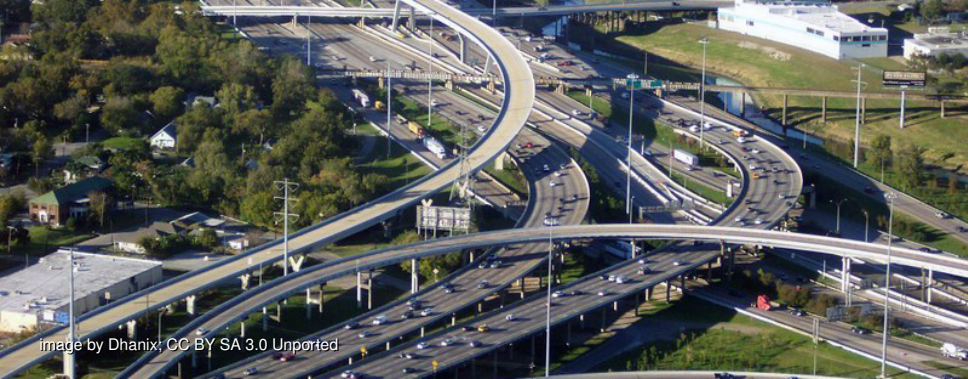


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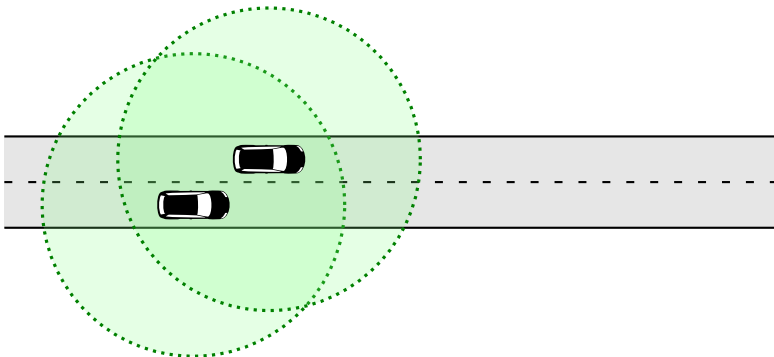
*Rens W. van der Heijden, Ala'a
Al-Momani, Frank Kargl, Osama M.F.
Abu-Sharkh*

20.09.2016

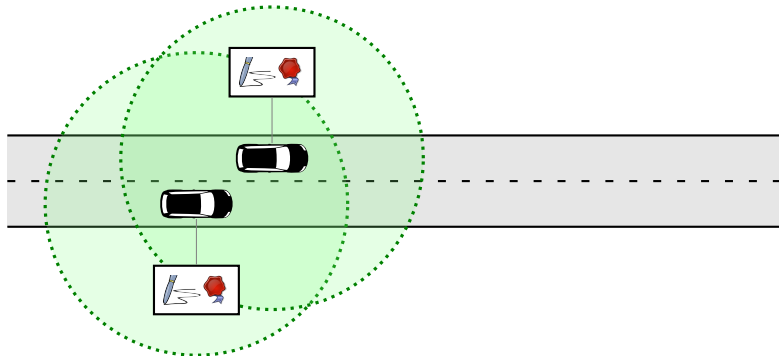
Enhanced Position Verification for VANETs using Subjective Logic

Vehicular Technology Conference Fall 2016

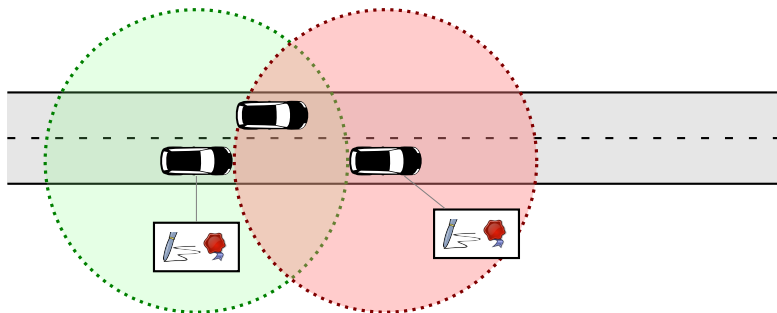
Application scenario



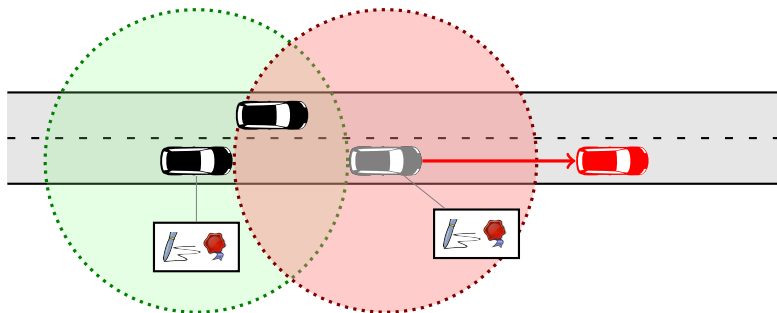
Using signatures



Misbehavior with (valid) keys

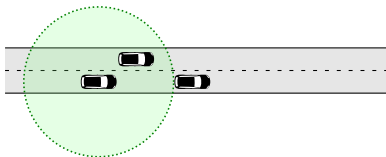


Misbehavior with (valid) keys



Detectors

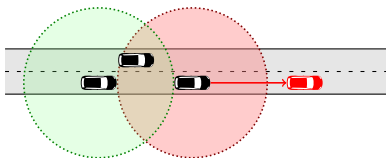
Acceptance Range Threshold¹



¹T. Leinmüller, E. Schoch, F. Kargl, and C. Maihöfer, "Decentralized position verification in geographic ad hoc routing," *Security and Communication Networks*, 2008.

Detectors

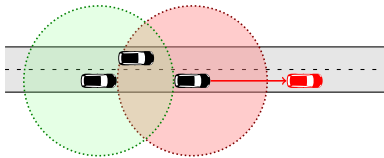
Acceptance Range Threshold¹



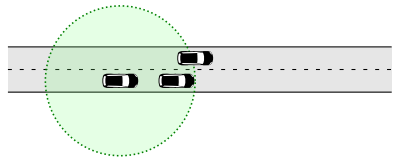
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Detectors

Acceptance Range Threshold¹



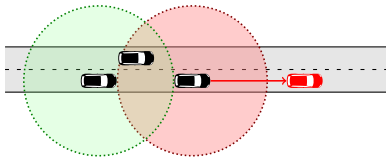
Neighbor Table Exchange¹



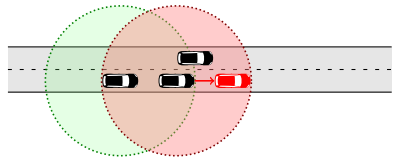
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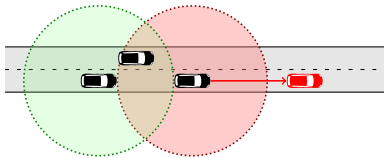
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Acceptance Range Threshold¹



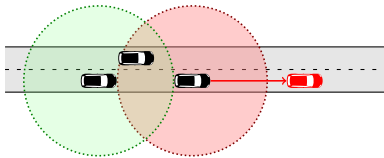
Neighbor Table Exchange¹



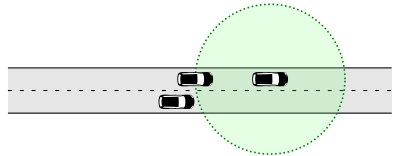
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Acceptance Range Threshold¹



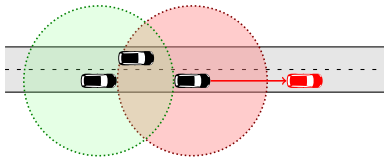
Neighbor Table Exchange¹



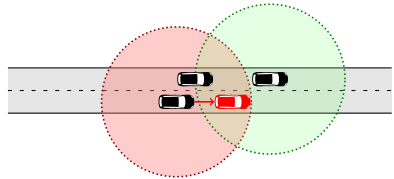
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Detectors

Acceptance Range Threshold¹



Neighbor Table Exchange¹



¹T. Leinmüller, E. Schoch, F. Kargl, and C. Maihöfer, "Decentralized position verification in geographic ad hoc routing," *Security and Communication Networks*, 2008.

Subjective logic

$\omega = (\textit{belief}, \textit{disbelief}, \textit{uncertainty})$,
where $\textit{belief}, \textit{disbelief}, \textit{uncertainty} \in [0 \dots 1]$
and $\textit{belief} + \textit{disbelief} + \textit{uncertainty} = 1$

Subjective logic

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Operators:

fusion, transitivity

Subjective logic

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Operators:

fusion, transitivity

Decisions:

convert opinion to a result: $\theta > \textit{belief} + \frac{\textit{uncertainty}}{2}$, where θ is a configured threshold (0.5 in this work).

Questions addressed in this work

- How can opinions be generated effectively?
- Can fusion improve overall detection performance?

Generating opinions

enhanced Acceptance Range Threshold

$$\omega_{eART} = \left(\frac{\delta}{2\theta} e^{-\frac{|\delta-\theta|^2}{2\sigma}}, \left(1 - \frac{\delta}{2\theta}\right) e^{-\frac{|\delta-\theta|^2}{2\sigma}}, e^{-\frac{|\delta-\theta|^2}{2\sigma}} \right)$$

Generating opinions

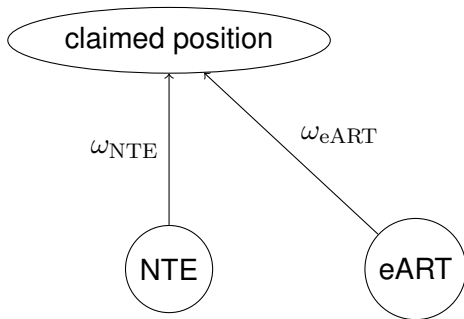
enhanced Acceptance Range Threshold

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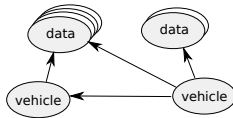
Neighbor Table Exchange

$$\omega_{NTE} = \left(\frac{\beta}{n} e^{-\frac{x}{10}}, \frac{n-\beta}{n} e^{-\frac{x}{10}}, e^{-\frac{x}{10}} \right)$$

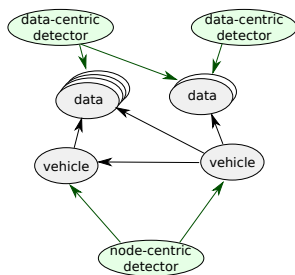
Framework based on subjective logic



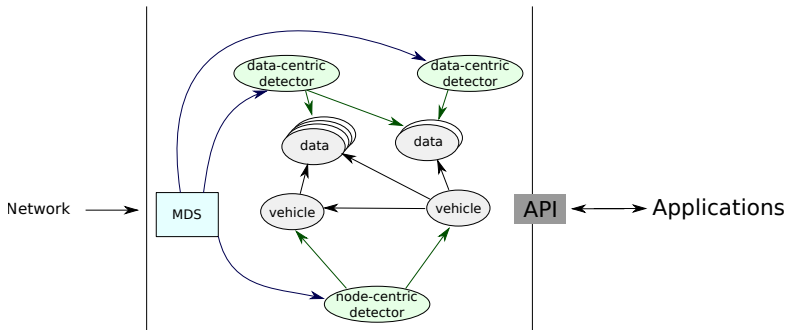
Maat: a new framework for misbehavior detection



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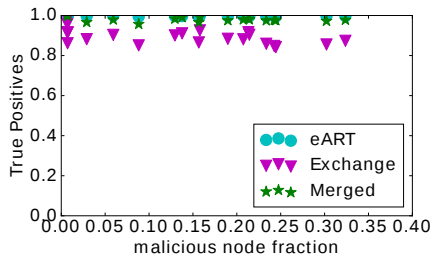
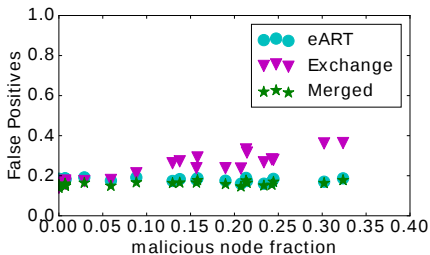
Maat: a new framework for misbehavior detection



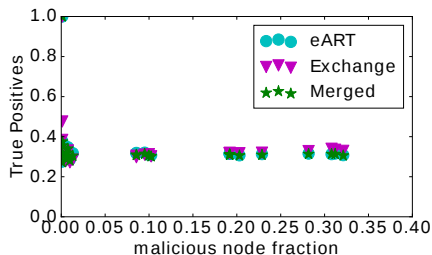
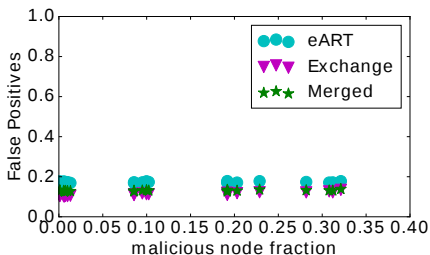
Evaluation: methods

- VEINS simulation
- LuST scenario
- Various attacker models
 - Randomized
 - Randomized Vector
 - Fixed Vector

Evaluation: randomized attacker



Evaluation: randomized vector attacker



Conclusion

Contributions:

- show subjective fusion improves results
- opinion conversion
- Improvement of ART
- Stronger attacker model

Conclusion

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- show subjective fusion improves results
- opinion conversion
- Improvement of ART
- Stronger attacker model

Future work:

- Rigorous analysis of fusion approaches
- Scalability
- Detection of misbehaving sensors

Questions?

W: <http://namnatulco.eu>

E: rens.vanderheijden@uni-ulm.de

T: @namnatulco

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