

Sustainable Communication Networks

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## Wolves on ice?! Extreme LoRa Applications

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#### **Overview: Applications and Discussion**



Wolf protection fences in north of Germany www.intelligenter-herdenschutz.de



Mosquito Counting in Thailand www.ict-trop-med.net



LoRa in the Antarctic



## Protecting livestock from wolves





#### Wolves recognition









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## Wolf Repelling

- $\rightarrow$ Ultrasonic, sonic, light pulses, etc.
- $\rightarrow$ Needs to be random and surprising to prevent accommodation
- $\rightarrow$ Needs to be safe for livestock
- $\rightarrow$ Needs to work from distance (10-20 meters at least)











#### **Communication architecture**





#### Mosquito Counting in Thailand





## Mosquito Counting in Thailand



- Count mosquitos in the wild based on their wingbeat sound
- LoRa used for communication (large distances, no infrastructure)
- ✓ Machine learning model trained for recognition





#### Wireless Problems

Wireless signal is very sensitive to the environment, especially to obstacles and water.
 Experiment from Thailand, Feb. 2020





#### Reception success on a map



→Needs line of sight
→Foliage is an obstacle
→Elevated gateways will help (accessibility?)

Dinarte Vasconcelos, Myat Su Yin, Fabian Wetjen, Alexander Herbst, Tim Ziemer, Anna Förster, Thomas Barkowsky, Nuno Nunes, Peter Haddawy: <u>Counting mosquitoes in the wild:</u> <u>An internet of things approach</u>, Proceedings of the Conference on Information Technology for Social Good, 2021.





# Signal Strength over Distance

→As expected, signal strength goes down with distance, quite fast



#### LoRa Reception quality over distance





## LoRa on ice

→Various sensing campaigns for ice thickness in the Antarctic by the Alfred-Wegener-Institute (Germany).







#### LoRa on ice: communication architecture







## Experiment 1 in Bremerhaven (Germany)

#### $\rightarrow$ Boat with LoRa, gateway on the roof of the institute









## Experiment 1 in Bremerhaven (Germany)

→Boat speed approx. 33km/h→Different data rates





## Experiment 2 in the Antarctic

→Goal: measure the ice thickness over the complete summer on a fixed location, transmit the data to the base station at Neumeyer III.







## Experiment 2 in the Antarctic

#### $\rightarrow$ Unexpectedly, the ice broke very early and carried away our experiment..



Fig. 12. Drift of the measurement system. Blue: position data received by the gateway, red: only locally recorded position data



## Many thanks go to...

#### Jens Dede: the wolves project





#### Jan Rohde and AWI team: LoRa on ice



#### Excursion: LoRa and heat

→An interesting experiment performed by the group of Prof. Kay Römer at TU Graz: heat the nodes!



Cattani, M.; Boano, C.A.; Römer, K. An Experimental Evaluation of the Reliability of LoRa Long-Range Low-Power Wireless Communication. *J. Sens. Actuator Netw.* **2017**, *6*, 7.





Excursion: LoRa and heat



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