

Competition: Using Enhanced OF∂COIN to Monitor Multiple Concurrent Events under Adverse Conditions

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## What is it about?

Performance evaluation and comparison of IoT communication protocols in **harsh** RF environments

- Performance metrics
  - Reliability
  - Latency
  - Energy consumption
- Multiple concurrent events
  - One-to-one
  - One-to-many
  - Many-to-one

## Challenges

- Multiple (concurrent) events
- Adverse conditions (harsh RF environments)
- Large-scale deployment



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# Enhanced OF∂COIN

Derived from previous year's  $OF\partial COIN^1$ 

- Concurrent transmissions
  - ► Constructive interference
  - ► Capture effect
- Opportunistic multichannel hopping<sup>2</sup>

<sup>1</sup>X. Ma et al. "Using OFPCOIN under interference". In: Proceedings of the 2017 International Conference on Embedded Wireless Systems and Networks (EWSN '17), Dependability Competition. 2017.

<sup>2</sup>P. Zhang, O. Landsiedel, and O. Theel. "MOR: Multichannel opportunistic routing for wireless sensor networks". In: *Proceedings of the 2017 International Conference on Embedded Wireless Systems and Networks (EWSN '17)*. 2017, pp. 36–47.

## Implementation

# Contiki OS

- TelosB sky mote
- ▶ Flocklab<sup>3</sup> + Jamlab<sup>4</sup>
- ► D-Cube<sup>5</sup>

<sup>3</sup>R. Lim et al. "Flocklab: A testbed for distributed, synchronized tracing and profiling of wireless embedded systems". In: *Proceedings of the 12th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN '13)*. 2013, pp. 153–165.

<sup>4</sup>C. A. Boano et al. "Jamlab: Augmenting sensornet testbeds with realistic and controlled interference generation". In: *Proceedings of the 10th International Conference on Information Processing in Sensor Networks (IPSN* 2011). 2011.

<sup>5</sup>M. Schuß et al. "A Competition to Push the Dependability of Low-Power Wireless Protocols to the Edge". In: *Proceedings of the 2017 International Conference on Embedded Wireless Systems and Networks (EWSN '17)*. 2017, pp. 54–65.

### **Frame Structure**

► Identical part ← Constructive interference

- Different part  $\leftarrow$  Capture effect
- Decision making of re-transmissions

Octets:	4	1	1	2	1	3	1	1	2
	Preamble Sequence	Start of Frame Delimiter	Frame Length	Public Information	Identical Part Checksum	Private Information	Topology Information	Different Part Checksum	Footer/ CRC
	Identical Part					Different Part			

## Timeline

#### Example of a one-to-one scenario



## **Network Coordination**

#### One-to-one scenario



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## **Network Coordination**

## ▶ One-to-one scenario x2



## Results

## Performance in different scenarios

- ▶ Reliability: 88.89%
- ▶ Latency: 332.49 ms
- Energy consumption: 10579 J

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# **Any Questions?**

