EWSN 2017
Dependability Competition
Awards and Presentations

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EWSN dependability competition 2016 (Graz, Austria)
EWSN dependability competition 2017 (Uppsala, Sweden)
Competition: Motivation

- Increasing need for dependable networked embedded systems
- A large number of solutions were proposed by academia & industry in the last decade

→ Hard to know which of those perform(s) best in a given application scenario
→ Performance has rarely been benchmarked under the exact same settings
→ Focus has rarely been on end-to-end performance

"Let chaos reign"

Evaluation Scenario

- Sensor network monitoring discrete events
  - Sensing node in proximity of a light source detecting status changes (on/off)
  - Events are immediately reported to a sink node
Evaluation Scenario

- Sensor network monitoring discrete events
  - Sensing node in proximity of a light source detecting status changes (on/off)
  - Events are immediately reported to a sink node
  - Multi-hop wireless network
Evaluation Scenario

- Sensor network monitoring discrete events
  - Crowded RF spectrum
  - RF interference generated using JamLab in the 2.4 GHz band
Location

- Uppsala University campus in Polacksbacken
  - 3rd floor of Lägerhyddsvägen 2, Hus 1

Location quite challenging for low-power wireless communications
Location

- Uppsala University campus in Polacksbacken
  - Old military building, very thick walls (≈ 350-400 m² area)
Solutions have been evaluated according to three criteria:

1. Reliability of transmissions
   - Number of changes in the LED status that were missed (i.e., that were not correctly reported to the sink)

2. End-to-end latency
   - Time necessary to communicate a change in the LED status to the sink node
   - Measured with microseconds precision using GPS timestamps

3. Energy-efficiency
   - Power consumed by all nodes in the network (measured in hardware every 16 μs)

For each criterion, a separate ranking is derived
- The team with the best rankings across all three metrics wins!
Benchmarking Tool: D-Cube

- GitHub: [https://github.com/TuGraz-ITI/D-Cube](https://github.com/TuGraz-ITI/D-Cube)

This year’s prototype (EWSN’17)

Last year’s prototype (EWSN’16)
Benchmarking Tool: D-Cube

- **GitHub**: [https://github.com/TuGraz-ITI/D-Cube](https://github.com/TuGraz-ITI/D-Cube)

This year’s prototype (EWSN’17)

- Raspberry Pi3 with custom made add-on card
  - Latency profiling: GPS module with timestamping support
  - Energy profiling: simultaneous sampling ADC @62.5 kHz
  - Target platform: MTM-CM5000-MSP nodes (TelosB replicas - 10 kB RAM)

More info this afternoon at 15:10!
Execution

- 10 teams answered to the call for competitors
- Step 1: Remote preparation
- Step 2: on-site preparation day (Saturday)
- Step 3: on-site evaluation day (Sunday)
Generated Interference

- Two separate evaluations
  1. 45 minutes under varying interference patterns resembling Wi-Fi video streaming, file transfer, and malicious nodes
  2. 5 minutes "extreme" scenario with very high interference
Fun Times
Comparing Results Live!

- Every team knew how the other teams were performing and had to adjust / parametrize their solutions accordingly!
Comparing Results **Live**!

- Every team knew how the other teams were performing and had to adjust / parametrize their solutions accordingly!

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<th>Team 07</th>
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Size of the submitted *ihex* binary
And the winners are…

(announcing the top five teams)
Official Results – 1st Evaluation

- Top five solutions achieved > 95% reliability!
- Latency was often kept below 100 ms
- Very low energy consumption (0.01 - 0.03 J/s for each node)
Official Results – 1st Evaluation

- **4th place (ex-aequo):**
  
  **Team #03:** Using OFPCOIN under Interference

  Xiaoyuan Ma, Weisheng Tang, Wangji He, Fuping Zhang, and Jianming Wei
  (Shanghai Advanced Research Institute, China; Chinese Academy of Sciences, China)
Official Results – 1st Evaluation

- 4th place (ex-aequo):
  **Team #10**: Energy-Efficient Network Flooding with Channel-Hopping
  Philipp Sommer and Yvonne-Anne Pignolet
  (ABB Corporate Research, Switzerland)
Official Results – 1st Evaluation

- **3rd place:**
  Team #04: Towards Low-Power Wireless Networking that Survives Interference with Minimal Latency
  Beshr Al Nahas and Olaf Landsiedel
  (Chalmers University of Technology, Sweden)
Official Results – 1st Evaluation

2nd place:
Team #01: RedFixHop with Channel Hopping
Antonio Escobar, Javier Garcia, Francisco Cruz, Jirka Klaue, Angel Corona, Divya Tati
(Infineon Technologies AG, Germany; RWTH Aachen University, Germany; Kinexon GmbH, Germany; eesy-innovation GmbH, Germany; Airbus Group Innovations, Germany)
Official Results – 1st Evaluation

1st place:

Team #05: Robust Flooding using Back-to-Back Synchronous Transmissions with Channel-Hopping
Roman Lim, Reto Da Forno, Felix Sutton, and Lothar Thiele
(ETH Zurich, Switzerland)
Official Results – 2\textsuperscript{nd} Evaluation

**ENERGY**
- Team 05: 117.83 J
- Team 01: 231.86 J (+96.78%)
- Team 04: 228.36 J (+93.80%)

**LATENCY**
- Team 05: 106.2 ms
- Team 01: 149.1 ms (31.88%)
- Team 04: 163.9 ms (54.26%)

**RELIABILITY**
- Team 05: 62/62 (100.00%)
- Team 01: 62/62 (100.00%)
- Team 04: 54/62 (87.10%)
Official Results – 2\textsuperscript{nd} Evaluation

**Number of Results**
- Team 05: 62/62
- Team 01: 62/62
- Team 04: 54/62

**Reliability**
- Team 05: 100.00%
- Team 01: 100.00%
- Team 04: 87.19%

**Energy Consumption**
- Team 05: 117.83 J
- Team 01: 231.86 J (+96.78%)
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**Latency**
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**RELIABILITY**

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**ENERGY**

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**LATENCY**

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- **Team 01**: 149.1 ms (31.88%)
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Congratulations to the Winners!

- 1st place (Team #05)
  - Robust Flooding using Back-to-Back Synchronous Transmissions with Channel-Hopping
  - Roman Lim, Reto Da Forno, Felix Sutton, and Lothar Thiele
    (ETH Zurich, Switzerland)

- 2nd place (Team #01)
  - RedFixHop with Channel Hopping
  - Antonio Escobar, Javier Garcia, Francisco Cruz, Jirka Klaue, Angel Corona, Divya Tati
    (Infineon Technologies AG, Germany; RWTH Aachen University, Germany; Kinexon GmbH, Germany; eesy-innovation GmbH, Germany; Airbus Group Innovations, Germany)

- 3rd place (Team #04)
  - Towards Low-Power Wireless Networking that Survives Interference with Minimal Latency
  - Beshr Al Nahas and Olaf Landsiedel
    (Chalmers University of Technology, Sweden)

- Coming up next: presentations of the three best teams
Thanks to Everyone supporting the Competition

- Thiemo, Christian, Ambuj, Haris, Kasun, Joel, Georgios, TU Graz, …
- But especially one person:

- Coming up next: presentations of the three best teams