Instituto Politécnico de Castelo Branco
Escola Superior de Tecnologia

RTCM
Rede Temática de Comunicações Móveis

Performance Assessment of ESP8266 Wireless Mesh Networks

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Outline

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Introduction

- Collect and analyze data such as temperature and humidity of fruit crates or containers (e.g., cherry and peach) when stored or transported in refrigerated chambers
- The contribution of Wireless Mesh Networks in the context of the Internet of Things (IoT)
  - **A viable, low cost and highly scalable tool**
- Performance assessment of ESP8266 + painlessMesh on key indicators: **delivery ratio** and **one-way delivery delay**

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Wireless Mesh Networks (WMN)

- Originally developed for military applications but have gained considerable popularity
- Dynamically self-organized and self-configured
- WMN don’t form a hierarchy
- Remain functional even if one node fails

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Testbed

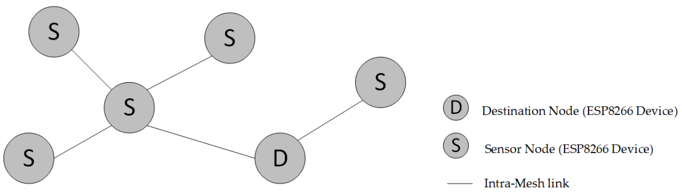

Figure 1. Example of a painlessMesh topology

Figure 2. ESP8266 device

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Testbed (2)

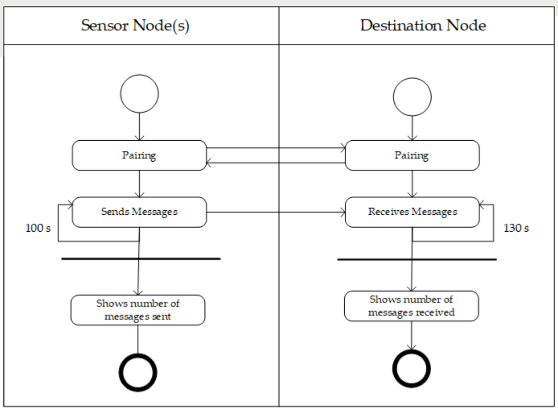

Figure 3. UML modelling of message exchange.

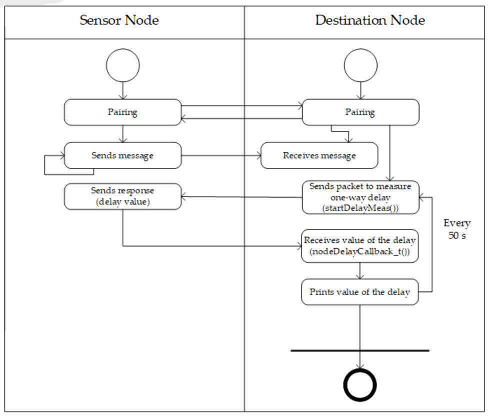

Figure 4. UML modeling for calculating one-way delivery delay.

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Performance Assessment

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Setup

(unicast transmission)

- **Delivery Ratio:**
  IwIP Variant
  1 Sensor and 1 Destination
  - MSS = 536 bytes
  - MSS = 1460 bytes

  Number of nodes variation
  - 1 Sensor and 1 Destination
  - 2 Sensors and 1 Destination
  - 3 Sensors and 1 Destination
  - 4 Sensors and 1 Destination
  - 5 Sensors and 1 Destination
- **One-way delivery delay**

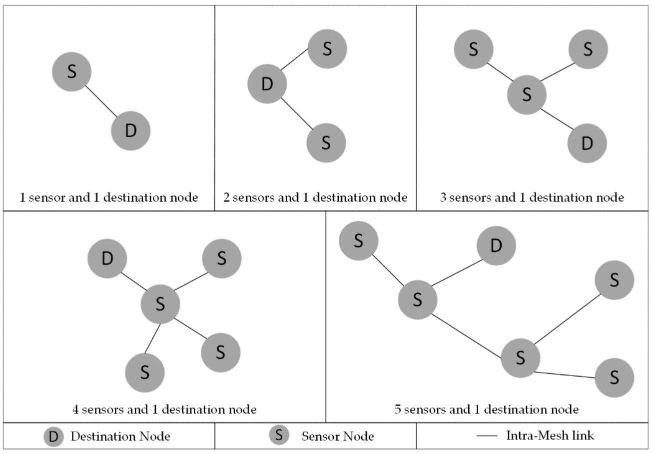

Figure 5. Number of nodes variation scenarios

- ➢ Different traffic loads
- ➢ Different message payload sizes

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Results and Discussion (lwIP Variant)

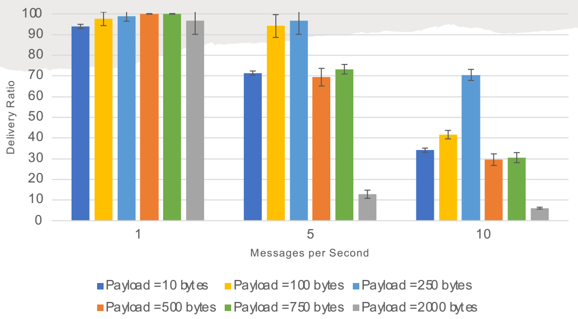

Figure 6. Delivery ratio of messages (1 sensor and 1 destination, MSS = 536 bytes) (%).

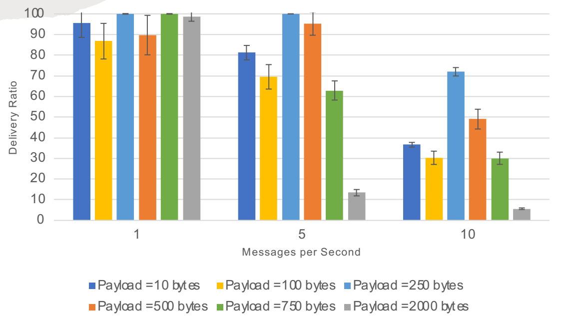

Figure 7. Delivery ratio of messages (1 sensor and 1 destination, MSS = 1460 bytes) (%).

- There was no statistical evidence that there were benefits to using the MSS = 1460 bytes configuration

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Results and Discussion (Number of nodes variation)

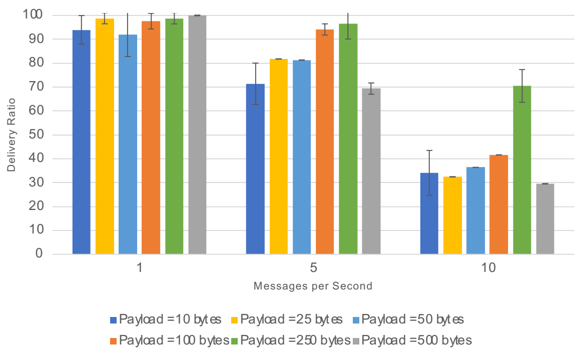

Figure 8. Delivery ratio of messages (1 sensor and 1 destination) (%).

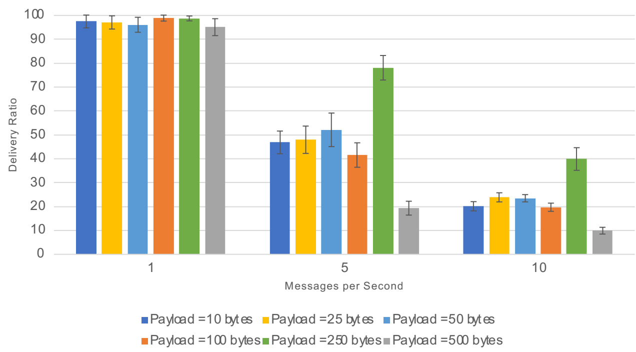

Figure 9. Delivery ratio of messages (2 sensors and 1 destination) (%).

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Results and Discussion (Number of nodes variation) (2)

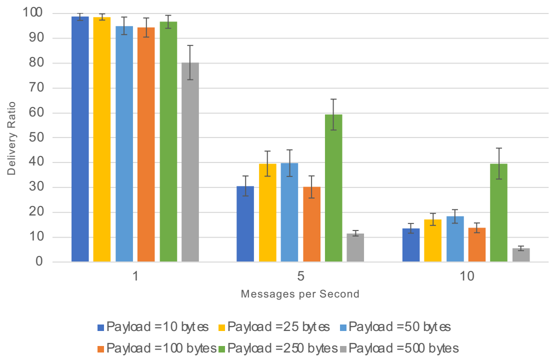

Figure 10. Delivery ratio of messages (3 sensors and 1 destination) (%).

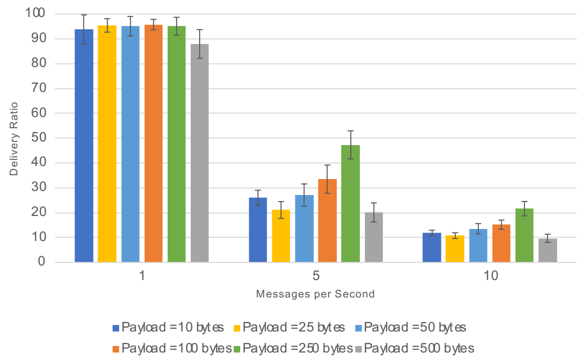

Figure 11. Delivery ratio of messages (4 sensors and 1 destination) (%).

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Results and Discussion (Number of nodes variation) (3)

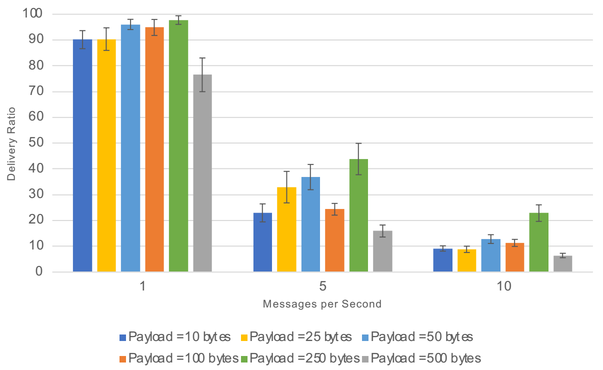

Figure 12. Delivery ratio of messages (5 sensors and 1 destination) (%).

- The number of messages sent per second has a clear impact on network performance.
- The scenarios with four and five sensor nodes did not lead to a drop in network efficiency as pronounced as the one recorded in scenarios with two and three sensor nodes.
- Regardless of the number of nodes in the network, 250-bytes was the payload that registered the highest delivery ratio.

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Results and Discussion (One-way delivery delay)

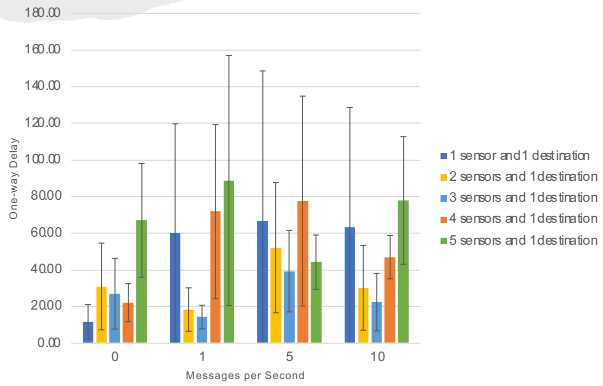

Figure 13. One-way delivery delay in the painlessMesh network as a function of the number of network nodes.

- Clear volatility in the network delivery delay, with a very high confidence error range
- There is evidence that the introduction of additional nodes leads to increased congestion in the network.
- Increasing the number of messages exchanged between nodes also leads to increased congestion.

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Conclusions and Future Work

- There is no statistically significant benefit in using messages with larger MSS sizes (1460 bytes).
- The performance results were affected with the increase in the number of sensor nodes, the message send rate and the message payload size, as expected.
- Regarding the delivery delay it was possible to conclude that there is a high volatility, perhaps justified by the network topology management performed by the painlessMesh library.
- A basis for future work on mechanisms, schemes and protocols to improve the performance of the painlessMesh.

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Thank you for your attention

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