

LinkBo: A Single-Wire, Low-Latency, and Robust Protocol for Variable-Distance Chip-to-Chip Communications

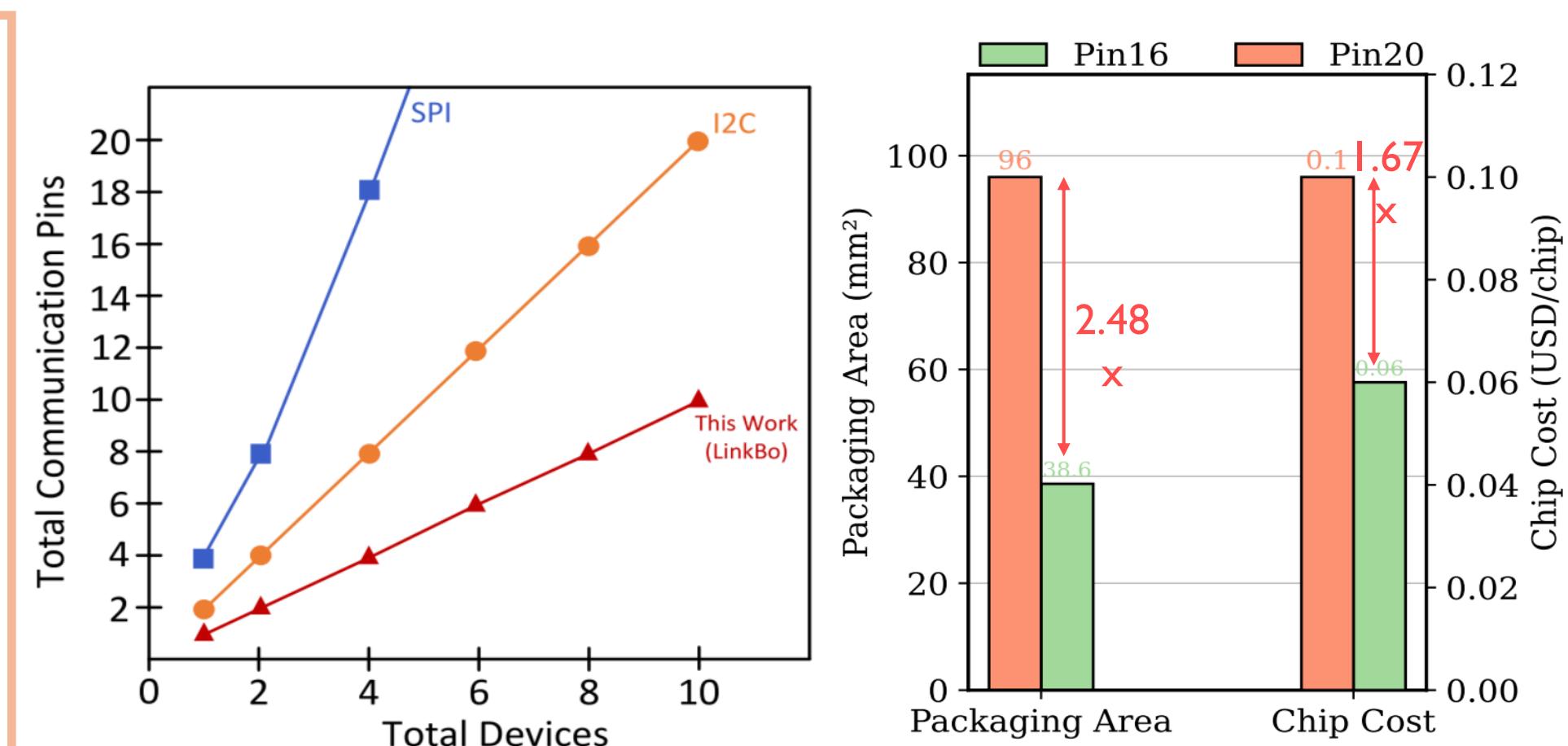
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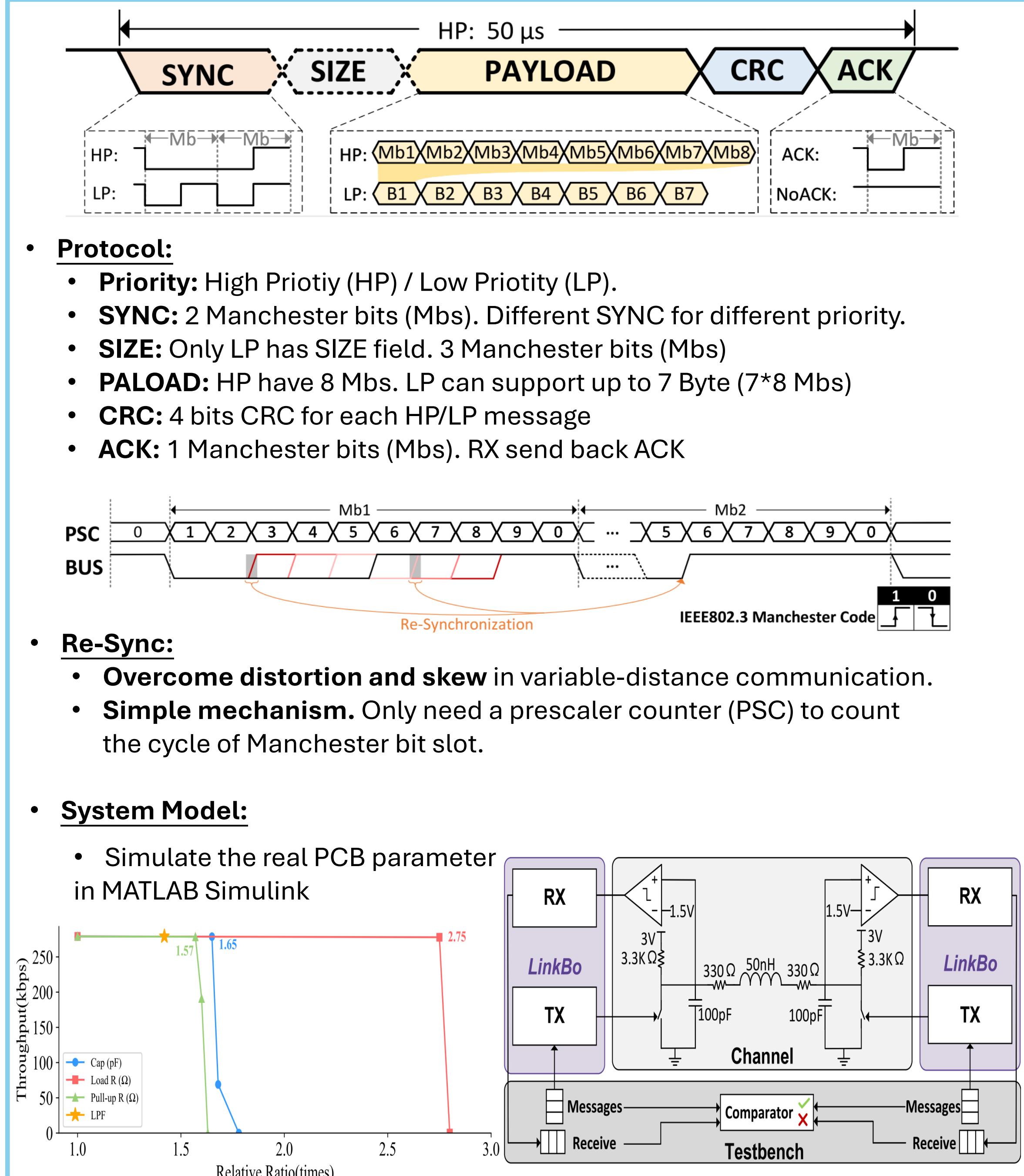
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Introduction

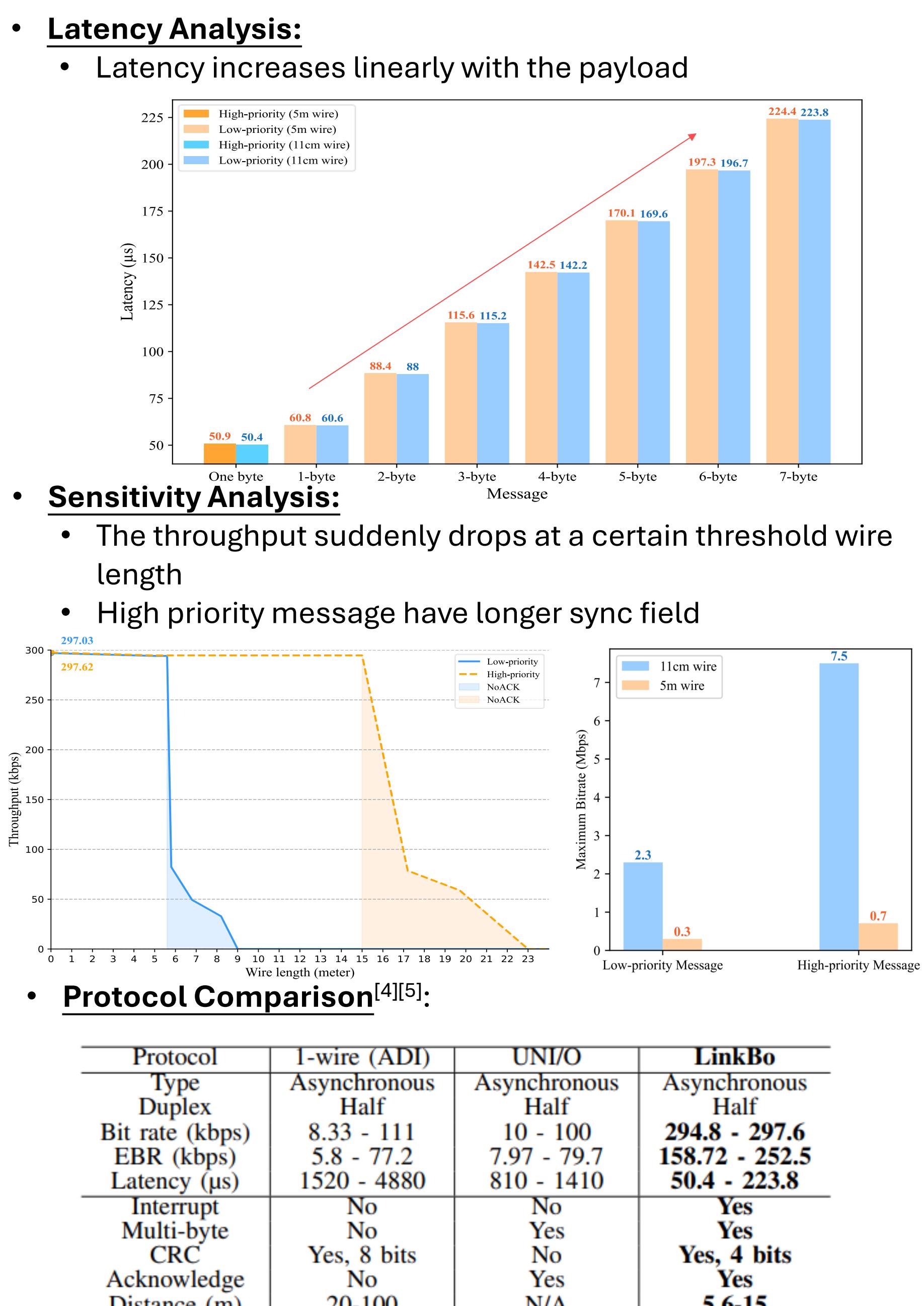
- Conventional protocols (SPI, I²C) need 2–4 wires^[1] → pin count scales with device number → 1.67x-2.48x package area & cost^{[2][3]}.
- Single-wire protocols save pins, but state-of-the-art (1-wire^[4]) suffers from:
 - Very low bit rate (16.3 kbps)
 - High latency
 - Weak robustness
- This Work (LinkBo):**
 - Novel single-wire protocol with **lower latency & higher throughput**
 - Robust hardware architecture**, supporting variable speed & distance and demonstrating on FPGA
 - Performance evaluation** under parasitics, wire lengths, and clock frequencies



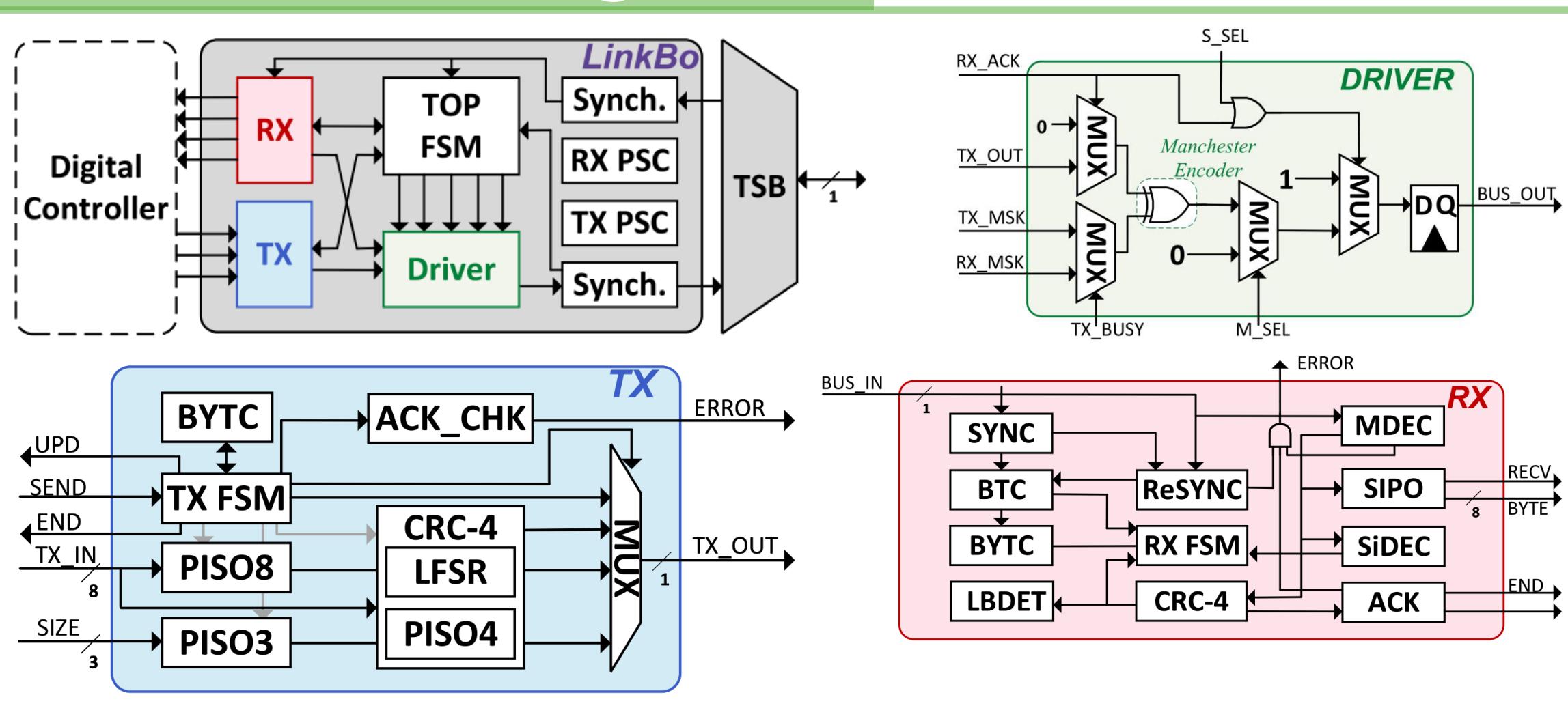
Protocol @ LinkBo



Experiment and Result



Hardware Architecture @ LinkBo



Conclusion and Future work

- Conclusion:**
 - LinkBo can minimize the number of communication pins to a **single pin**.
 - A low pin-count package can save the **2.48x** area and **1.67x** cost.
 - LinkBo protocol achieves a low latency of just **50.4 μs**, which is **20x** faster than ADI 1-wire, **6.3x** faster than UNI/O
 - Robust over **15 m** @ **300 kbps** and **11 cm** @ **7.5 Mbps** on **FPGA**
- Future Work:**
 - Extreme-Edge Applications
 - Single-wire protocol for **area & cost-efficient domain-specific chips**
 - Latency-Distance Trade-off
 - Push boundaries to **extend distance while lowering latency**
 - Multi-Device Support
 - Design **robust arbitration** for multi-drop / peer-to-peer networks

References:

- [1] F. Leens, "An introduction to i 2 c and spi protocols," IEEE Instrumentation & Measurement Magazine, vol. 12, no. 1, pp. 8–13, 2009.
- [2] N. S. B.V, "Sot109-1," 2016.
- [3] N. S. B.V, "Sot163-1," 2016.
- [4] A. D. Inc., "Overview of 1-wire technology and its use," 2008.
- [5] M. T. Inc., "Uni/o bus sepecification," 2009.