Achievement #1: Taking Advantage of Packet Collisions

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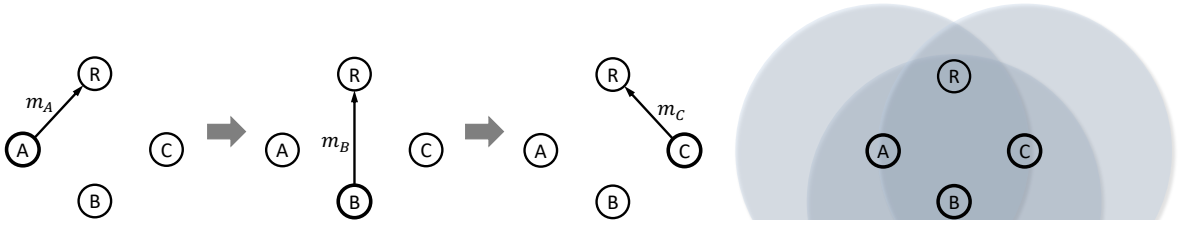
For decades, practical wireless protocols have been designed under the assumption that packet collisions are harmful. The protocols thus try to avoid packet collisions using complex mechanisms so that neighboring nodes transmit one after another over point-to-point links, as illustrated in Figure 1a. The ability to avoid packet collisions, however, relies on accurate and up-to-date knowledge of the network state. As the state of a wireless network can change fast and unpredictably, this approach has led to brittle or inefficient protocols.



(a) Conventional wireless protocols try to make nodes A, B, and C transmit one after another to avoid packet collisions at the receiver R.

(b) Synchronous transmissions embrace collisions by making nodes send at the same time.

Figure 1: Illustration of conventional transmissions versus synchronous transmissions (taken from [4]).

Our work on *synchronous transmissions*, illustrated in Figure 1b, has challenged this long-standing practice. We showed that by embracing packet collisions it is possible to design low-power wireless protocols whose logic is independent of the network state, thus achieving unprecedented reliability and efficiency even when nodes are exposed to high interference from other wireless technologies or moving at high speed [1, 2, 3, 5].

Academic Impact. The results of this work have been published at top networked embedded and wireless systems venues—ACM SenSys (2×), ACM/IEEE IPSN, ACM HotWireless—and won the **ACM SenSys Best Paper Award** and the **ACM/IEEE IPSN Best Paper Award**. Since its inception in 2016, all top three teams at the annual EWSN Dependability Competition have built on synchronous transmissions, and over a hundred communication protocols and network services have been proposed that adopt this concept [4].

Real-World Impact. Our work has also inspired several companies to build on synchronous transmissions, from global players such as ABB, Toshiba, and Airbus to start-ups such as Ackcio, RedNodeLabs, and Bernitz Electronics. Today, the concept is used in applications without high dependability requirements (e.g., smart light bulbs), yet industry observers believe it is a key enabler for future safety-critical cyber-physical systems.

References

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