

# SPI VS I2C VS UART

*Pick the bus by the job. UART for a simple stream, I2C when pins are short and speed does not matter, SPI when you need speed. A side-by-side comparison.*

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Pick the bus by the job. Reach for UART for a simple point-to-point stream, I2C when you are short on pins and speed does not matter, and SPI when you need speed and can spare a pin per device. Most boards run more than one of them at once.

## THE TRADE-OFF AT A GLANCE

BUS	WIRES	CLOCK	DEVICES	SPEED
UART	2 (TX, RX)	none (async)	2, point to point	low to moderate
I2C	2 (SDA, SCL)	shared	many, by address	moderate
SPI	3 plus 1 per device	shared	one per chip-select	high

Read the table as three trade-offs. UART costs the fewest ideas but only joins two devices. I2C adds as many devices as you like on the same two wires, at a lower speed. SPI buys the highest speed and full-duplex data, and pays a chip-select pin for every peripheral.

## WHICH BUS DOES A PART USE?

You rarely choose a sensor's bus; the part chooses for you. Its datasheet's first page states the interface, and that decides how you wire it and how many pins it costs. Read that line before you commit a design to a part.

- [SparkFun. Serial Communication \(a shared primer across UART, SPI, and I2C\).](#) [learn.sparkfun.com](https://learn.sparkfun.com)

THE THREE ON-BOARD BUSES SIDE BY SIDE: WIRES, SPEED, AND HOW MANY DEVICES EACH CARRIES.

A single One Thousand Drones board often carries all three at once: USB serial back to the host, SPI to a fast converter, and I2C to a slow housekeeping sensor, each chosen for what it connects to.

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**CHECKPOINT****1. You are out of pins and the sensor is slow. Which bus fits?**

- a. SPI
- b. I2C**
- c. UART

ANSWER · B

*I2C puts many devices on two wires at a modest speed, which is exactly the pin-starved, slow-sensor case.*

**2. You need the highest data rate to a fast ADC. Which bus fits?**

- a. SPI**
- b. I2C
- c. UART

ANSWER · A

*SPI is the fastest of the three and is full-duplex, at the cost of a chip-select pin per device.*

**3. Where do you find out which bus a given sensor uses?**

- a. By measuring the idle voltage
- b. By counting its pins
- c. On the first page of its datasheet**

ANSWER · C

*The interface is stated up front on the datasheet, so the part effectively picks the bus and you read it off the page.*

- See also: [SPI, the four-wire bus](#)
- See also: [I2C, the two-wire bus](#)
- Next: [USB basics](#)