**is 4 bit binary required, is it used in systems?**

Yes, 4-bit binary systems have been historically used and are still relevant in certain contexts.

**What is 4-bit binary?**

* A group of 4 bits is called a **nibble**.
* It can represent possible values: 0 to 15.
* Commonly used for encoding a single hexadecimal digit or a decimal digit in Binary-Coded Decimal (BCD).

**Uses of 4-bit binary in systems:**

* **Early microprocessors:**  
  The first commercial microprocessor, the **Intel 4004**, was a 4-bit CPU with a 12-bit address bus.
* **Embedded microcontrollers:**  
  4-bit microcontrollers have been used in simple devices like electronic calculators, coffee makers, microwave ovens, early electronic games, and remote controls.
* **Binary-Coded Decimal (BCD) representation:**  
  Each decimal digit is stored as a 4-bit binary number, useful for precise decimal arithmetic in calculators and financial computing.
* **Digital electronics:**  
  4-bit counters, adders, and other components are widely used in timing circuits, traffic signal controls, digital clocks, and motor control.
* **Modern AI and machine learning hardware:**  
  There is emerging use of 4-bit precision for efficient neural network quantization to reduce memory and speed up inference.

**Summary:**

* While broad-use 4-bit CPUs are mostly obsolete, **4-bit binary is still fundamental** in digital design and embedded applications where low complexity and small size are critical.
* It helps with decimal-to-binary mappings, small-scale arithmetic, and compact data representation in specialized hardware.

If you want, I can provide examples of 4-bit adders or how BCD works in 4 bits!

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