Microprocessors, Embedded Processors, Modern Sensing Systems

Digital electronics became common in underwater sensing systems about 1970. The technology was CMOS to achieve the low power that autonomous, battery powered operation required. Complimentary Metal-Oxide Semiconductors were an odd corner of digital circuitry then because they were slow. But they had no quiescent power and only drew charge from the power source when they made a transition. At that time, computers used TTL or DTL logic but drew current even when there were no transitions. RCA devised a line of logic circuits with designations like CD4000 and they sort of mimicked what was available in TTL up to about CD4050, but not exactly. The arrangement of the pins was slightly different. After about 4050 the CMOS engineers decided to make plug in replacements for the TTL equivalents. At that time, RCA made a CMOS microprocessor, the 1802, and since it was entirely CMOS, at low clock speeds, the power was very low. NASA chose it for space missions. Even when there were other more capable microprocessors available at low power a decade later, they continued to use the 1802 based on their long experience with it. So space probes out beyond Saturn are running code on the 1802 or COSMAC as it was called.

At 12 volts, CMOS is limited to about 5 MHz and at 5 volts, a more acceptable level since it is compatible with TTL, the limit is about 2 MHz. While this is not an impossible limit for a uP, (the 1802 was customarily run at 1.2288 MHz, a frequency that provided standard UART baud rates by binary division) it did cause problems for interfaces to sensors. Counters were unable to keep up with high frequency devices, even 1 MHz was too fast for ripple counters. The development of finer masks in the semiconductor industry reduced the capacitance of the gates in CMOS devices and for awhile, Fairchild, a late entry to the CMOS industry, had faster CMOS, typically 5 MHz at 5 volts. But Fairchild ceased production and Harris bought RCA's CMOS product line. And finally, high speed CMOS, a CMOS version of the TTL line replaced most enhancements of CMOS but with the TTL standard pin out. This series, 74HC00 and up is typically 12 MHz at 5 volts.