The 20th century has been distinguished by the silicon-based information revolution, where bits are encoded as charges which are manipulated and stored via field effect transistors. The continued exponential growth of information technology based on straightforward extrapolations of this paradigm is not guaranteed, and there has therefore been a search for alternatives. The most celebrated are based on “new” forms of carbon, including nanotubes and graphene, although the underlying paradigm of charge manipulation remains unchanged. Another and more radical possibility is to exploit the quantum properties of spin and orbit rather than charge. While “exotic” materials have been successfully used to demonstrate some of the associated physics, silicon turns out to be an excellent host for the new effects. We describe here the underpinning science and the implications for future technologies.

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