One of the first tasks to be performed in the design of ICs for fiber-optic receivers is choosing an appropriate IC technology. Primary factors to consider are speed, performance, reliability, and cost. The ultimate choice will depend on the specific application and the anticipated volume of production. For high-volume data communication applications, such as LANs (Local Area Networks) the best choice will likely be bulk CMOS, because of its low cost and adequate performance in a high SNR environment. Conversely, in low SNR applications, such as telecommunications, or in high-speed ATM (Asynchronous Transfer Mode) switching, where extra speed and performance justify a large increase in circuit costs, HEMT (High Electron Mobility Transistors) or HBTs might be used. Since HEMTs and HBTs are fabricated from III-V compounds, it is possible to integrate light sources and detectors on the same substrate with the circuitry; this can be advantageous for low-noise operation and can be used to control I/O impedance levels, thereby reducing interconnect problems.

Overview of Available IC Technologies

In the following section we will list some of the available IC technologies and discuss their advantages and disadvantages for use in high-speed serial communication links.

BJT  Silicon bipolar junction transistors are versatile devices; they offer high-speed, high reliability, and relatively low cost. They could be used in both telecommunications and data communication applications at data rates from 1–10 Gb/s [1].

CMOS  CMOS is well known for its low cost, high reliability, and high packing density. The speed is almost as good as BJTs; as gate lengths shrink, the speed will continue to increase. CMOS is ideal for datacom applications such as FDDI.
and ATM receivers. CMOS has been used for gigabit-per-second data links [2], and is currently applicable to data rates up to 2.5 Gb/s, with this number increasing as the minimum gate length drops.

**BiCMOS** It is often advantageous to combine the speed and high transconductance of BJTs, with the high input impedance and high packing density of CMOS [3]. BiCMOS has been utilized in a 6-GHz, 60-mW PLL, which could be used in a complete fiber-optic receiver [4, 5]. BiCMOS is more expensive than either CMOS or BJT, but is also more versatile; applications include both telecom and datacom systems operating at data rates of 1–10 Gb/s.

**SOI CMOS** Silicon-on-Insulator (SOI) is an emerging technology with a long history [6]. In the early eighties CMOS SOS (Silicon-on-Sapphire) was used for radiation-hardened military applications, but was too expensive for the consumer market. Recently, high quality transistors have been fabricated using a thin-film of silicon on top of an insulating oxide layer. SOI has the advantages that parasitic capacitances to the substrate are drastically reduced, if not eliminated, cross-coupling is reduced substantially, and latch-up is no longer a consideration, allowing devices to be packed extremely close to one another. The devices are also easily scaled for deep-submicron ULSI applications. Past results have been impressive, producing ring-oscillator gate delays of 13 ps! Presently the technology is not widespread and is still expensive, (this is due primarily to wafer costs; the actual processing of SOI is simpler than bulk CMOS because of the elimination of wells, well contacts, and field implants) but increased volume of production is expected to drive the costs down and make this a common technology in the future. SOI could be used in both telecom and datacom and could operate at data rates as high as 20 Gb/s.

**GaAs FET** GaAs field-effect transistors have been used extensively in MMICs (Monolithic Microwave Integrated Circuits) and have proven reliability. GaAs FET processing is more expensive than silicon-based technologies, but the higher speed might be attractive for some telecom applications. GaAs FETs have been used in multi-gigabit-per-second systems [7] and are applicable for data rates in the range of 1–20 Gb/s.

**HEMT** High Electron Mobility Transistors (HEMTs) have been used in millimeter-wave, low-noise applications, and could be used in high-speed fiber-optic receivers [8]. One disadvantage is the high-cost, but this could be offset by the fact that light sources and detectors can be integrated together on the same substrate. As long as one must use III–V compounds for electro-optic devices, it might actually be more economical to integrate, at least, some of the receiver circuitry, such as low-noise amplifiers, with the electro-optics, thereby reducing noise and allowing for controlled impedance interconnections. HEMTs would typically find application in systems operating at 10–20 Gb/s and beyond.