# Connecting in the Future

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Some interesting developments within the microwave electronic industry over the past decade include the convergence towards more standard interconnects, the resilience of existing technologies, and the comparatively smaller incremental improvements in these interconnects versus achievements in active components. In the early 90's, the need for microwave components was driven primarily by military applications. Since the quantities were small, often only a few hundred pieces, and cost pressures were minimal, a wide range of unique microwave connectors were developed.

In particular, this period saw the emergence of "push-on" miniature connectors, like the GPO, OSP, SMP that often incorporated unique features that prevented interconnection between different vendors. This worked for much of the 90's until the emergence of telecommunication systems with OC-192 and OC-768 electrical data paths. Although many of the systems at the higher data rates were little more than experiments, the volume generated by these applications quickly dwarfed the needs of military applications.

Like many industries, growth and maturity of this technology drove a consolidation period where the majority of vendors provided compatible solutions. At the same time, innovation revolved from providing improvements in electric and mechanical performance to focusing on cost reduction efforts.

Consequently, performance of these connection systems has remained basically the same over this entire period. For the most part, the performance of a 40 GHz connector manufactured in 1993 is basically the same as one made today, and the price point has dropped approximately 75% over that period. On the circuit board side of the connector, FR4 has managed to outlive numerous predictions of its demise.

In the early 90's, it was predicted that FR4 would need to be replaced with lower loss materials when speeds reached a GHz or more. The rationale was that dissipation losses in the material would prevent effective signal transmission over any reasonable distance. Today, FR4 is still very much alive and remains a robust

material for transmission through 10 GHz. Certainly, active equalization or other forms of signal conditioning within chipsets has extended the distance and frequency of this material. Also playing a major role is the infrastructure available to process this material set.

The gradual evolution of board materials and interconnects stands in marked contrast to the advancements in active components. Entirely new material sets, such as SiGe, InP, as well as device developments like HBTs, are now commercially available. These new technologies have reduced the cost of signal processing and transmission by several orders of magnitude, while their passive counterparts have made much slower progress in cost and performance.

Looking forward, the slow progress in the passive area enables a commodity purchasing mentality on the part of the OEMs. At the same time, this fosters a shift to the lowest cost manufacturing area — something that has already occurred in much of the RF connector industry. To move passive interconnects off of this trend will require new material developments coupled with more integrated solutions that bring enhanced value to the customer.

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