THE GENESIS AND DEVELOPMENT OF MMICS-A PERSONAL VIEW

(Invited paper)

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INTRODUCTION AND SUMMARY

MMICs have their roots at least 36 years into the past and have been commercially available for more than 30 years. Genuine foundry services stretch back to 1985. Since then there has been a maturing in the basic MESFET technologies (capability, reliability, yield etc.) and an expansion in the range of available technologies, e.g. PHEMT and HBT have been added to many companies portfolios. Foundry services are important in that they offer a route to "fab-less" organisations to procure MMICs. This, however, can have an inhibiting effect on the circuit designers flexibility. Commercial foundry operation demands that the risks be low and many designers feel that they cannot take chances with novel circuit concepts. There are, of course, as with many generalisations some honourable exceptions to this statement. A route through this conflict must be found if further progress is to be made.

A BRIEF HISTORY OF MMICS

MMICs can trace their ancestry back to 1963 when the arsenic trichloride vapour epitaxy process was invented. This was the first successful method of growing device quality thin films of GaAs. As a consequence MESFET work started shortly afterwards in the mid 1960s with the first commercially available discrete device being launched in 1970. The world's first MMIC was demonstrated in 1976 with the first commercial MMICs, relatively simple devices, in the early 1980s. True foundry operation followed in 1985. After a rush of new start-ups and many failures, MMIC sales have since then enjoyed a healthy compound annual growth rate and there is now a multi-100M $ world wide business. New technologies, such as the PHEMT and HBT have joined their MESFET cousin and contributed to this growth. Advances in Si technology, however, are now eating into the lower frequency (1-3 GHz) GaAs preserves and it is interesting that many of the newer applications for volume GaAs are now > 20GHz. The long term future for GaAs is secure.

CIRCUIT COMPLEXITY.

The very first MMICs were simple, single function, devices and many of todays MMICs remain of this nature. Economics, however, (cost/sq.mm.) have caused many price sensitive and competitive applications to push for more complex, multifunction, circuits and these are now rapidly growing in importance. However, the vast majority of MMICs still employ an essentially microstrip style of design rule, albeit with the GaAs medium allowing significant miniaturisation. This is **NOT** the way forward.

Designers have available to them a high yield, flexible medium that is capable of much more and ways must be found to allow them to explore and exploit the potential locked away. This will result in smaller, more complex circuits and will cause a demand driven feedback into the technology. For example, designers will start pushing for more layers of metal in the process to allow true 3-D designs to be carried out. As well as stretching the technology this will continue to demand more from the CAD. MMICs in the new millennium should not, and must not, look like direct descendants of those available today.