Strategy Analytics Insight
Current Status & Future Prospects for GaAs

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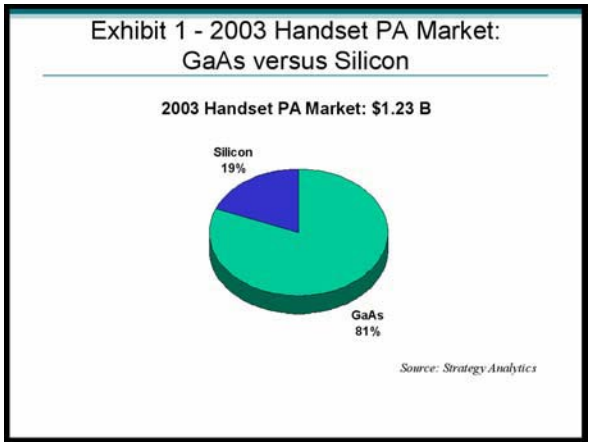
***Snapshot* — Whilst silicon technologies will continue to impinge on GaAs markets, GaAs technology will continue to play a pivotal role in the cellular handset market, increasing its penetration of PA applications and retaining a near 100 percent penetration of the switch IC segment. WLAN and millimetre-wave auto RADAR applications will provide emerging growth opportunities for the GaAs industry. Overcapacity remains a problem in the GaAs device industry and the market will see continuing consolidation.**

I. Current Status

The mobile phone consumer segment remains the main driving force for the consumption and development of RFIC GaAs-based products. Popularity of enhanced functions such as built-in cameras has at the same time as boosting shipments placed tougher demands on chip makers. The move towards third generation handsets challenges power amplifiers to provide better characteristics such as PAE and linearity. This has played to the advantages offered by GaAs-based devices and in 2003, Strategy Analytics calculates that GaAs technology represented 81 percent of the cellular power amplifier market. Silicon LDMOS power amplifiers from Renesas Technology represented the only significant challenge to the dominance of GaAs technology in the cellular power amplifier market (Exhibit 1).



Switching constitutes the second highest demand for GaAs in handsets. Whilst there are other options available for the switch in cellular handsets, GaAs pHEMT technology provides the best compromise in terms of performance and cost. Stand-alone multi-port transmit / receive switches will continue to garner a small share of the market in competition with silicon-based switchplexers, particularly in multiple band and multiple mode handsets. Strategy Analytics expects that PA modules will increasingly incorporate the switching function, using GaAs p-HEMT technology.

A key trend in the past year has included further progression away from discretes and MMICs to modular products. RF modules incorporating active semiconductors and passives (inducters etc.), are now the principal commercial product for the majority of the industry leaders. These incorporate more and more functionality in ever smaller dimension modules.

Packaging technology is now playing as important a role as the semiconductors themselves. Success in the marketplace is contingent on having not only the high performance HEMT and HBT amplifier devices but also the requisite mass production laminate substrate technology. A further conspicuous industry development has been the switch to lead-free packaging to comply with environmental regulations. Overall, it has become even more expensive to participate in the RF product business.

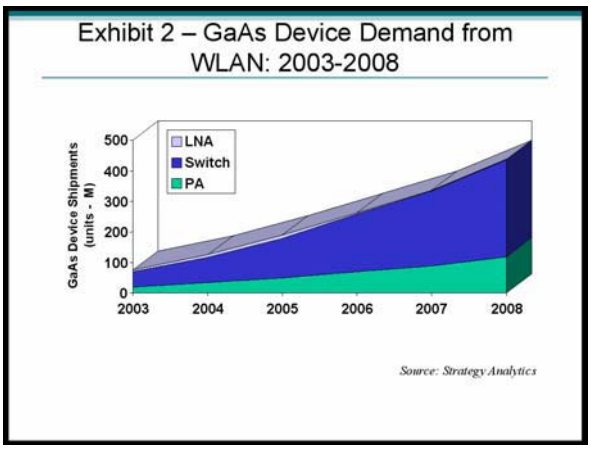
On the back of the mobile phone sector, the first real signs of an industry wide revival started to be seen by the final quarter of 2003. Despite a tough marketplace, company financials confirmed that business was looking much better. Merchant RFIC players were making one announcement after another of new contract awards with existing and new customers. In particular, RFMD announced record revenues and its main merchant market competitor; Skyworks was also reporting stronger financials thanks to sales of modules and sub-assemblies into the cellular market.

II. Future Prospects

The 802.11 WLAN market represents an emerging market for GaAs devices. Switches and power amplifiers will represent the main opportunities for GaAs devices. There will also be a marginal market for standalone LNAs, but this will decline rapidly as the LNA function becomes integrated into the transceiver. GaAs power

amplifiers will enjoy a larger market in 802.11 than SiGe. SiGe, preferred for 802.11b, has to contend with the maturity of 802.11b in the market, and the growing popularity of 802.11g. The increasing demands on power and linearity (OFDM modulation) from 802.11g devices will represent a growing market for GaAs devices. GaAs will also be preferred for 5GHz (802.11a) and 802.11a/g dual-band operation.

GaAs devices will represent 100% of the WLAN switch market. Strategy Analytics assumes that dual-band systems will in many cases incorporate two switches per system to handle the 5GHz and 2.4GHz transmit/receive chains (Exhibit 2).



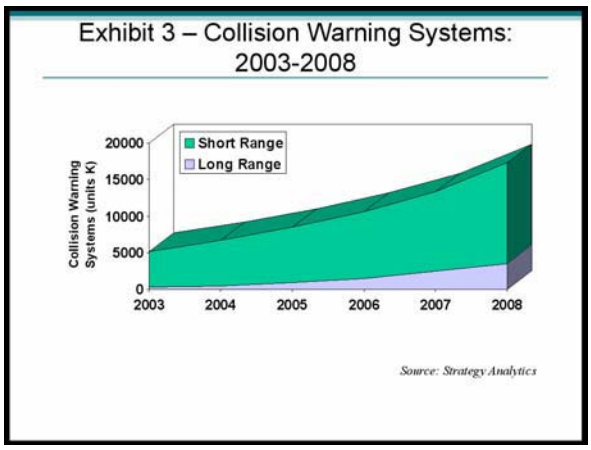
Early leaders in the GaAs device market for WLAN applications include Microsemi, ANADIGICS and Raytheon (now Fairchild RF). Skyworks has also entered the market with front-end modules incorporating HBT PAs in conjunction with pHEMT switches. Some of the parts also include filters derived out of LTCC components.

Millimetre-wave applications are exclusively GaAs-focused, but the market for GaAs devices in millimetre-wave applications has not traditionally resulted in high volume. Strategy Analytics forecasts that the automotive sector will propel GaAs device demand from millimetre-wave applications as a result of long and short-range warning systems becoming increasingly common on passenger vehicles (Exhibit 3).

Ultrasonics, camera and RADAR technologies will be used extensively, but only RADAR systems will find applications in both short and long-range applications. Major vehicle manufacturers looking to use auto RADAR on their vehicles include Daimler Chrysler, Ford, General Motors and Toyota.

Two main technologies have been used to date for long-range distance warning systems on passenger vehicles:

- Systems based on laser technology – Lidar
- Systems based on millimeter-radar sensing – auto RADAR



Laser-based systems are cheaper than auto RADAR and found early adoption in the Japanese market. However, laser-based systems are unable to operate effectively in adverse driving conditions (heavy fog, rain, snow etc).

Auto RADAR systems are based around millimetre-wave frequencies of 76-77GHz and have the ability to operate in weather conditions that prove difficult for laser-based systems.

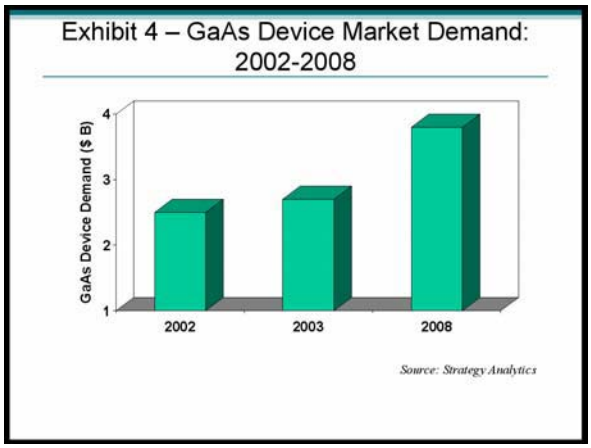
Short-range systems can potentially cover a variety of applications including parking, pre-crash/side crash sensing, back-up aid, blind-spot detection and "stop & go" tasks. Ultrasonics, camera and auto RADAR technologies will all be utilised in short-range sensing systems. Early use of auto RADAR has been on systems based around 17GHz applied for "back-up aid" systems. The use of auto RADAR in parking aid systems is also in evidence, particularly in luxury vehicles.

Strategy Analytics expects that long-range systems based on 76-77GHz RADAR will be based exclusively on GaAs technology. Current systems use either MMICs (UMS, Mitsubishi Electric) or discretes (E2V Technologies). Short-range systems based on auto RADAR will also initially use GaAs technology. However Strategy Analytics expects hybrid systems based on a mix of SiGe and GaAs being implemented in the future.

GaAs will always be a "technology enabler" and whilst this paper has concentrated on three applications, discussing the main market for GaAs devices as well as two potential sectors that will provide growth for the industry in the future, other key applications that will drive demand for GaAs devices include fibre-optic systems, DBS and cable applications as well as Satcomms, point-to-point and point-to-multi point systems and the traditional demand from the military sector (Exhibit 4).

Despite the momentum that the cellular handset market is generating in 2004, and the growth from other applications, overcapacity remains a problem in the GaAs

device industry and the market will see continuing consolidation. Possibly the most high profile announcements followed Freescale Semiconductor and Eudyna Devices. Freescale Semiconductor is the new name for Motorola SPS, whilst Eudyna Devices is the combination of the GaAs assets of Sumitomo Electric Industries' electronic devices division and Fujitsu Quantum Devices.



III. Conclusions

Strategy Analytics forecasts that the cellular market will continue to be the primary driver for the GaAs device market. RF modules incorporating active semiconductors and passives (inducters etc.), are now the principal commercial product for the majority of the industry leaders. Packaging technology is now playing as important a role as the semiconductors themselves. Emerging applications for the GaAs device market include WLAN and automotive RADAR. Overcapacity remains a problem in the GaAs device industry and the market will see continuing consolidation.

The accompanying presentation to this paper is available by contacting the authors directly.

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