The growing smartphone market, expected to reach almost $2.1 billion smartphones annually by 2022, represents a great opportunity for suppliers of different smartphone components and technology solutions.

Thermal management of handheld devices, such as smartphones, is becoming increasingly challenging. As detailed in the report, the main reasons for this are the growing number of smartphone functionalities and raised customer requirements for processing speed, leading to increased heat dissipation. Additional components needed to ensure new smartphone functions desired by customers, including wireless charging, high-resolution cameras, 3D gaming, security, authentication, and high-speed streaming, also result in denser component integration, making thermal management even more difficult.

Actually, smartphones contain several components that generate heat, and components whose performance and lifetime is negatively impacted by heat. Excessive heating of some components, such as lithium ion batteries, has to be avoided for safety reasons. The processor is the hottest component in a smartphone. Amongst other heat-generating components in a smartphone are image sensors, light sources and the battery.

Suitable thermal management solutions are now sought to avoid hot spots in smartphone and keep the component temperature at acceptable levels. The enclosure temperature, or skin temperature, must be also kept relatively low to avoid users feeling uncomfortable when using the smartphone.

Smartphones pose a significant challenge to the implementation of traditional cooling schemes, such as heat sinks and fans, due to form factor limitations and the specific way the device is used by customers. As detailed in the report, there are different approaches for thermal management, based both on hardware and software solutions. Software thermal management (STM) has several advantages. It enables additional
design flexibility and an optimal reaction to a given thermal event and can be improved by a software update in existing products. Contrary to hardware solutions, such as heat pipes, STM does not take additional space in smartphones.

The optimal way to deal with heat in smartphones would be to reduce heat generation, by using higher performance chips. Significant improvements have been made in chip manufacturing, with the 10 nm node introduced in 2016, and chip architectures, including multiple core architectures, with “high-power” and “low-power” cores, associated with appropriate software control. However, in the future, processor improvements might be not fast enough to follow rapidly elevating customer requirements for smartphone functionality and performance.

So other thermal management solutions will increasingly be needed. As shown in the report, similar trends were observed in the past, when thermal transfer sheet performance was not sufficient to dissipate heat from poorly thermally designed processors, leading to heat pipes being introduced into the first smartphones from NEC and Sony. Today, the Samsung Galaxy S8, LG G5, Google Pixel 2 XL are just a few examples of smartphones relying on heat pipes to improve their thermal management.

Alternatively, vapor chambers might perform better than heat pipes in the near future. Ultrathin vapor chambers are already under development by several players, such as Furukawa Electric, TaiSol, AVC and Delta, but still face difficult technology challenges.

Until recently, the thermal management in smartphones was only of minor interest to smartphone component and device designers. Beside some “dedicated” thermal management components like heat pipes and thermal transfer sheets, most smartphone components have been designed and built without thermal performance in mind.

According to Yole Développement’s analysis, this will greatly change in the future. A fierce battle for each mm³ of volume available in smartphones to implement components enabling new functionality and for larger batteries will lead to efforts to enhance thermal characteristics of existing smartphone components, instead of adding dedicated bulky thermal components.

Future efforts will be focused mainly at the packaging level, in chip packaging and Printed Circuit Boards (PCBs). These two solutions will account for more than ¼ of the $3.6 billion market for thermal components solutions by 2022. Fan-out packaging solutions and high-density thermally-enhanced PCBs will especially attract interest. Amongst other, leading PCB suppliers such as Mektec, Samsung Electro-Mechanics, AT&S and Unimicron, and leading packaging suppliers such as Amkor Technology, ASE, TSMC and STATS ChipPAC will take part in this spectacular thermal transition in smartphones. The integration of several functions into one component is another promising approach for future smartphones.

Despite cost barriers in the cost-sensitive smartphone industry environment, the huge quantities of thermal management components needed result in attractive market value. Moreover, new technology solutions add more product-differentiating value compared to their competitors and open market opportunities in other applications areas, such as medical, gaming, pico-projectors, virtual reality and drones.
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