InstantFocus Technology

MediaTek White Paper

May 2015

Introducing MediaTek's InstantFocus

In camera daily use, users ask for a fast and continuous autofocus experience in camera and video mode, and expect no missed object when captured or recorded. The MediaTek InstantFocus technology is designed to retrieve the depth information of camera system and fast lock focus lens position on subject.

InstantFocus technology encompasses a depth detection system, an image signal processing system, hybrid focus control system and depth analysis research. Depth detection system provides object depth information, such as a camera sensor with phase detection pixels, multi-camera system or laser system. Image signal processing systems, ISP, capabilities include image quality enhancement, such as noise reduction, color, sharpness enhancement under different lighting conditions. Hybrid focus control system plays a role as subjects' distant decider.

The MediaTek Phase Detection Automatic Focus (PDAF) technology has two design architecture possibilities, as shown in Figure 1. MediaTek ICs can support a variety of camera sensors with phase detection pixels.

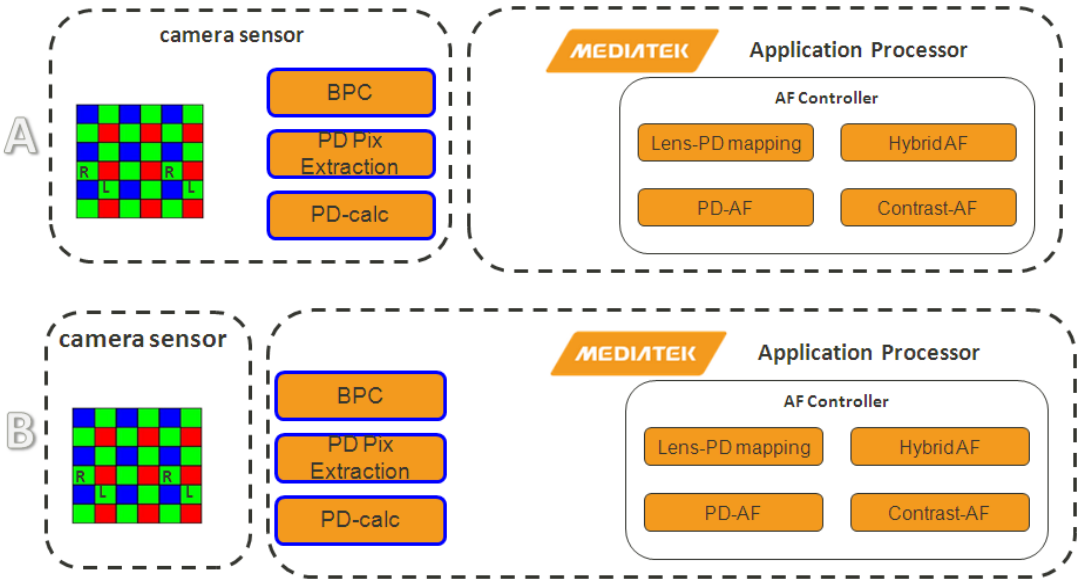

Figure 1. MediaTek's A and B Architecture Design Possibilities

With type B, there's no need to add an extra sensor processing for phase detection, thereby both reducing overall cost and power consumption, as shown in Figure 2 below. The outstanding MediaTek ISP performance with BPC/NR technology maintains image quality. Flexible MediaTek IC architecture for variable PD solutions and highly integrated hybrid-AF algorithms can support more PD sensors or other depth information combinations.

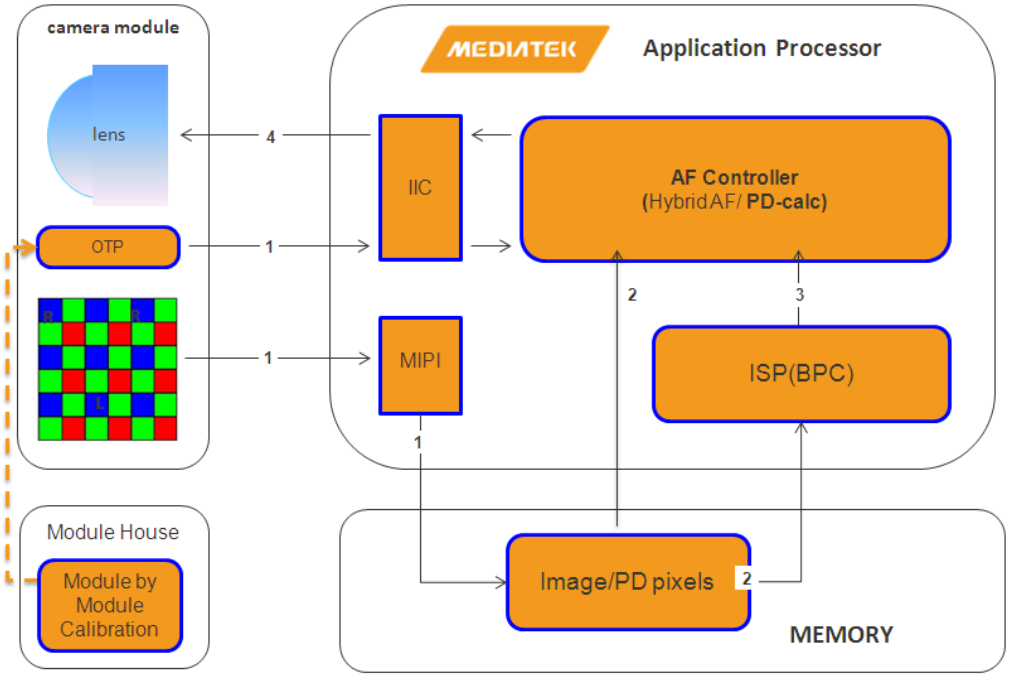

Figure 2. Cost Effective PDAF System

The images below demonstrate these features.

Always Clear Tracking Focus

Figure 3. Instant Focus and Tracking Focus Effect

MediaTek's Algorithms

Mediatek has developed the InstantFocus technology based on the foundation of native ISP architecture and depth information with PDAF computation on the ICs. Our cost effective native PDAF technology offers both high quality and mass production efficiencies. The main challenges of instant autofocus are image quality enhancement, phase detection computation, and the hybrid autofocus system.

Image quality enhancement

Since image signals on PD pixels are different from normal image pixels in the neighborhood, PD pixels are compensated by Mediatek advanced ISP to restore images without resolution degradation in real time.

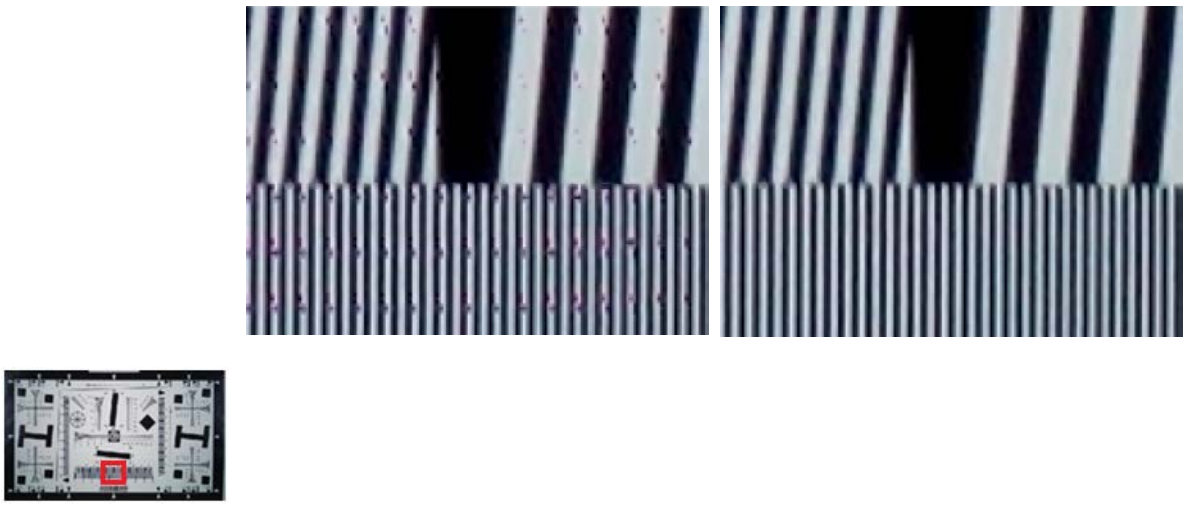

Figure 4. PD Pixels Compensation Result with Mediatek Advanced ISP

Phase Detection Computation

Phase difference comes from special pixels, referred to as "PD pixel" in the image sensor that can receive light from a certain sides of the lens. These two signals are shifted with respect to each other if the scene is out of focus, and we can calculate in-focus lens position from the shift amount.

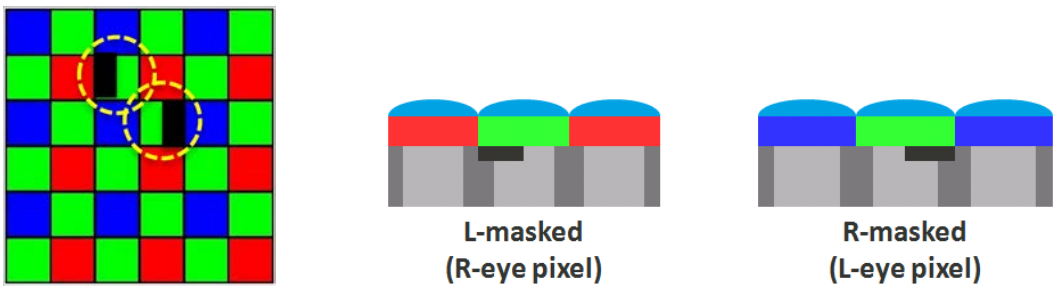

Figure 5. PD Pixel Structure inside Image Sensor

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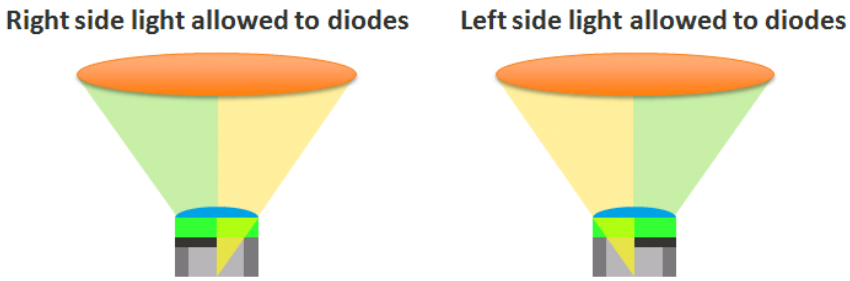

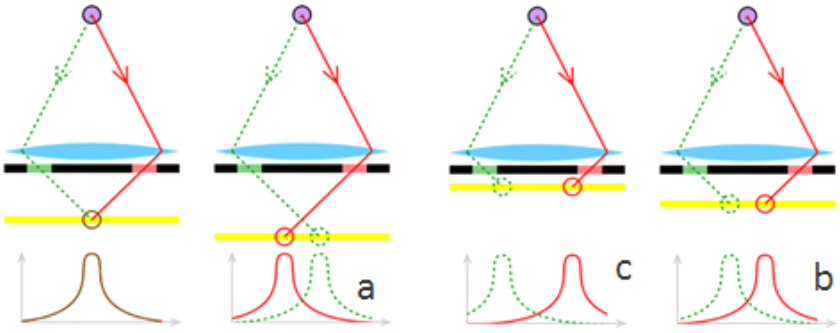

Figure 6. Phase Difference from Two Signals

Hybrid Autofocus System

The Hybrid Autofocus system combines depth information from PD with contrast autofocus (AF). The confidence of PDAF accuracy depends on the SNR and dynamic range of these two signals. In a normal scene with higher confidence depth information, the hybrid focus system will have 1-step focus performance. If a scene is detected as low confidence with PDAF, more AF steps are used to fine search in-focus lens position to achieve a better user experience.

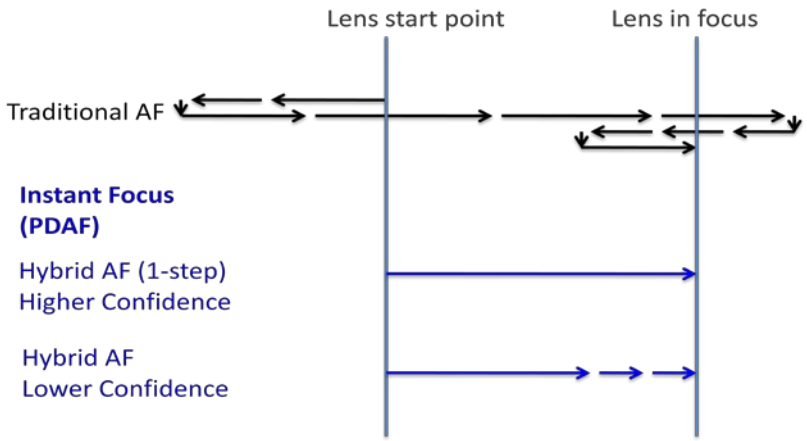

Figure 7. Search Strategy of Hybrid AF

New Technology and Leadership in Focus Technology

MediaTek's InstantFocus technology has set several world-leading records:

- The first native support for PD Sensors without stack processor
- The first multiple depth source support for focus, such as pure PD sensor, stack PD sensors, Laser or stereo cameras.
- Performance is much faster than traditional AF and close to that of the leading phone, the iPhone6.

Compared with other solutions and leading phones, shown in Figure 8 and Figure 9 below, MediaTek's InstantFocus technology provides excellent focus speed enhancement with extensive scene coverage.

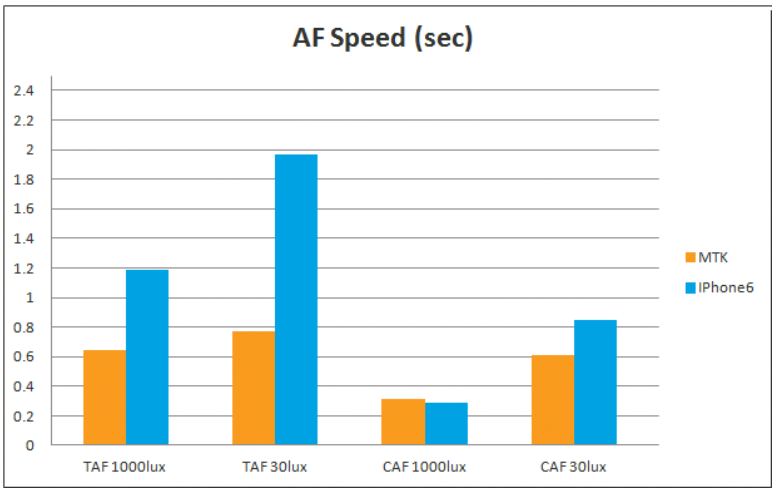

Figure 8. Autofocus Speed

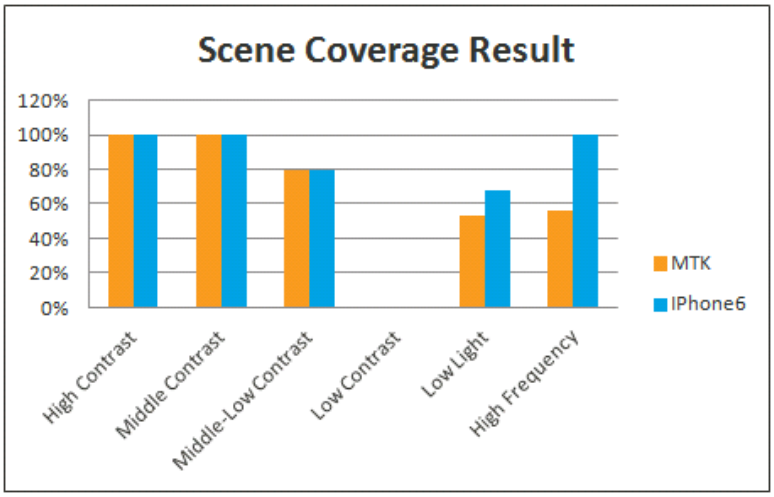

Figure 9. Scene Coverage Result

At the March 2015 Mobile World Conference MediaTek demonstrated the superiority of its autofocus technology in comparison with a major competitor's technology, as shown in this video.

https://www.youtube.com/watch?v=KznSNvXRZgk&index=2&list=PLBJH2-5oUEptmJMMA5A0RuSed-bE-Wx5M

Indeed MediaTek InstantFocus is a breakthrough camera feature. By adopting InstantFocus our customers are able to provide much faster focus performance than traditional contrast AF, and always clear when captured or recorded. MediaTek will keep striving for excellence in user capture experience.