

Toward Unified Ultimate Gaming Experience

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Abstract—On 11 June, 2020, IEEE announced the kick-off of its Mobile Gaming Working Group, which is dedicated to developing standards for mobile gaming. More than 80 company delegates from different stakeholders in the gaming industry joined the first working group in-person meeting, working under the sponsorship of the IEEE Consumer Technology Society Standards Committee. IEEE P2861,¹ the first project launched by this working group and authorized by the IEEE Standards Association (IEEE SA), is to develop a standard for optimizing the performance of game applications and devices, along with the evaluation methods on game fluency and optimization effect. To learn more, please visit the working group.² To further elevate the standardization efforts from the game industry, IEEE Consumer Technology Society established the Electronic Games and Sports Standards Committee, abbreviated as (CTS/EGSSC), and it has been officially recognized by IEEE SA Standards Board.

STANDARD CONSENSUS

■ **THE BENEFIT OF** the Android ecosystem is in its diversity. Consumers have a huge range of devices to choose from all with different price levels. But this diversity can be extremely difficult for game developers. Releasing one game application across all platforms while providing smooth gaming experience presented a unique

challenge.³ Each device is designed around a system-on-chip (SoC) with a number of CPU and GPU cores, shipped with different graphics drivers and different sized screens, made and tuned by different manufactures. Getting the game to work on these devices were not only a task of rewriting the game software for the device, but also about optimization for rendering performance, stability, and resource usage.

For example, many different processors found in the devices support different graphics feature set. Also, most manufacturers customize the scheduler and power management features

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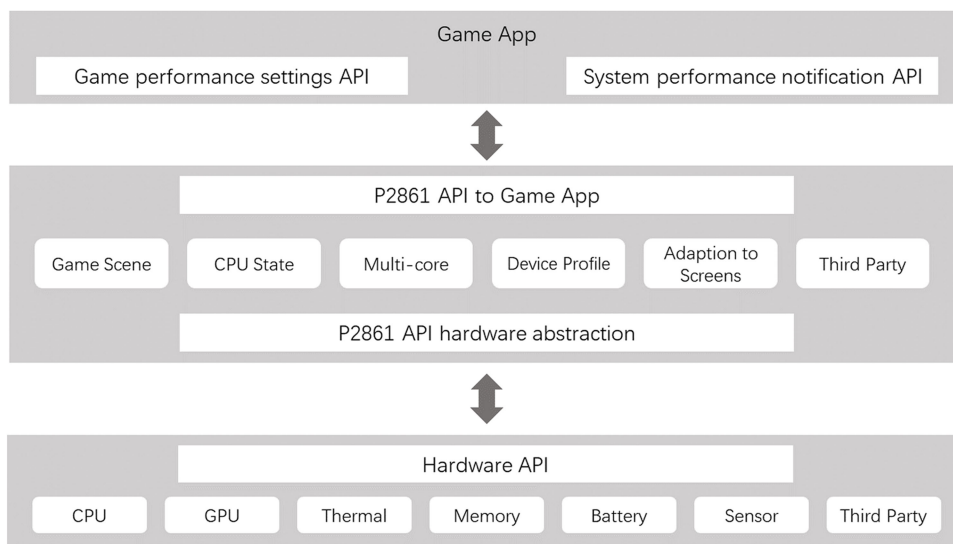


Figure 1. System architecture.

of their devices. It means two devices that share the same underlying hardware can have very different performance characteristics. To get the best results on Android devices, game developers have to work individually with OEM engineers for the specific implementation and even to contribute code changes to the OS and renderer engine.

The IEEE Mobile Gaming Working Group aims to optimize the user experience of mobile gaming by solving the issues between the high demands from game applications and the resource limitation on mobile devices. Inspired by the success practice of MTGPA (Magic Tencent Game Performance Amelioration, the official technical solution focusing on the software and hardware collaboration for Tencent Games.)⁴ project partnership, IEEE P2861 defines criteria and mechanism to optimize the performance of game application and device, along with the evaluation methods on game fluency and optimization effect. The specification establishes a unified optimization framework for game developers and mobile phone manufactures, and provides the fundamental capability and interface to adjust hardware and software resources for the need of game applications, as depicted in Figure 1.

Despite Android's fragmented ecosystem, IEEE P2861 provides the game developers who stuck with the platform ways to work around the problem. The working group has

established the consensus on the following core elements, which help to maximize the guarantee of the gaming experience.

- **Game scenarios protection**

The strategy is to divide a game into different game scenes according to certain rules (such as loading contents, entering game lobby, or performing actions like ultimate kill, aiming or shooting, etc.), and then provide finer-grained performance guarantees accordingly, referring Figure 2.

For example, rendering is the No.1 CPU consuming task, which results in performance bottleneck as maintaining a solid frame rate. It is necessary to classify the scene to different importance levels and prioritize the highest-level (critical) scene with guaranteed resources, with regards to the underlying adjustment from the device manufacturer. By categorizing the gaming scenes and adjusting CPU and GPU consumption accordingly, it will also help to manage power usage and device thermal to maximize battery life while prevent CPU throttling.

- **CPU state notification**

The game application is able to adjust the CPU settings or reduce the CPU load with the knowledge of CPU state information. If the configuration tuning can be done in a timely and accurate manner, the lagging issues can still be avoided so that the gaming experience will not

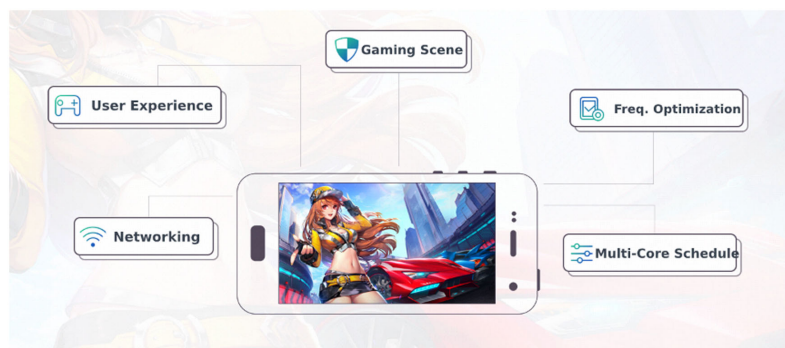


Figure 2. Optimization scenarios.

be compromised. It would require a communication channel between the system and application with regards to the CPU control policies, which vary for different manufactures.

- **big.LITTLE core scheduling**

Multicore is a common heterogeneous processing architecture that integrates number of cores in a single processor to provide further performance and efficiency gains, especially in processing multimedia applications like gaming. big.LITTLE core includes a high-performance core (called “big”) and a low-power core (called “LITTLE”).

Game applications should be able to allocate shorter periods for processing intensive tasks such as rendering, and alternately longer periods for light-weighted tasks for balancing.

- **Device profile**

A Device profile should reflect the actual performance when running a game application. It is not only a result of powerful CPU and GPU, but also a result of system optimization including both hardware and software. By utilizing the data analysis on the game server, a set of optimized game parameters can be pushed to the device according to its profile, which is a comprehensive model obtained by AI algorithm. It will also be beneficial for the game developers who can have a thorough view on the device properties so that device specific enhancements can be realized.

- **Screen adaptation**

Device manufacturers are launching special-shaped screens that are remarkably different, for example screens with notches and water drop-shaped screens. The implementation of the screen interface is also different between manufactures and changed over time along with the update of

Android OS. It becomes the worst nightmare for developers and results in enormous workload to do the screen adaptation. IEEE P2861 intends to provide a unified interface for special-shaped screens, making it compatible with different Android versions and manufacturers.

- **Third-party support**

More information should be defined and exchanged between game application and device in order to serve more customization needs from both parties, such as parameters of the internal linear motors.

IEEE P2861 takes a step forward on the way of providing the best experience to the customers who may play games on various type of devices. With the standardized features implemented, it is expected to reduce game loading time by 20%–50%, and to decrease low frame per second (fps) occurrences by 20%–40%.

“The work ahead is of utmost important,” said Nathan Chen at the working group meeting, General Manager of Technical Operations and Security, Tencent Games, “Tencent Games are set to continue its technology research and development and work closely with our ecosystem partners to jointly promote the development and implementation of the IEEE P2861 standard, bringing more benefit to gaming developers, and greatly enhance the user experience.”

LATEST PROGRESS

Sponsored by the IEEE Consumer Technology Society Standards Committee, a family of standards have been approved by IEEE SA, namely IEEE P2861.1⁵ “Standard for Troubleshooting Touch Operation Issues for Mobile

Gaming,” IEEE P2861.2⁶ “Standard for Mobile Gaming Systems Integration Framework,” and IEEE P2861.3⁷ “Standard for Haptic Interface Enhancement for Mobile Gaming.”

IEEE P2861.1 draft, initially discussed during the in-person working group meeting held on 11 November 2020, specifies the necessary information and procedures to reduce touch-to-display latency in gaming; track and resolve issues in the touch operation on mobile devices, detect and troubleshoot touch screen lag problems for game applications, and improve overall user experience.

To further elevate the standardization efforts from the game industry, IEEE Consumer Technology Society established the Electronic Games and Sports Standards Committee, abbreviated as (CTS/EGSSC), and it has been officially recognized by the IEEE SA Standards Board.

■ REFERENCES

1. “IEEE P2861 project authorization request,” 2020. [Online]. Available: <https://standards.ieee.org/project/2861.html>
2. IEEE P2861 Mobile Gaming Working Group Website. 2020. [Online]. Available: <https://sagroups.ieee.org/2861/>
3. E. Au, “Standards for the gaming industry,” *IEEE Veh. Technol. Mag.*, vol. 15, no 4, p. 148, Dec. 2020, doi: [10.1109/MVT.2020.3023362](https://doi.org/10.1109/MVT.2020.3023362).
4. Tencent MTGPA (Magic Tencent Game Performance Amelioration) Project. 2018. [Online]. Available: <https://tgpa.bkapps.o.tencent.com/>
5. “IEEE P2861.1 project authorization request,” 2020. [Online]. Available: https://standards.ieee.org/project/2861_1.html
6. “IEEE P2861.2 project authorization request,” 2020. [Online]. Available: https://standards.ieee.org/project/2861_2.html
7. “IEEE P2861.3 project authorization request,” 2020. [Online]. Available: https://standards.ieee.org/project/2861_3.html

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