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HARMONY OS's FEATURES AND CHALLENGES

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ABSTRACT

Harmony operating system (Harmony OS) is the English name for Hong Meng operating system which means" to bring more harmony and convenience to the world". Harmony OS is the first open source operating systems developed in China since China's economic opening 41 years ago, developed by Huawei Technologies Co. Ltd. It is an operating system that was launched after the United States launched a blockade which part of the US-China Trade war. This blockade has makes the Android operating systems is no longer available to support Huawei mobile phone industry.

Keywords: [*open source software, operating system, Harmony OS's features, Harmony OS's challenges]*

INTRODUCTION

Open source software is computer software which source code can be freely obtained from the Internet. The copyright holder of this software reserves a part of the rights under the provisions of the software agreement and allows users to learn, modify, increase, and improve the quality improvement of the software. The following is the rationality of using open source software.

Autonomous and Personalized

If we use proprietary software and need key features that can help improve the business, we must submit a request to the developer and wait. Unless the company is large enough to easily attract the attention of developers, it may take a while. If we use open source software, we can change the content according to our schedule. We can modify the software to ensure that it has the functions required by its own business. Even if we can't write the code ourselves, because it's open source, but we can let others add code for us is an option.

Security, stability, and reliability

An open source application is usually developed by thousands of people. Just because many people stare at the code, they usually find and solve serious problems quickly. When errors or even minor errors are found in proprietary software, it may take weeks or even months to fix the patch, and critical security issues may take a while to resolve. Also, people outside the publisher do not know what is wrong with the software, so when using proprietary applications, the enterprise must rely on blind trust.

Openness and Transparency

Proprietary software has many "*dark dead ends*" that hide many errors. The source code is very important for troubleshooting and understanding how the product works. In large software companies, only a few people can access the source code, and those who can access the source code are usually not directly accessible to users. Being able to access the source code is also

very important to fix the security breach. Some open source products are so successful that their commercial competitors cannot survive.

Flexibility
Everyone knows that typical commercial software licenses are uncertain. Many people should have encountered this kind of trouble, even for software licenses obtained from large developers. In contrast, open source licensing is easier and more flexible.

Durability
When you use proprietary software, the developer may decide to stop developing the software or refuse to continue to support the old version of the application. The company may also go bankrupt, and its products may have legal gaps for some time or forever. Open source software almost guarantees its existence. Although there is no 100% certainty when an open source application is provided online for free, there will be a community to support it, which should be permanently available and the old version may still be available for those who do not upgrade to newer hardware.

About Harmony OS open source software
Harmony operating system is a microkernel-based full-scene distributed OS. It is a set of operating systems mainly oriented to the future 5G leading era of the Internet of things. Harmony operating system realizes asynchronous expansion, which can be deployed flexibly corresponding to different devices, and it has a three-layer architecture, the first layer is the kernel, the second layer is basic services, and the third layer is the program framework. Harmony may open a unified operating system for multiple devices such as mobile phones, computers, tablets, TVs, automobiles and smart wearable devices, and is compatible with all Android applications and all web applications. Its creation was originally designed for industrial and telecommunications networks, not as you think it is designed for mobile phone operating systems used in mobile phones, when doing this system does not want to replace Android.

Harmony system's development path
The inspiration for developing the harmony system came from Nokia 's development team, which is Finnish multinational telecommunication, information technology, and consumer electronics company. Initially applied to the Internet of Things, never thought of replacing Android, but never thought of being sanctioned by the United States, which made it impossible to use Android and relevant Google products. This affected developer speeds up the research, development, and improvement of the Harmony System. It has started planning and research in Shanghai, Jiao Tong University since 2012.

It was named "Huawei LiteOS" at the beginning of its establishment, which is a lightweight software system similar to AliOS. Huawei has applied for the "*Huawei Hong Meng*" trademark in 2018, the application date is August 24, 2018, the registration announcement date is May 14, 2019, and the exclusive permission period is from May 14, 2019, to May 13, 2029 day. The Huawei operating system team led by a professor developed an independent property rights operating system and then named it Hong Meng on May 17, 2019. Huawei officially released the Hong Meng system on August 9, 2019. Yu Cheng Dong also announced that Hong Meng OS is an open source.

Background

Huawei Technologies Co. Ltd. It was established in 1987 and is headquartered in Long Gang district, Shenzhen city, Guangdong province, China. Huawei is the world's leading provider of information and communication technology solutions, focusing on the ICT field, adhering to stable operation, continuous innovation, and open cooperation, and building end-to-end in telecommunications operators, enterprises, terminals, and cloud computing. Solution advantages, providing competitive ICT solutions, products, and services to operator customers, enterprise customers, and consumers, and is committed to realizing the future information society and building a better fully connected world.

The development of 5G technology for Huawei's harmonious system

5G technology has great strategic significance. The technology and existing Wi-Fi will be reasonably integrated to improve the performance of the router. It has extremely high network speed. In addition to the increase in network speed. In addition to the increase in network speed, if the home broadband is upgraded, the promotion of 4K television sets, even 8K television sets will bring new improvements in video and games. Many people are concerned about whether the United States sanctions will affect Harmony's use of 5G technology.

For Huawei's technology, the 5G technologies solution is completely unaffected by the sanctions, because, after the incident, Huawei has taken various actions and measures in the past to reduce the impact on the company's operations and supply. Since the beginning of 4G in 2010, Huawei has begun to invest in 5G. Huawei has carried out 5G scale commercial trials with three major operators in many cities in China, all of which have reached commercial standards. From 5G chips, 5G base stations, bearers, core networks to 5G terminal equipment, Huawei is the first manufacturer to provide a complete 5G solution.

METHODOLOGY

This paper will be based on a qualitative research method, literature studies on Harmony operating system features and challenges will be outline and guideline and recommendation about Harmony system will be outlined too.

Features of Harmony OS

From the currently known information, the features of Harmony OS is that the core technical advantages are mainly reflected in two points:

The first point: Microkernel

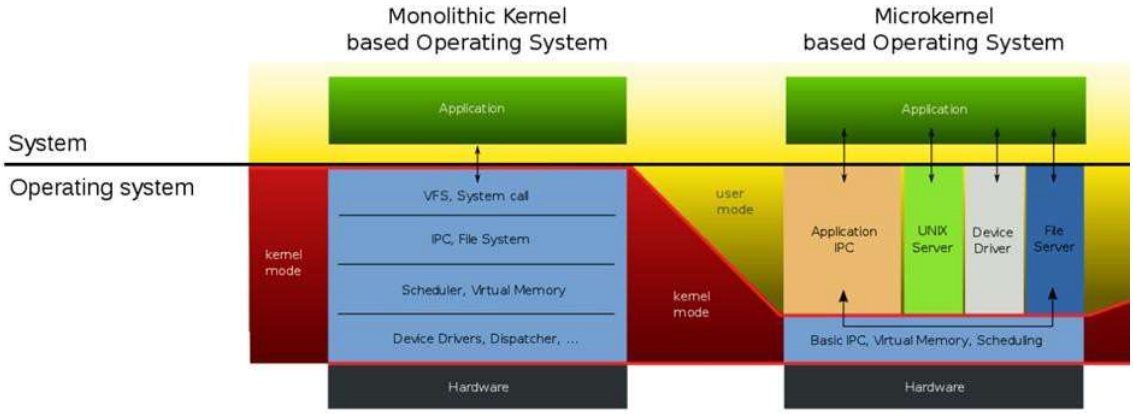

Figure 1: Structure of the monolithic kernel and microkernel-based operating systems

The Huawei's Harmony system uses a microkernel. Compared with the macro kernel used in the Android system, the microkernel brings many new advantages:

1. High security. The amount of code in the microkernel is greatly reduced, resulting in higher security. Some microkernels have only 10,000 lines of code, which can realize formal proof and prove the security of the code mathematically.
2. Highly reliable. The core of the microkernel is very stable and has high reliability. Many system services run on user-mode modules, which does not affect system stability.
3. High scalability. Since many system services are transferred to the user-mode service module, it can be conveniently tailored and added according to the needs of the terminal, achieving high scalability.
4. High maintainability. User mode modules can be started, stopped, uninstalled, and upgraded independently of each other.
5. Support distributed computing. The user-mode service modules are all independently operated and naturally support distributed computing.

The second point: Ark Compiler

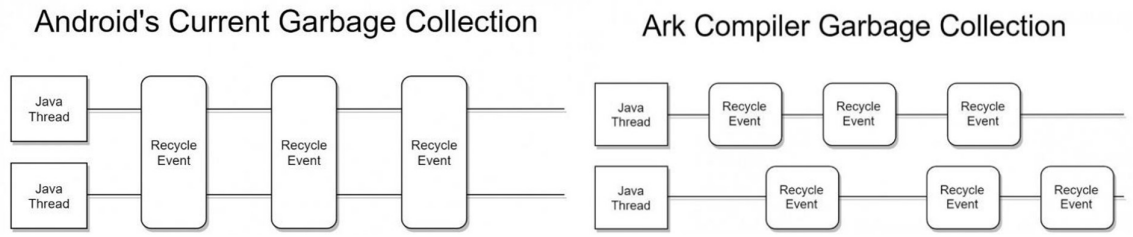

Figure 2: Differences between existing Android and Ark compilers

The vast majority of current applications on the Android platform are written in Java. The CPU can only understand assembly instructions, so a virtual machine (VM for short) is required. The virtual machine contains a converter and a compiler for converting JAVA high-level language into a machine-understandable language. However, the existence of VM will cause the program to run slowly or even freeze, and the unified collection of memory garbage including VM will also cause freeze. The biggest advantage of the Huawei compiler is that it bypasses the VM. In other words, using the Ark compiler, the developer's application will be converted into code that the machine can recognize before downloading, so it can be quickly

installed, started, and run on the phone without having to be compiled by the VM. To some extent, the Ark compiler advances the compilation process to the application development stage, thereby greatly reducing the operating burden on smartphones and operating systems.

Huawei Ark compiler performance improvement

Figure 3: Ark compiler system performance table

According to Huawei, after using the Huawei Ark compiler, the improvement effect is as follows:

- EMUI 9.1 only applies the Ark compiler to the system component system server, the system smoothing speed is increased by 24%.
- The system response speed is increased by 44%
- Third-party applications, such as the current Chinese version of Twitter (Sina Weibo Express Edition), have improved operation fluency by 60%.

Challenges of Harmony OS

Harmony OS mainly faces three challenges as follows:

Completeness of ecological construction of own brand system
To let others brand see the ecological feasibility of their systems and the good performance of their products, may be necessary to build a complete system ecology of their brand products. The Huawei brand has already involved many products in terms of hardware, and it is not only limited to mobile devices but has also been deployed in smart homes. In the 5G era, interconnection has become a hot issue, and Huawei needs to focus on building the ecosystem of its products.

In addition to the smart screen, can Huawei Harmony system connect cars, wearable devices, computer phones, smart speakers and other products in series, showing the good interconnection performance of Harmony system, and bring a different experience from the current popular system, it will become one of the challenges facing for the Harmony system.

Compatibility and comprehensiveness of software applications.
The software ecology of the system requires a long-term development process. In the early days of the new system, the number of software becomes an important issue. At present, the compatible Android application selected by Harmony OS is a relatively stable method.
However, in the future, compatibility with Android software alone is not enough. The main reason is that it is difficult to bring differences in software experience from the Android system. Besides, a software ecosystem specifically for a certain system is also a natural barrier to competition.

The balance between openness and closure.

Although Harmony OS has been confirmed as an open source system, Huawei Harmony system also faces challenges in the trade-off between openness and closedness of the system. On the one hand, today's operating system, relying on a single brand to support the entire ecosystem is more difficult to succeed, and more needs for the support of other brands Harmony system will face the problem of how to attract the support of other brands and how to give technical support to these brands.

On the other hand, the openness of open source also brings about management problems of third-party software. Similar to the Android system, although the system has strong software compatibility, the API levels adopted by developers are different. The tripartite software experience is also inconsistent. The solution method has become the problem of Harmony for this open source system. If adopt a closedness method, the control of tripartite software is relatively simpler, but at the same time, it also tests how its hardware ecology and services can be sufficiently attractive to consumers. After all, under the mainstream operating system now, it seems that only the Apple brand has achieved success with its hardware ecosystem, and this success is difficult to replicate.

RECOMMENDATIONS

Improvement of third-party software support

Huawei should pay attention to the requirements for third-party software and provide higher-quality software. After all, there have been lessons in the system software market. The third-party software of the Windows Phone system is poor quality, and the lack of software ecology causes the system to become a final failure is one of the main reasons.

Unification of control functions of household electronic products

Realize the function of creating a family-like Microsoft account, distinguish between adults and minors in the family. Realize unified management and control of home smart screens, PADs, mobile phones, computers, etc. Set up these electronic products separately, the equipment that can be used by minors in the family, the available period, and the duration of time that can be used.

CONCLUSION

Huawei's strong resistance in the US-China trade war has provided breathing time for other related manufacturers in China, which makes Huawei stand up especially of global significance. The various manufacturers in China are both competitors and form a delicate but real community of interests of open source technology. The establishment of Harmony's ecosystem is not only a matter of life and death for Huawei but also a decisive weight for the future survival environment of all relevant manufacturers in China.

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