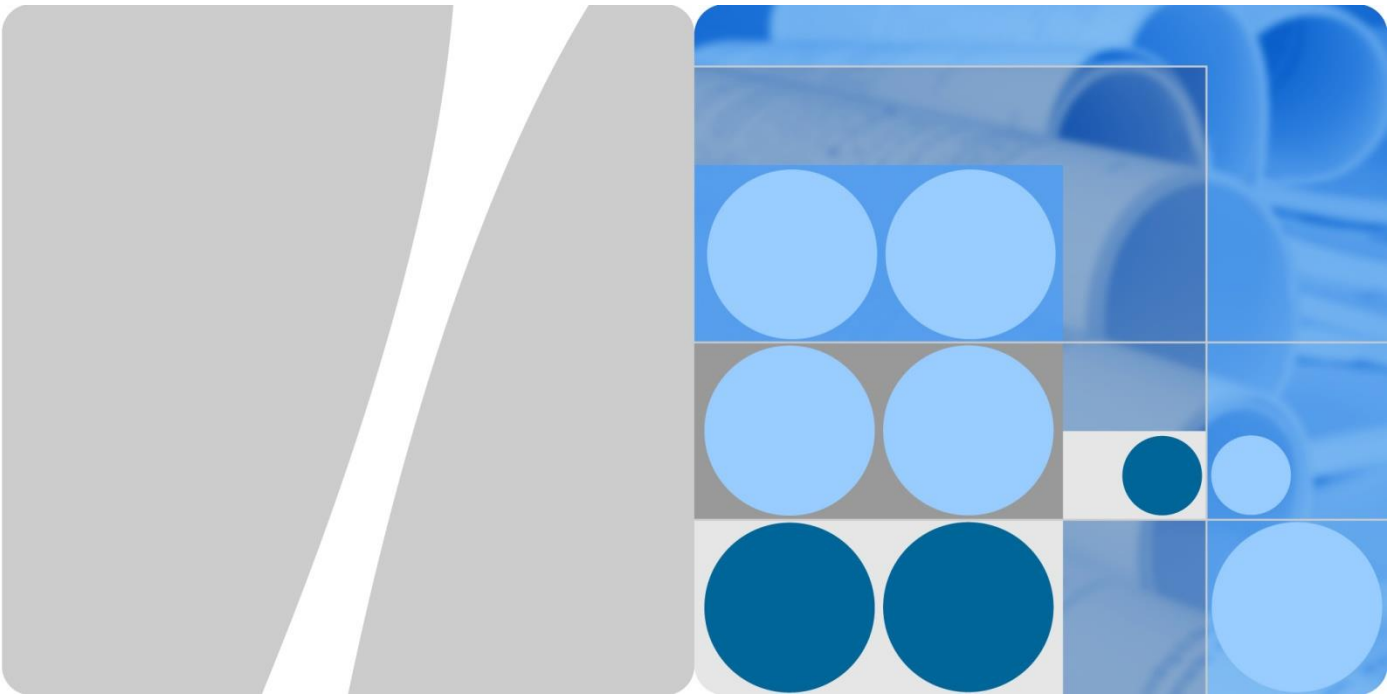

EMUI 9.0 Security Technical White Paper

Issue 1.0

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Contents

Note: * indicates a feature not supported by all devices. Supported features vary depending on device models or market features in difference countries. For details, refer to specific product description.

Figures

1 Overview

As the mobile Internet develops, mobile smart devices become major network access devices and store much user data, including users' personal information. In addition, an increasing number of apps from uncontrollable sources are installed on the devices. Due to these reasons, privacy and security issues become increasingly prominent, and security issues in mobile smart devices become consumers' major concern.

Apps on mobile smart devices come from various channels, some pre-installed by vendors and some possibly from third parties. Users may download malicious apps. Malicious apps may infringe upon users' privacy or steal users' assets, bringing various potential security threats.

Huawei attaches much importance to the security of mobile smart devices to provide chip-level security assurance while ensuring good user experience. This white paper systematically describes the security and privacy protection solutions delivered by the Emotion UI (EMUI), with a focus on the enhancement and supplementation made by EMUI on the basis of Android.

EMUI is a deeply customized mobile device system based on Android. It is applied to products running different hardware chip platforms. Therefore, the security implementation methods may differ depending on hardware and chips. For the actual specifications of different devices, refer to corresponding product manuals.

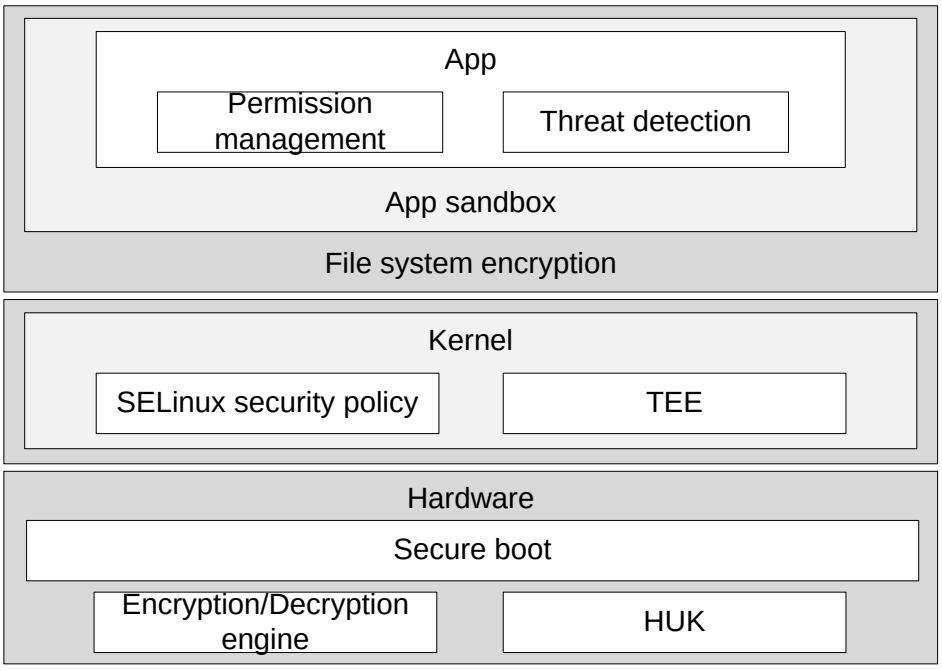
Security is a systematic project. EMUI provides end-to-end security protection from the hardware, system, and app to the cloud (as shown in Figure 1-1), including security and privacy protection for the hardware chip, system kernel, data, app, network, payment, cloud service, and device management.

EMUI provides a secure boot mechanism from the underlying hardware chip to prevent the EMUI read-only memory (ROM) image from being tampered with. The ROM image can normally run on a device only after passing signature verification, which ensures secure boot for the boot loader, recovery, and kernel image. In addition, the Android native system provides verified boot to ensure the secure boot of the Android system and prevent tampering and malicious code implantation, thereby ensuring system security from the hardware chip to the Android boot.

To ensure data security, the system encrypts user data using a hardware-based hardware unique key (HUK) and user lock screen passcode. Data files of different apps are stored in the directories of the corresponding apps, so that the files of one app cannot be accessed by other apps. The data erasure function is provided for permanently erasing data during device recycling or factory default restoration to prevent unauthorized data restoration. EMUI also allows cloud services to help users back up and synchronize data to ensure data security.

For app security, in addition to the Android security sandbox and permission management mechanisms, EMUI pre-installs the Phone Manager to provide virus scanning, block and filter, traffic management, notification management, and other functions. With these functions, the system can automatically detect viruses and Trojan horses in apps and provide fine-grained permission, traffic, and notification management functions.

Figure 1-1 EMUI security architecture



- Hardware chip: secure boot, hardware encryption/decryption engine, HUK, device attestation, hardware random number generator (RNG), integrated Secure Element (inSE), Trusted Execution Environment (TEE), secure storage, Trusted UI (TUI), fingerprint authentication, facial recognition, and electronic identification (eID)
- System security: integrity protection covering verified boot, Huawei Kernel Integrity Protection (HKIP), and EMUI Integrity Measurement Architecture (EIMA); kernel security, covering Security-Enhanced Linux (SELinux) access control, kernel address space layout randomization (KASLR); system software upgrade
- Data security: lock screen passcode protection, file system encryption, Huawei Universal Keystore (HUKS), secure erasure, and password vault
- App security: app signature, app sandbox, runtime memory protection, secure input, app threat detection, AI security defense, malicious website detection, and traffic management
- Cyber security: VPN, SSL/TLS, Wi-Fi security, and secure Wi-Fi detection
- Communications security: defense against rogue base stations, block and filter, and device interconnection security
- Payment security: Huawei Pay, secure keys, payment protection center, and verification code short message protection
- Internet cloud service security: Huawei ID, code scanning login, account protection, Huawei ID message, HiCloud, account-based keys, and HiCloud cloud backup

- Device management: Factory Reset Protection & activation lock, mobile device management (MDM), and MDM API
- Privacy protection: permission management, audio/video recording reminder, location service, notification management, app lock, file safe, Private Space, and differential privacy

2 Hardware Security

This chapter describes Huawei devices' hardware chip security, including the following security features:

- Secure boot
- Hardware encryption/decryption engine
- HUK
- Device attestation
- Hardware RNG
- inSE
- TEE
- Secure storage
- TUI
- Fingerprint authentication
- Facial recognition
- eID

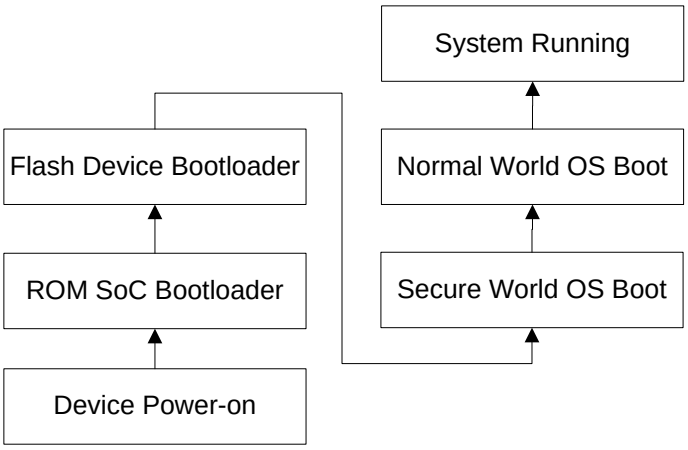
Secure Boot

Secure boot prevents the loading and running of unauthorized apps during boot. The bootstrap uses a public key to verify the digital signatures of software, ensuring the trustworthiness and integrity of the software. Only image files that pass the signature verification can be loaded. Examples of these files include the boot loader, kernel image, and baseband firmware. If the signature verification fails during boot, the boot process is terminated.

The bootstrap is a boot program in the hardware chip and is called the ROM SoC Bootloader. This code snippet is written into the ROM inside the chip during chip manufacturing, not modifiable after delivery, and first executed after device power-on.

The ROM SoC Bootloader performs basic system initialization and then loads the Flash Device Bootloader from the flash storage chip. The ROM SoC Bootloader uses the public key in the eFuse space (fuse blowout protects public key data from being tampered with) of the main chip to verify the digital signature of the Flash Device Bootloader image. Flash Device Bootloader is executed only after the verification succeeds. Then the Flash Device Bootloader loads, verifies, and executes the next image file. The similar process is repeated until the entire system is booted, thereby ensuring trust chain transfer and preventing unauthorized programs from being loaded during the boot process.

Figure 2-1 Secure boot



Hardware Encryption/Decryption Engine

The chip provides a high-performance hardware encryption/decryption acceleration engine which supports the following algorithms:

- 3DES
- AES128 and AES256
- SHA1 and SHA256
- HMAC-SHA1 and HMAC-SHA256
- RSA1024 and RSA2048
- ECDSA-256

HUK

The HUK is the hardware trust root stored in the eFuse space in the chip, accessible only to the hardware encryption/decryption engine, and variable depending on the device. The HUK provides a device-unique key for lock screen passcode protection and file system encryption.

Device Attestation

To prove that a device is trusted, a device certificate is preinstalled in the TEE of the EMUI to uniquely identify the device.

For devices that do not have a preinstalled device certificate, the EMUI derives a Rivest-Shamir-Adleman (RSA) and elliptic curve cryptography (ECC) public/private key pair bound to the device hardware and service information in the TEE to certify the devices.

Hardware RNG

Random numbers used for generating session keys and initialization vectors (IVs) and those for anti-replay require high entropy values. To reach an acceptable security level, Huawei mobile phone chips provide a NIST SP 800-90A-compliant RNG named CTR_DRBG. The seeds of this RNG come from NIST SP 800-90B-compliant hardware entropy sources.

inSE

To address mobile payment security issues, Huawei has proposed the integrated Secure Element (inSE) solution that integrates the security chip into the processor. Compared with software security solutions and separate chip security solutions, the inSE security solution uses the SoC security design and software algorithm to provide dual protection by both software and hardware. This solution provides software security protection capabilities and also protects against attacks from the physical layer with higher security, ensuring the security of mobile phones.

The inSE received China Financial National Rising Authentication (CFNR) *Technology Certification of Mobile Financial Service - Chip Security*, passed China UnionPay's *UnionPay Card Chip Security Specifications*, and obtained the Certificate for Commercial Cipher Product Models. The inSE has also passed the EMVCo chip security certification that allows for international mobile payment and mobile finance services.

TEE

EMUI supports the TEE secure operating systems of various chip platforms. Based on the HiSilicon platform, iTrustee is a TEE OS designed by Huawei using ARM TrustZone. It is a customized real-time OS that creates a TEE to provide a protected and isolated environment for users' confidential data and apps. Built based on Huawei-developed microkernel, iTrustee complies with GlobalPlatform TEE specifications and features high security, high performance, high scalability, and high stability. It provides SDK and DDK frameworks for developing security services.

Secure Storage*

The secure storage function is a TEE-based secure file system (SFS) for the secure storage of keys, certificates, personal privacy data, and fingerprint templates.

The trusted application (TA) running in the TEE uses a secure storage API to encrypt and store data in the SFS. The encrypted data is accessible only to the TA.

The AES256 hardware encryption/decryption used by the secure storage function is compatible with the GlobalPlatform TEE standard. The secure storage keys are derived by the HUK and not sent outside of the TrustZone. Data encrypted using the keys cannot be decrypted outside of the TrustZone.

EMUI further provides a Flash-based Replay Protected Memory Block (RPMB) to prevent system data from unauthorized deletion and access. The RPMB is directly managed by the TEE and bound with the keys derived by the HUK. Only the TEE can access the RPMB-protected data, and the external Android does not provide any interface for accessing the RPMB. The RPMB uses built-in counters, keys, and the HMAC verification mechanism to defend against replay attacks and prevent data from being maliciously overwritten or tampered with.

TUI*

In app environments in Android, the payment amounts or input passwords displayed by apps may be hijacked by malicious apps. For this reason, the TEE Trusted UI (TUI) display technology (compliant with GlobalPlatform standards) that can prohibit screenshots is provided for Android to protect content displayed by TAs by prohibiting access from Android. In this way, the TUI prevents the hijacking and tampering of displayed data and input by malicious Android apps.

Fingerprint Authentication

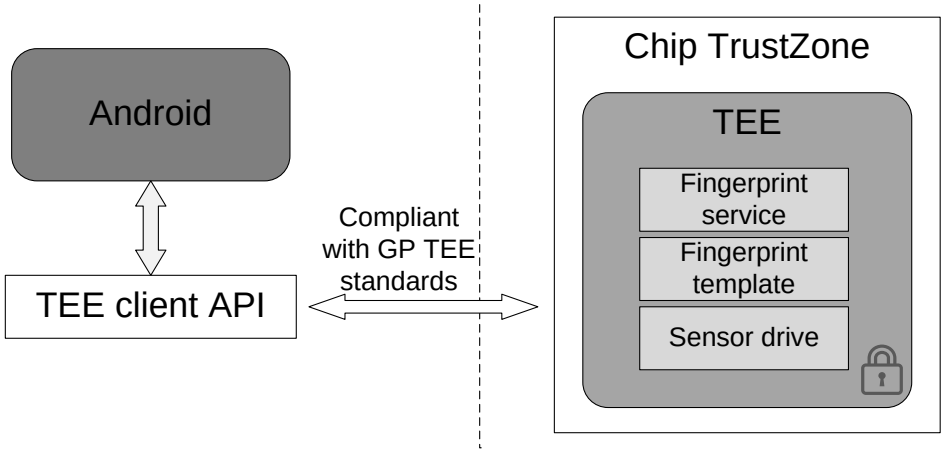
A fingerprint is a person's inherent physiological characteristic mainly used for identity authentication and other important occasions.

Fingerprint authentication may be affected by external factors that reduce fingerprint recognition rate, such as smudged fingerprint collector, unclean fingers, or wet fingers. Fingerprint authentication provides convenient identity identification, but users may easily forget a lock screen passcode. The system requires users to enter the passcode if the lock screen passcode is not used in three days, so as to enhance user memory of the passcode.

EMUI implements all fingerprint-related processing, such as image pre-processing, feature extraction, template generation, entry, and authentication, in the TEE based on the chip hardware isolation of the TrustZone. The external Android fingerprint framework is only responsible for fingerprint authentication initiation and authentication result, but does not handle the fingerprint data. Any external third-party Android app cannot obtain the fingerprints or send the fingerprint data outside of the TEE.

The fingerprint template data is stored in the TEE secure storage using AES256 encryption to prevent the leak of the fingerprint encryption key and users' fingerprint data. EMUI does not send or back up fingerprint template data, either encrypted or unencrypted, to any external storage media, including the cloud.

Figure 2-2 Fingerprint security framework



Facial Recognition

Facial recognition is a biometric recognition technology developed for identification based on human facial characteristics. It is mainly used in face unlock and face payment scenarios.

EMUI implements all face-related processing, such as face image collection, and feature extraction, comparison, and storage, in the TEE based on the chip hardware isolation of the TrustZone. The external Android facial framework is only responsible for facial authentication initiation and authentication result, but does not handle facial data. Any external third-party Android app cannot obtain facial data or send the facial data outside of the TEE.

Facial feature data is stored in the TEE secure storage or RPMB. A built-in security chip is used to encrypt and decrypt facial feature data, preventing the leak of the encryption key and facial data.

eID*

The electronic identification (eID) is an ID card app jointly developed by Huawei and the Third Research Institute of Ministry of Public Security of the People's Republic of China. The eID card functions the same as the physical ID card in scenarios approved by the Ministry of Public Security. In addition to common user identity authentication, the eID card can be used for mobile payment on public transportation if allowed by the card swiping terminal and provides authentication interfaces for third-party mobile phone apps for quick identity authentication.

Huawei complies with the eID standards in implementation and provides the full lifecycle management of the eID on the device, providing users with convenient and secure network digital identity services. Huawei eID solution employs Huawei inSE security chip, security camera, and TEE to provide end-to-end high security protection for the provisioning, download, use, and deregistration processes. eID information is encrypted and stored in the inSE security chip and can only be accessed by specific programs.

3 System Security

This chapter describes device security. EMUI enhances the security of the Android system based on Android's own security mechanisms, such as Linux Kernel LSM, permission control, and process protection.

Integrity Protection

Verified Boot

EMUI supports the verified boot function of Android and provides block device-based integrity check to prevent permanently-resident rootkits from holding root permissions. This function ensures that the device status at startup is the same as the last time it is used.

Huawei Kernel Integrity Protection (HKIP)*

To better protect kernel integrity, EMUI uses hardware Hypervisor virtualization technologies to implement real-time kernel integrity protection in order to protect key positions through measures such as preventing kernel code fields, key kernel code, and important system registers from being tampered with and preventing malicious code injection under privilege mode.

EIMA

EIMA measures integrity of key system code and resource files. Once detecting that the information is maliciously tampered with, EIMA notifies related system modules.

Kernel Security

SELinux Access Control

EMUI supports the Android-native SELinux feature and implements mandatory access control (MAC) on all processes, files, and operations. The access control policy cannot be modified by any third party and is protected during boot. The SELinux can prevent processes from writing and reading protected data, bypassing kernel security mechanisms, or attacking other processes.

Kernel Address Space Layout Randomization (KASLR)

EMUI supports KASLR. Each time the system is started, KASLR randomizes the address space layout of the kernel. KASLR makes the address space layout unpredictable and makes it difficult to launch code reuse attacks, which further enhances system kernel security.

System Software Upgrade

EMUI supports over the air (OTA) upgrade to fix possible vulnerabilities in a timely manner. The upgrade package signature is verified during system software upgrade. Only verified upgrade packages are considered legitimate and can be installed.

In addition, EMUI provides software upgrade control. At the beginning of OTA upgrade after a software package is downloaded, EMUI applies for upgrade authorization by sending the digest information of the device identifier, the version number and hash of the upgrade package, and the device upgrade token to the OTA server. The OTA server verifies the digest before authorization. If the digest verification succeeds, the OTA server signs the digest and returns it to the device. The upgrade can be implemented only after the device passes the signature verification. If the device fails the signature verification, an upgrade failure is displayed to prevent unauthorized software upgrade, especially upgrade using vulnerable software.

Security patches periodically released based on Android are verified and integrated into the system software upgrade package. Security patches* are automatically updated during system upgrade to ensure the security of the EMUI system.

*Note: The delivery time of security patches to be integrated into the upgrade package may vary according to the region and mobile phone model.

4 Data Security

This chapter describes EMUI data security protection. The EMUI file system is divided into the system partition and user partition. The system partition is read-only, isolated from the user partition, and inaccessible to common apps. For data stored in the user partition, the system provides file-based data encryption and directory permission management to restrict data access between apps. Some Huawei devices support SD cards which store much user data. Once a device gets lost, the SD card can be plugged out and inserted into another device for data reading, which causes a data breach. To resolve this problem, EMUI provides the SD card lock and encryption functions to secure the SD card data.

Lock Screen Passcode Protection

The lock screen passcode is protected by the HUK. All processing of lock screen passcodes created, modified, or verified during routine operation is done in the TEE. EMUI restricts users' consecutive failed password attempts to prevent brute-force cracking of lock screen passcodes.

File System Encryption

In the case of the loss of a mobile phone, to prevent unauthorized users from launching physical attacks (for example, directly reading the flash memory) to obtain device data and cause data leak, EMUI provides data encryption protection for the user file system.

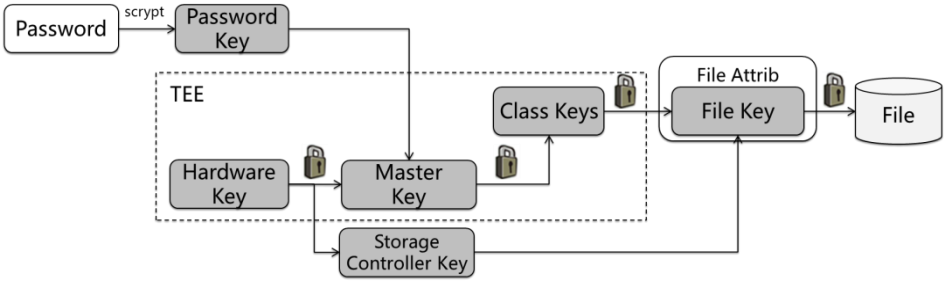
EMUI uses the kernel encryption file system module and hardware encryption/decryption engine to deliver Android-based (Android *N* or later versions) file-level encryption by utilizing the AES256 algorithm in XTS mode. In addition, the key for encrypting user password is protected using the user lock screen passcode and a key derived by the HUK to prevent unauthorized access to stored data. During boot, a device is encrypted and locked by default, allowing only specific apps, such as phone call and alarm, to run. To use other functions or access user data, users must enter a correct lock screen passcode to unlock the device. Moreover, the device provides the dictionary attack prevention mechanism to prevent brute-force password cracking.

To secure user data and app experience, the storage area of the Android system (Android *N* or later versions) is divided into the device encrypted (DE), credential encrypted (CE), and non-encrypted (NE) partitions. App data is stored in the CE partition by default to ensure app security.

- DE partition: Data in this partition is protected by the HUK and can be accessed when the screen is locked after power-on. Such data includes data related to Wi-Fi authentication, Bluetooth match, alarm, ring, etc.

- CE partition: Data in this partition is protected by both the lock screen passcode and HUK and can be accessed only after the user enters the lock screen passcode to unlock the screen. Such data includes photo albums, contacts, messages, calendar, call records, and location information.
- NE partition: Data in this partition is not encrypted, which is a rare case. Such data includes the OTA upgrade package.

Figure 4-1 File encryption



Huawei Universal Keystore (HUKS)

The HUKS provides interface functions similar to Java Cryptography Architecture Keystore for EMUI apps, including password algorithms, key management, and certificate services. The key and certificate of the HUKS are stored in the TEE. The device certificate injected during manufacturing shows that the passwords are stored in the TEE. The device certificate is unique on each device.

The HUKS allows EMUI apps to apply for certificates from the CA server using CMP and provides key attestation. The HUKS provides the key and certificate service for the Huawei Pay biometric authentication payment. In addition, the HUKS is integrated with the Standard Of auThentication with fingERprint (SOTER) standard framework and extends Keystore interfaces to support SOTER standards for EMUI apps.

By using the HUKS, EMUI app developers can manage the lifecycle of keys and certificates and invoke password algorithms, and device certificates in the TEE are used as proof for trustworthiness. The cloud server can use key attestation to authenticate EMUI devices. The HUKS, combined with biometric authentication, provides TEE-level login and payment services for payment apps. In addition to EMUI apps, the HUKS can also provide services for trusted apps in the TEE to expand their capabilities.

Secure Erasure

Common factory default restoration operations do not ensure that all data stored on a storage device is deleted. For efficiency, users usually use the logical address deletion method. However, this method does not clear the physical address space and the data can be restored.

EMUI allows users to thoroughly erase user data from devices when restoring factory settings. EMUI uses the internal storage space formatting method to overwrite file encryption keys to totally erase the keys, so that ciphertext user data cannot be decrypted. This data erasure method ensures data security for users who want to resale or dispose of devices.

Password Vault

An increasing number of apps are available for mobile phones, and logins for these apps require user names and passwords. In case you forget your user name or password for an app, a password vault is available. The password vault can store your logins for apps and associate with your fingerprint, Face ID or lock screen passcode to auto-fill your user name and password for login.

The password vault (supported only by Huawei HiSilicon platform-based devices of EMUI 9.0 and later versions) stores encrypted app account and password on devices, providing hardware-level encryption and storage capabilities. The account and password are encrypted using AES128 in the TEE, and the encryption key is stored in a TEE-based SFS.

Currently, the password vault does not provide cloud synchronization or backup capabilities. The account and password data stored in the password vault can be encrypted and transferred between Huawei devices that support password vault using Phone Clone. (Password vault clone is available only to Huawei devices that support the PKI certificate.) Alternatively, users can restore the encrypted data saved on the PC back to the device previously possessing the data.

5 App Security

This chapter focuses on the security of app programs. Application programs can be obtained from various channels, so users may download malicious apps at any time. If not properly handled, the malicious apps may bring security risks to the security and stability of the system, and may bring damages to user personal data and even personal property.

Therefore, EMUI provides functions like threat detection and mitigation, and malicious website detection to ensure security of the app programs.

App Signature

Only app programs with complete signatures can be installed in EMUI. App signatures can be used to verify the integrity and legitimacy of apps. The system will verify the app signature to check whether the app is tampered with before installing the app.

The system will also verify the app signatures before updating the pre-installed apps or user-installed applications (UIAs). The apps can be updated only when their signatures are the same as those of the apps to be updated, which prevents malicious apps from taking place of the existing apps.

Android app programs use self-signed certificates, and such certificates do not need to be signed by certification authorities. Code signatures are used to:

- Check app integrity (whether the app has been tampered with) and legitimacy (whether the app is from an authorized developer).
- Check whether self-signed certificates are consistent before updating the apps. The apps can be updated only when their new and old signature certificates are consistent.
- Establish trust between apps. Based on mutual trust, apps of the same user ID can securely share code and data.
- In addition to the self-signed certificate mechanism, Huawei adds secondary signatures and security metadata to Huawei apps available in the AppGallery. This enhances lifecycle management and control of apps and enhances app integrity check. This process does not damage the original self-signed certificate mechanism.

App Sandbox

EMUI uses the app sandbox mechanism originally provided by Android, making sure that all apps run in the sandbox and are isolated from each other to ensure security when running.

Runtime Memory Protection

Malicious programs will probably obtain memory addresses by viewing the memory if the allocated memory addresses are relatively fixed during program running. To solve this problem, EMUI supports Android's original address space layout randomization (ASLR).

ASLR and data execution protection (DEP): ASLR is a security technique involved in protection from buffer overflow attacks. To prevent an attacker from locating attach code positions, ASLR randomly arranges the address space positions of the stack, heap, and libraries. ASLR makes it harder for attackers to exploit memory vulnerabilities. DEP marks specific memory locations in a process as non-executable, helping prevent attacks on memory vulnerabilities.

Secure Input

EMUI provides secure input function when users are entering passwords. If the secure input function is enabled, the system will automatically switch to secure input when the user enters the password. Secure input and common input are managed separately. To safeguard user passwords, the secure input method does not support memorizing or association functions. It cannot connect to the Internet or collect user passwords. After the secure input is launched, screen recording cannot be performed in the background, and no third-party apps can capture screenshots.

NOTE

Self-developed input methods will be used in some bank APKs, and the secure input method does not take effect.

App Threat Detection

Security risks may exist in third-party apps, so downloading apps from third-party channels may introduce malicious threats.

The Android OS can check whether app sources are legitimate during app installation. By default, only apps in Huawei AppGallery can be installed. It is recommended that the mobile phones be set as disabling installations of apps from unknown sources to avoid risks.

Huawei AppGallery provides more than 10 top anti-threat engines and the manual approval mode to ensure the security of official app sources. Users are recommended to download apps from Huawei AppGallery to ensure app security.

Phone Manager with built-in industry-leading antivirus engines is provided on the devices. It has powerful anti-threat engines at both the local end and the cloud that support local and online scanning, enabling users to find out and check whether viruses exist in apps installed by users. Once a virus is detected, the system will give a warning immediately and prompts the user to handle the virus.

AI Security Defense*

EMUI provides a hardware-based AI computing platform for security protection of devices. It has a built-in industry-leading AI antivirus engine that encompasses a security defense-oriented AI model built upon deep learning and training. EMUI monitors the behavior of unknown app software in real time (unknown malware includes new viruses, new variants of viruses, and dynamic loading of malicious programs), and runs the AI model on devices to analyze the behavior sequence of unknown software to quickly and effectively detect threats and improve app threat detection capabilities. Once a malicious app is detected using AI

security defense, the system will give a warning immediately and prompts the user to handle the app.

Malicious Website Detection

EMUI can detect whether the websites are phishing websites or websites with malicious threats when Huawei browser is used or text messages are sent. When a user uses Huawei browser to browse a malicious web page, EMUI checks the website so that Huawei browser can intercept the access to the website, and prompt the user of the security risks. It can identify malicious website URLs carried in received text messages and prompts users of the security risks.

Traffic Management

EMUI provides the traffic management function, including the management of mobile data traffic and traffic consumed over Wi-Fi. They are measured separately to implement fine-grained management. The traffic management function enables real-time monitoring of the traffic usage of each app and displays the results to the user. In addition, it can control networking types of various apps to prevent mobile data consumption in the background.

6 Network Security

When devices connect to the network, secure connections are needed. Otherwise, they may connect to malicious sites, resulting in data breach. This chapter focuses on EMUI security mechanism of the network connection and transmission. EMUI uses standard network security protocols, such as VPN, SSL/TLS, and Wi-Fi, to ensure the security in device connection and data transmission.

VPN

With a VPN, a user can establish a secure private network using public network links. The VPN user can perform secure data transmission and has overall control rights on the network.

Devices support VPN settings. Users can set VPN parameters and therefore access sensitive information on the devices securely.

The supported VPN modes are PPTP, L2TP, L2TP/IPsec PSK, and L2TP/IPsec CRT.

SSL/TLS

Devices support SSLv3 and TLSv1.0, TLSv1.1, and TLSv1.2. They also support SSL/TLS through a third-party OpenSSL protocol stack.

Wi-Fi Security

Wi-Fi connection can be authenticated using various methods, such as WEP, WPA/WPA2 PSK, 802.1x EAP, WPS, and WAPI.

In addition, devices also support the Wi-Fi hotspot function, which is disabled by default. Wi-Fi hotspot, once enabled, supports WPA2 PSK authentication to ensure the security of the connections.

Secure Wi-Fi Detection

Wi-Fi in public areas provides convenience to people, but at the same time, it may be illegally used to steal users' privacy and perform phishing, which will bring security issues like privacy disclosure and economic losses to users. EMUI provides Wi-Fi threat detection engine on access points. It detects the Wi-Fi hotspots to be connected. Once security risks are detected, it will prompt users so that they can take measures to ensure connection security.

7 Communication Security

This chapter describes security protection that EMUI provides for device communication. Users may frequently receive crank calls and fraud messages. To minimize the possibility that users are deceived, EMUI provides functions such as defense against rogue base stations and block and filter to safeguard communication.

Defense Against Rogue Base Stations*

Text messages sent from rogue base stations disturb users and may contain malicious website URLs. Once users click such URLs, they may have economic losses or other adverse impacts. EMUI provides chip-level rogue base station prevention function based on HiSilicon chips (not supported on other chip platforms). It analyzes parameter characteristics of rogue GSM/LTE base stations and normal base stations and selects the most secure base station. (LTE rogue base stations can be identified and prevented only by HiSilicon Kirin 980 or later chips.) When a modem decodes system messages, it can identify rogue base stations and will not select the cells where rogue base stations reside.

Block and Filter

In daily life, many users have ever received harassing text messages or calls about product sales, real estate investment, or bank loan. EMUI is able to block such harassing text messages and calls. Users can enable or disable the blocking and recording functions, and clear or restore the blocking records. In addition, users can mark harassing calls with different types and blacklist them to prevent further harassment. Users can blacklist a phone number from contacts, call records, or text messages, or manually create a blacklist item.

Device Interconnection Security

EMUI provides authentication services for devices that log in with the same Huawei ID and can perform security authentication for two connected devices on a LAN to check whether the devices are trusted devices using the same Huawei ID. Devices not registered under this Huawei ID will not pass the authentication.

Devices that support one-key hotspot and Huawei Share can connect to devices that log in with the same Huawei ID through Bluetooth or Wi-Fi P2P to share Wi-Fi hotspots and files.

If a device has one-key hotspot enabled, the device will send signals through Bluetooth Low Energy to connect to devices that log in with the same Huawei ID. The EMUI device authentication services perform the authentication process based on the trusted public keys of both devices to verify whether the other device is using the same Huawei ID. If the authentication is successful, the EMUI device authentication services will provide the key

used for creating this hotspot session, so that the one-key hotspot can use the session key to encrypt private hotspot connection information.

Users can enable Huawei Share to share files with nearby devices that log in with the same Huawei ID. The device will use EMUI device authentication services to verify whether the devices are under the same Huawei ID and encrypt and transfer files.

8 Payment Security

This chapter describes security protection for Huawei Pay and other mobile payment apps. For third-party payment apps, EMUI can identify malicious apps, isolate the payment environment for protection, and support verification code encryption to ensure payment security.

Huawei Pay

Using Huawei Pay, users can conduct payment on supported Huawei devices in a convenient, secure, and confidential way. Huawei Pay has enhanced security in both hardware and software design.

Huawei Pay is also designed to protect users' personal information. It will not collect any transaction information that can be used to identify a user. Payment happens only among payers, payees, and card issuers.

Huawei Pay Components

Secure element: is a chip that has been certified and recognized in the industry. It complies with the requirement for digital payment in the finance industry.

NFC controller: processes near field communication protocols and supports communication between the app processor and secure element and between the secure element and POS machine.

Huawei Pay app: refers to "Wallet" on devices that support Huawei Pay. In this app, users can add and manage credit and debit cards and conduct payment. Users can also query their payment cards and other information about the card issuers.

Huawei Pay server: manages the status of bank cards in Huawei Pay and the device card number stored in the secure element. The server communicates with devices and payment network servers at the same time.

How Does Huawei Pay Use the Secure Element?

Encrypted bank card data is sent from a payment network or card issuer to the secure element. The data is stored in the secure element and protected by the security functions provided by the secure element. During transaction, a device directly communicates with the secure element using a dedicated hardware bus through the NFC controller.

How Does Huawei Pay Use the NFC Controller?

As the entry of the secure element, the NFC controller ensures that all contactless payments are conducted through POS terminals near the payment devices. The NFC controller only marks the payment requests from devices in the field as contactless transaction.

Once a cardholder uses the fingerprint or passcode for payment, the controller sends the contactless response prepared by the secure element to the NFC field. In this manner, detailed payment authorization information for contactless transaction is saved only in the local NFC field and will not be disclosed to the app processor.

Bank Card Binding

When a user adds a bank card to Huawei Pay, Huawei securely sends the payment card information and other information about the user account and device to the card issuer. The card issuer then determines whether to allow the user to add the card to Huawei Pay.

Huawei Pay uses the server invoking commands to send and receive packets exchanged with the card issuer or network. The card issuer or network uses these commands to verify, approve, and add payment cards to Huawei Pay. The sessions between clients and servers are encrypted using SSL.

Complete payment card numbers will not be stored on Huawei servers. Instead, unique device card numbers are created, encrypted, and stored in the secure element. Huawei is inaccessible to the encryption method. Each device card number is unique, different from a common bank card number. Card issuers can prevent the use of device card numbers on magnetic stripe cards, phones, or websites. Device card numbers will only be stored in secure elements and will never be stored on Huawei Pay servers or backed up to HiCloud.

Adding Bank Cards to Huawei Pay

The process of manually adding a payment card requires the user's name, card number, card expiration date, and card verification value (CVV) code. Users can enter such information in the Wallet app or use the camera function to fill in the information. After the camera captures payment card information, the Wallet will try to fill in the card number. After all information is entered, the process verifies the information except the CVV code. This information is encrypted and sent to the Huawei Pay server.

If any clauses and conditions are returned by the card issuer for the payment card confirmation process, Huawei downloads the clauses and conditions and displays them on the user's device.

If the user accepts the clauses and conditions, Huawei sends the accepted clauses and CVV code to the card issuer and carries out the binding process. The card issuer determines whether to allow the user to add the payment card to Huawei Pay according to the user's device information, such as the name, device model, Huawei mobile phone to which Huawei Pay is bound, and approximate location when the user adds the payment card (if GPS is enabled).

The following operations are performed in the binding process:

- The device downloads the credential file representing the bank card.
- The mobile phone binds the payment card to the secure element.

Extra Verification

Card issuers determine whether to perform extra verification on bank cards. According to the functions supported by card issuers, users can select text message verification as the extra verification means.

Users can select the contact information archived by their card issuers to obtain text message notification and enter the received verification code in the Wallet app.

Payment Authorization

The secure element permits the payment only after receiving authorization from the mobile phone and determining that the user has passed authentication through fingerprint or device passcode. Fingerprint payment, if available, is the default payment mode. Users can use the passcode instead of fingerprint at any time. If fingerprint match fails once, the system automatically prompts you to enter the passcode.

Using Huawei Pay for Contactless Payment

If a Huawei mobile phone is powered on and detects an NFC field, it displays related bank cards. The user can access the Huawei Pay app and select a bank card, or use a specific fingerprint sensor to evoke the payment page when the device is locked.

If the user is not authenticated, no payment information will be sent. After the user is authenticated, the device card number and dynamic security code dedicated for transaction are used during payment.

Suspending, Removing, and Erasing Payment Cards

Card issuers or payment networks can suspend the payment function of Huawei Pay payment cards or remove the cards from devices even if the devices are not connected to cellular networks or Wi-Fi networks.

Secure Keys*

Second-generation U key (such as USB key and audio key) is the main network transaction security solution for banks. Because it is external security hardware, the second-generation U key is prone to damage and lose, has a low use rate and poor user experience, and is not convenient to carry. For apps with a mobile payment function, the main security strategy is to bind with mobile phones during transactions through bank payment channels. The transactions are confirmed through SMS messages and pose high security risks. Users are worried that their money may be stolen during payment.

Huawei secure keys are combined with an independent internal secure element. The secure element is an authenticated chip widely accepted in the industry and supports banks' mobile phone certificate services. Huawei secure keys combine traditional plug-in U keys with phones to form portable secure keys in order to provide finance-level hardware protection for electronic payment.

When providing banks' mobile phone certificate services, Huawei's remote Trusted Service Manager remotely manages the secure element and establishes a Secure Channel Protocol (SCP) channel with the secure element to create a trusted, independent, and secure running space within the secure element. After an applet is installed in the space, independent public/private key pairs are generated within the secure element. The applet uses the TEE TUI to set a bank certificate PIN. After the TUI is launched, screen interaction events are managed by the TEE to prevent Android background apps from capturing screenshots, recording the screen, and tracking on-screen touch points and ensure secure entering of the certificate PIN. Users verify their PINs on the TUI to complete transactions during certificate use.

During the entire lifecycle from public and private certificate key generation to certificate destruction, the private key is always in the secure element and therefore is secure.

Viewing Secure Keys Apps

Secure keys can check app package names and signatures. Only official apps will appear on the management screen to avoid malicious fake apps. One-click query and management of secure keys apps is allowed using the Huawei Wallet APK setting interface.

Secure Keys Switch

The phone system has a switch to avoid background programs and apps from maliciously invoking the bank certificate. Turning on and off the switch is equal to inserting and removing a traditional USB key. When the switch is turned off, all certificate-related business cannot be conducted. Therefore, secure keys can offer users the experience of being able to control hardware security.

Payment Protection Center

The payment protection center protects payment apps. It can isolate payment apps and detect app sources and threats in payment environments to secure financial, property, insurance payment apps.

App source detection: Apps in the payment protection center must come from the payment area in the Huawei AppGallery or payment apps that have passed Huawei payment market's payment area authentication.

Smart reminder: When a user launches a qualified app, the phone will automatically remind the user to add the app to the payment protection center.

Access control and isolation: The payment protection center can access apps inside the space and control or isolate apps outside the space. As some payment apps (such as Alipay and WeChat) frequently interact with the external network, the center prevents access only from untrusted apps (malicious apps that have been detected) outside the area.

Financial property apps (such as China Merchants Bank) do not need to interact with the external network. The payment protection center deeply isolates such apps and prevents access from third-party apps outside the area.

Threat detection and system protection: The payment protection center can detect malicious threats, Wi-Fi threats, text verification codes, and ROOT, and protect input methods.

Protecting SMS Verification Codes

Currently, SMS verification codes have become an important authentication factor for mobile apps. Once an SMS verification code is intercepted, the user is faced with information breach or economic loss risks. To minimize such risks, EMUI provides protection for SMS verification codes to prevent malicious apps from intercepting users' text messages.

EMUI has an additional SMS verification code intelligent identification engine at the system layer. After identifying an SMS verification code, the engine sends the text message only to the default SMS client set in the EMUI system. If the default SMS client is EMUI's built-in SMS client, the SMS client encrypts the text message with the verification code and filters access to the message, preventing third-party SMS clients or apps from accessing the message. Even if a third-party SMS client or app directly accesses the SMS database, text messages with verification codes are encrypted, and the client or app cannot decrypt them.

NOTE

This function takes effect only when EMUI's built-in SMS client is set as the default SMS client.

9 Internet Cloud Service Security

Huawei has established a series of powerful cloud services to help users use devices more effectively. In design, these Internet services inherit the security objectives promoted by EMUI on the whole platform. Cloud services protect users' personal data stored on the Internet or transferred over the network, defend against threats and network attacks, and prevent malicious or unauthorized access to such information and services. Huawei cloud services use a unified security architecture which does not affect the overall usability of EMUI while ensuring user data security.

Huawei ID

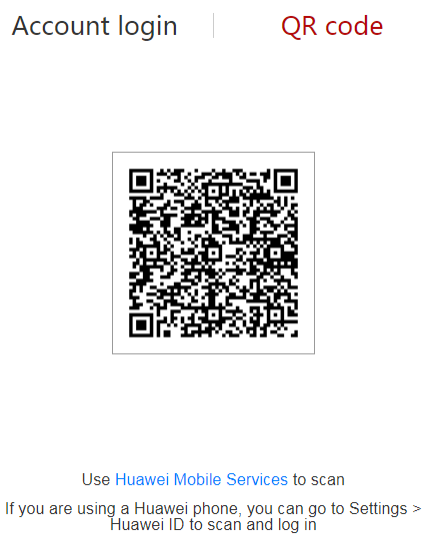
A Huawei ID can be used to access all Huawei services, such as HiCloud, AppGallery, HiGame, Huawei Video, and Huawei Music. Ensuring Huawei ID security and preventing unauthorized access to user accounts are important to users. To achieve this goal, Huawei requires that users use a strong password which is not commonly used and contains at least 8 characters in forms of lowercase and uppercase letters and digits. On this basis, users can add characters and punctuation marks (the maximum password length is 32 characters) to make the password stronger and therefore more secure.

In case of major changes to a Huawei ID, Huawei will send a text message, email, and notification to the concerned user, such as when the password is changed or the Huawei ID is used on a new device. If any exception occurs, Huawei will prompt users to immediately change the passwords. Huawei has also adopted various policies and procedures to protect users' Huawei IDs, including limiting the numbers of login and password resetting attempts, continuously monitoring fraudulent activities for attack identification, and regularly reviewing existing policies for timely update according to new information that may affect user security.

Code Scanning Login

To facilitate users' access to Huawei Internet cloud services through browsers using their Huawei ID, the Huawei ID provides the code scanning login function. After logging in with their Huawei ID on a Huawei phone, users can use the code scanning function and scan the QR code on the login page to access corresponding Huawei Internet cloud services.

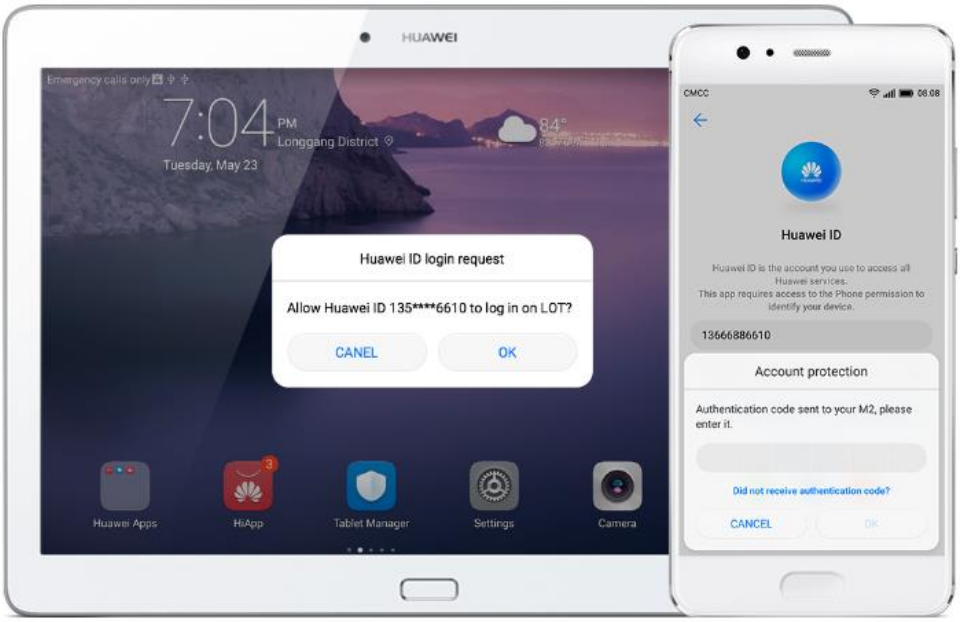
Figure 9-1 Code scanning login



Account Protection

Two-factor authentication is the optimal account protection solution and ensures more secure Huawei ID use.

Figure 9-2 Account protection



Account protection only allows users to log in with their Huawei ID using their trusted devices. If a user logs in with their Huawei ID using a new device, the user will need to enter their Huawei ID password and security verification code. The verification code is automatically displayed on their trusted devices or sent to their trusted phone number. If the

new device passes the verification, it will become the user's trusted device. For example, a user has a HUAWEI M2, and the user wants to log in with their Huawei ID on their new HUAWEI P10. Their HUAWEI P10 will require them to enter their Huawei ID password and the verification code displayed on their HUAWEI M2. Therefore, Huawei IDs and using Huawei ID business (such as HiCloud, AppGallery, Wallet, and HiGame) become more secure.

Huawei ID Message

The Huawei ID message function is a message sending and receiving service applicable to Huawei devices. This function supports texts and attachments, such as photos, contact information, and location information. The information is displayed on all registered devices of the user so that the user can continue the dialog on any of the devices. Huawei does not record users' information or attachments. In addition, the content is under end-to-end encryption protection.

HiCloud

HiCloud provides the function of storing users' contacts, messages, photo albums, call records, reminders, calendars, browser bookmarks, and other contents, and synchronizes information between the users' devices. The user can log in with their Huawei ID to set HiCloud and choose services as they want.

When the user logs out of their Huawei ID, related authentication information will be deleted. After obtaining user confirmation, HiCloud will delete all related data to ensure that the user's personal data is not stored on the unused device. The user can log in with their Huawei ID on a new authenticated device to restore the HiCloud data.

Huawei ID–based Key

HiCloud files divide into different blocks. Each block is encrypted or decrypted using AES128. HiCloud encryption and decryption require Huawei ID login. After a user successfully logs in with a Huawei ID, HiCloud derives an encryption factor for the Huawei ID and sends the factor and block metadata to the hardware encryption and decryption system. HiCloud files are encrypted and decrypted in this system and are then sent to the user's device through secure transmission channels. When the user data is stored on HiCloud, it is protected through the key bound to the Huawei ID. This means that no one else can read or write the data.

HiCloud Backup

HiCloud backup backs up data (including device settings, app data, and photos and videos on the device) to the cloud only when user devices can access the Internet through Wi-Fi. HiCloud will encrypt and protect backed-up data.

10 Device Management

This chapter describes the device management function of EMUI. For enterprise users, EMUI supports the native "Android for Work" framework of Android and provides capabilities such as enabling enterprise users of third-party MDM platforms to apply for enterprise certificates and granting the authorization. For scenarios where the user loses his/her mobile phone, EMUI provides Find My Phone/Factory Reset Protection, remote lock, remote data erasure, and other functions.

Find My Phone & Activation Lock (for Mainland China)

EMUI provides the function Find My Phone, which needs to be manually enabled by the user. After enabling the function, the user can locate (including active positioning and automatic location reporting at a lower battery level) a lost device, cause the phone to ring, lock, and erase device data by logging in to the cloud service website (cloud.huawei.com) or using the Fine My Phone function on a Huawei phone to ensure device data security. (Note: The function is available only in mainland China.)

In addition, EMUI provides the function of activation lock. Enabling Find My Phone will enable the activation lock function on the mobile phone at the same time. If an unauthorized user attempts to forcibly erase data from the lost phone, after reboot of the phone, the user needs to log in to the Huawei ID to re-activate the phone. This function ensures that unauthorized users cannot activate or use the phone, protecting security of the phone.

Factory Reset Protection & Activation Lock (for Outside Mainland China)

EMUI provides the factory reset protection function, which is enabled by default after the user logs in to the Google account. When the function is enabled, the user can locate (including active positioning and automatic location reporting at a low battery level) a lost device, ring a phone, phone lock (including screen lock, reporting location tracks, and automatically entering low power mode) and erase device data by logging to the Google account website (accounts.google.com) or using the Device Manager App on a Huawei phone to ensure device data security.

In addition, EMUI provides the activation lock function. Enabling the factory reset protection function will enable the activation lock function on the mobile phone at the same time. If an unauthorized user attempts to forcibly erase data from the lost phone, after reboot of the phone, the user needs to log in to the Google account to re-activate the phone. This function ensures that unauthorized users cannot activate or use the phone, protecting security of the phone.

MDM

The MDM function is completely inherited from the native "Android Enterprise" (previously "Android for Work") framework of Android. By creating managed profiles, the enterprise IT system can easily control and manage Android devices. Android Enterprise supports mainstream third-party EMM vendors. It communicates with the EMM server and distributes device configuration and management policies through the device policy controller app on the device.

In addition, EMUI opens authorization APIs for device management to EMM vendors. In regions where Google Mobile Services are unavailable or scenarios where the vendors do not want to rely on Google Mobile Services, the vendors can install a third-party MDM client on the device and invoke the open APIs to control and manage the device. Invoking APIs must be authorized to implement permission control and to ensure security.

MDM API

Currently, EMUI opens device management interface SDK of Huawei phones and tablets to third parties through Huawei Developer platform, allowing device configuration and access control for EMM vendors and application developers. For details about the SDK, go to the Huawei Developer official website: https://developer.huawei.com/consumer/en/doc

For device management APIs required by enterprise mobile office customers, EMUI grants the customers corresponding use permissions by proving a signed enterprise certificate. The enterprises can apply for the device management API use permission from Huawei Developer.

Huawei issues device management certificates through Huawei open platforms to app developers qualified by Huawei. After the developer integrates the certificate into the developed Android package (APK), the APK can normally invoke the authorized APIs on Huawei devices.

When a user installs an APK having the device management certificate, EMUI analyzes and verifies each item of the certificate. After confirming that the signature is correct (the certificate is issued by Huawei and authentic), the APK passes the authorization and is normally installed. If the certificate fails the verification, the APK will not have the device management permission. Accordingly, invoking the device management APIs fails and the developer is prompted with a security exception to ensure security of Huawei devices.

11 Privacy Protection

This chapter describes user privacy protection. Huawei devices may contain user privacy data, such as contacts, short messages, and photos. To protect user privacy, EMUI ensures that preset apps fully meet privacy compliance requirements, and provides app permission management, notification management, location-based service (LBS), and other privacy management functions. In addition, to further protect users' privacy, EMUI provides extended functions such as file safe, Private Space, and positioning disabling.

Permission Management

The Android operating system provides a permission management mechanism, which is designed to allow or restrict apps' access to APIs and resources. By default, no permissions are granted to Android apps, and access to protected APIs or resources is restricted to ensure security of such APIs and resources. During installation, apps request permissions, and users determine whether to grant the permissions.

The user is only notified of requested permissions at the initial installation of the app, and can only complete the app installation after granting the permission. As a result, users fail to deal with extra permissions granted to the app.

To supplement Android's permission management, Huawei enhances the existing app permission management by enabling users to allow/deny permissions to an installed app for fine-grained control. The permission management function applies to the following permissions:

Android-defined permissions:

- Phone call
- Network
- SMS
- Contacts
- Call record
- Camera
- Location data
- Recording
- Wi-Fi
- Bluetooth
- Calendar

EMUI-defined permissions:

- Sending multimedia messages
- Using call transfer (CT)
- Suspended window
- Creating desktop shortcut

Audio/Video Recording Reminder

Some malicious apps can obtain permission to access the microphone or camera through spoofing, and record the audio or video at the backend to steal users' privacy data. To prevent such behavior from malicious apps, EMUI provides the audio/video recording reminder function. When an app running at the backend is using a microphone or camera, the system prompts the user that this app is using the microphone or camera. When the user touches the prompt, the app interface or the app's permission management interface is displayed.

LBS

To protect users' location information, EMUI can disable Wi-Fi and mobile base station positioning in addition to disabling the Global Positioning System (GPS) service when LBS is turned off. In this way, users' location positioning can be completely disabled, ensuring user privacy.

Notification Management

For troubles caused by frequent notifications from apps, EMUI provides a notification management function. Users can allow or forbid an app to send notifications. In scenarios where users allow the notification sending, EMUI provides fine-grained management for users to configure as required whether to allow the app to display notifications in the status bar, lock screen, or on the top of the screen as a banner, and to allow ringing or vibrating upon notification receiving, to avoid unnecessary troubles caused by frequent notifications.

App Lock

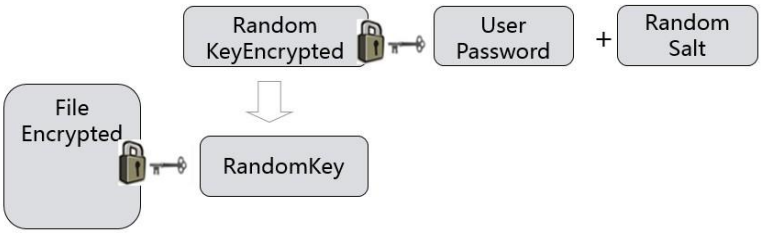
To protect the user's privacy when he/she lends the mobile phone to others, EMUI provides an App Lock mechanism. The user can set an access password for an app. Then, the user must enter the correct password for the app or pass fingerprint or facial authentication before using the app. This function prevents unauthorized access to locked apps and protects users' privacy.

File Safe

EMUI provides the file safe function, which allows users to add sensitive or important personal data to the file safe for protection. The file safe is a space encrypted using the user's password. All content in the safe is encrypted and protected using the user's key and be accessed only by the user.

Files in the file safe are encrypted using a randomly generated encryption key and AES256, and the encryption key is encrypted and protected using the safe password entered by the user. The user's password is not stored and cannot be restored.

Figure 11-1 File safe



Private Space*

To protect users' important privacy, EMUI provides Private Space. Designed based on the native multi-user mechanism of Android, Private Space is the encrypted and independent user space isolated from the master user space. Its app data is separately stored and isolated from app data of other users. Private Space provides isolation protection for data and apps stored in the internal memory. Users accessing Private Space cannot access the external SD card at the same time.

Private Space also provides an entrance hiding function. After the entrance to Private Space is hidden, other user space is completely unaware of Private Space unless switched to it on the user's lock screen homepage through the passcode or fingerprint. The quick user space switch function allows the user to use different fingerprints or passcodes to enter different user space: Use the device owner's fingerprint or passcode to enter Main Space; use the fingerprint or passcode to Private Space to enter Private Space.

NOTE

Main Space and Private Space must not have the same fingerprint or passcode.

To facilitate users' private data protection, the privacy space supports file (including three types of files, such as videos, audio, and images) transfer with Main Space.

Differential Privacy

EMUI uses differential privacy technology to protect information that users share with Huawei while improving user experience. Differential privacy adds random information to data before Huawei analyzes users' data so that Huawei cannot associate the data with your device. The data patterns appear only when user data is combined with the data from other users and the randomly added information averages out. These patterns help Huawei understand how users use their devices (for Huawei to improve related services and products) without collecting personal information.

Privacy Policy

EMUI provides an explicit privacy policy statement in the system and explicitly notifies users to check and confirm the statement in the startup wizard. In addition, the user can check the privacy policy statement in **Settings**. Due to different privacy policies in different countries, users in different countries should use specific privacy policy statements on EMUI released in the local countries.

Read Huawei Privacy Policy at:

http://consumer.huawei.com/minisite/worldwide/privacy-policy/cn/index.htm

12 Conclusion

EMUI attaches great importance to users' device security and privacy and provides an end-to-end (from bottom-layer chips and systems to apps) security protection capability based on chip hardware. EMUI constructs a trusted basic architecture for the device based on the chip hardware, and constructs security experience considering both security and user experience based on higher security and good computing performance of the device hardware.

EMUI is developed based on the Android operating system. At the system layer, EMUI enhances system security through enhancing kernel security. Based on underlying trusted platform and system security hardening, it provides a more secure system control capability for the upper layer. On the app layer, EMUI provides virus scanning, Block and Filter, data management, notification management, and other functions, and works together with the cloud to ensure security.

While providing security solutions, Huawei also attaches great importance to the establishment of the security process and security capabilities to implement security management through the product life cycle.

Huawei has set up a dedicated computer emergency response team (CERT) which is dedicated to improving product security. Any organization or individual that finds security vulnerabilities in Huawei products can contact Huawei at PSIRT@huawei.com. Huawei PSIRT will contact you in the shortest time while organizing internal vulnerability fixing, releasing vulnerability warning, and pushing patches for update. Huawei is sincerely willing to jointly construct Huawei device security with you.

13 Acronyms and Abbreviations

Table 13-1 Acronyms and abbreviations

Acronym/Abbreviation	Full Name
3DES	Triple Data Encryption Algorithm
ADB	Android Debug Bridge
AES	Advanced Encryption Standard
API	Application Programming Interface
ARM	Advanced RISC Machines
ASLR	Address Space Layout Randomization
CERT	Computer Emergency Response Team
HiCloud	HiCloud
DEP	Data Execution Prevention
ECB	Electronic Code Book
ECC	Elliptic Curves Cryptography
ECDSA	Elliptic Curve Digital Signature Algorithm
EAP	Extensible Authentication Protocol
EMM	Enterprise Mobility Management
EMUI	Emotion UI
GP	GlobalPlatform
HKIP	Huawei Kernel Integrity Protection
HMAC	Hashed message Authentication Code
HOTA	Huawei Over The Air
HUK	Hardware Unique Key
HUKS	Huawei Universal Keystore

Acronym/Abbreviation	Full Name
inSE	Integrated Secure Element
IPsec	IP Security
L2TP	Layer Two Tunneling Protocol
LKM	Loadable Kernel Module
LSM	Linux Security Modules
MDM	Mobile Device Management
NFC	Near Field Communication
NIST	National Institute of Standards and Technology
OTA	Over The Air
PPTP	Point-to-Point Tunneling Protocol
PRNG	Pseudo Random Number Generator
PSK	Pre-Shared Key
ROM	Read-Only Memory
RSA	Rivest Shamir Adleman
RPMB	Replay Protected Memory Block
SD	Secure Digital Memory Card
SELinux	Secure Enhanced Linux
SHA	Secure Hash Algorithm
SOTER	Standard Of auThentication with fingERprint
SSL	Security Socket Layer
TEE	Trusted Execution Environment
TLS	Transport Layer Security
TUI	Trusted User Interface
VPN	Virtual Private Network
WAPI	WLAN Authentication and Privacy Infrastructure
WEP	Wired Equivalent Privacy
WLAN	Wireless Local Area Network
WPA	Wi-Fi Protected Access
WPS	Wi-Fi Protected Setup

Change History

Date	Description
2018-11-30	Updated for EMUI 9.0: • Facial recognition • eID • Password vault • AI security defense • Huawei ID • AI application • Differential privacy
2017-10-31	Updated for EMUI 8.0: • HKIP • File system encryption key protection • SD card encryption • Secure input function improvement • Device interconnection security • Secure keys • Payment protection center optimization • Code scanning login • Find My Phone function improvement • Privacy space function improvement
2017-05-31	Released the first version.