FOGLINK

FOG LINK WHITE PAPER

Value transfer protocol and Fog Link OS open platform

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Contents

Abstract

FNK（Fog Link），Will be built FNK Supernode、IPFS(Inter Planetary File System)And fog computing nodes three types of network nodes。FNKUsing computers and peripheral peripherals of computers to recycle and reuse resources such as network transmission and storage space, according to the contribution of fog computing equipment.

Fog Link OS， Is FNK in DAPP platform Core competence，Fog Link OS huge release of the boundary and technical boundaries to allow more users to feel the convenience and change of block chain technology for work and life.

FNK will create a healthy and healthy development environment for application developers. Developers use FNK visualization operation to define their digital assets, and bring them into the application through the introduction of custom digital assets. In the FNK assets，The Fog Link OS traditional terminal will be used as a breakthrough point.

Fog Link OS Will support Fog Computing miner）、Block chain mobile phone、Private cloud disk and other equipment，Fog Link OS Gradually mature，More hardware terminal devices will be fitted，FNK 将 Open source to its own operating system, more developers can Fog Link OSTo develop and transplant its own equipment to create a greater contribution to the block chain industry.

Our idea is to pass in the early days Fog Link OS forIPFS(Inter Planetary File System) and Reasonable optimization of value transmission by several fog computing nodes，IPFS(Inter Planetary File System) On the basis of the principle of priority circulation of high quality resources。With high quality resources of IPFS nodes through FNK directly into IPFS, the transfer function will be in the process of FNK was presented in Fog Mine concept pool, all with IPFS value of the terminal will directly get IPFS or the equivalent of the FNK, the ability to calculate the fog obtained by the maximum value. In addition, it does not conform to the peripheral equipment that provides value for IPFS. It will become a real fog computing value output terminal, providing a strength for the stable operation of Fog Link OS. The

computing power generated by FNK's internal devices and peripherals can transform the output pipeline in accordance with the principle of maximizing value, ensuring the maximization of utilization and profit.

In the prototype design of Fog Link OS, we all use block chaining technology and elements to make the process generated by Block chain Contract have absolute flow and storage value, and Fog Link OS can be applied to mainstream devices through adaptation and transplantation.For example: in the Fog Link OS application in mobile phone design, user network boot device when the system will automatically assign the wallet address, to save the storage of his own force income and assets; in addition also have contact attributes wallet address, the user can use the mail list function in assets circulation.

In terms of security, Fog Link OS uses a specific encryption algorithm. In the mobile terminal strategy, text information and image information using encryption design, the use of FNK to solve the problem of network storage; SIM card shut down and wake by AI intelligent learning control, can realize zero harassment, physical location information conversion, transmission encryption and other practical security features on mobile devices. The maximum protection of the privacy and property of the user.

1. The combination of fog calculation and block chain

1.1. The concept and characteristics of fog calculation

The name "Fog Computing" was given by Stehr, a Buddhist in Columbia University, New York. His aim was to use "fog" to stop hacking. For the first time, CISCO put forward the new meaning of fog calculation. Fog computing is a distributed computing infrastructure for Internet of things. It can extend computing power and data analysis to the "edge" of network. It enables customers to analyze and manage data locally, so as to get real-time insights by connecting network.

In 2012 proposed by Salvatore et al in an article on the cloud data security in the article, through the use of false information as bait, fishing out QieMi "mole", and then achieve the purpose of protecting the real message of the user and cloud computing data, data processing and applications are stored in the cloud, fog

computing will scatter them at the edge of the network equipment.

The name of "fog calculation" is because the fog is closer to the ground by the relative cloud. Fog calculation has no powerful computing power, because the computing power is the peripheral and periphery of the computer and the scattered computing equipment.

Fog computing mainly uses devices in the edge network, with very low delay in data transmission. Fog computing, with a vast geographic distribution, is a large scale sensor network with a large number of network nodes. Fog computing has good mobility, and mobile phones can communicate directly with other mobile devices. Signals do not need to go to the cloud or even base stations to circle, supporting high mobility.In the FNK project, the OpenFog open source part is adopted in the fog calculation. OpenFog can meet the three basic needs of the transport industry: low latency, user privacy protection and different levels of resource acquisition.The fog is not more powerful computing server, network equipment, but by the performance of the weaker and more various functions of the distributed component, fog computing is semi virtual service computing architecture model, emphasis on quantity, whether a single computing node the ability to play a role. Compared with cloud computing, fog computing architecture is more distributed and closer to the edge of the network. Fog computing focuses data storage, data processing, and applications on devices on the edge of the network. Fog computing is a new generation of distributed computing, which is in line with the "de centralization" feature of block chain. Since CISCO made fog computing, already have ARM, DELL, Intel, Microsoft and other major technology companies and Princeton University added the concept of camp, and set up a non-profit organization open fog alliance aims to popularize promotion and accelerate open fog computing, networking and promoting the development of the industry chain block.

In the fog chain project on the deployment of FNK and OpenFog, from an infrastructure perspective, fog nodes and fog layers can appear in the FaaS. With FaaS, each layer of location and node deployment does not need to comply with a

single data center. However, this does not mean that it does not require security. Because of distributed data storage and network topology, both user and fog service providers face security threats.

Security is based on "things". These things must be based on the trusted hardware. This "trusted root" must be proved by the software that is running on it. Because near the end user and edge location, fog nodes must first be accessed and encrypted, providing integrity and isolation, and controlling privacy sensitive data. As the more complex topology is generated, the whole fog node "chain" will be trusted and security guarantees for other fog nodes and cloud ends. Because the fog nodes are also dynamically instantiated, the hardware and software resources must be trusted. Illegal components can not be involved in fog nodes.

There are many descriptions and attributes of security implementation, such as privacy, anonymity, integrity, trust, evidence, trusted root of hardware (ROT), verification and measurement.

1.1.1. Extensibility

It is important to deal with dynamic technology and business requirements for driving users to deploy fog nodes. Scalability in fog network can be understood as an effective system, and its scalability is carried out by adapting more devices.

1.1.2. Openness

Openness is the key factor for the successful application of the fog computing ecosystem to the Internet of things. If only a single supplier is owned and the supplier is limited, it will have a negative impact on the cost, quality and innovation of the ecosystem.

1.1.3. Operation autonomy

The fog deployment can have the ability to face the failure of external services and can also get support across the entire hierarchy. The autonomy in the edge network means that the intelligent and "peer" data produced by the "local device" can fully meet the business needs. Fog computing is based on decision making close to the equipment, not centralized decision-making like cloud, supporting some independent functions, such as: programmable, highly adaptive deployment,

allowing fog nodes and layers to complete new tasks, to accommodate dynamic operation and fully automated.

Autonomy is very important for fog computing system and fast and agile business operation decision. The data generated by the FNK device system is different from the data, knowledge, and decision-making patterns that can be understood by human beings alone. In the Open Fog architecture, autonomy ensures that FNK system devices produce useful data, fast transmission, and automatic fast decision, and automated processing.

Data is the key to the information system, and the Open Fog architecture is the same. Data generated by sensors and systems are chaotic and abrupt, and sometimes a large amount of data. Most importantly, there is no context for data. Context is based on operation decisions in FNK system. Context is only used when data are sorted, aggregated and analyzed. The analysis of data can be carried out on the surface of the cloud, but this increases the delay, and the uncertainty of the multi-layer transmission. So, the solution is to make all the operable decisions, once the data is converted into a meaningful context. This system can be faster and better to make decisions.

OpenFog computing resources can be logically layered in accordance with the functional requirements of the FNK system. Fog networks need to support hierarchical structures with local, neighbourhood, and regional levels to effectively divide computing tasks.

Fog calculation is quite different from cloud computing. Cloud computing is based on the service of IT operators and public cloud. The calculation of fog will be effective and emphasis on quantity, regardless of the strength of single computing node. Fog computing expands the network computing mode of cloud computing, expands the network computing from the network center to the network edge, and is more widely applied to all kinds of services. Fog computing has several distinct features: low latency and location perception, more extensive geographic distribution, adapting to mobility applications and supporting more edge nodes. These features make mobile service deployment more convenient and meet more

extensive node access.

1.2. Combination of fog and block chain technology

Fog computing architecture, using a large number of edge devices and computing terminals, together with traditional cloud services, performs data storage, computation, network connection and management related tasks. Compared with the traditional architecture, the fog computing architecture is characterized as follows:

(1) deploying in the vicinity of the location of the user and the commercial center for low delay storage;

(2) small form of equipment, light weight, easy to store and carry;

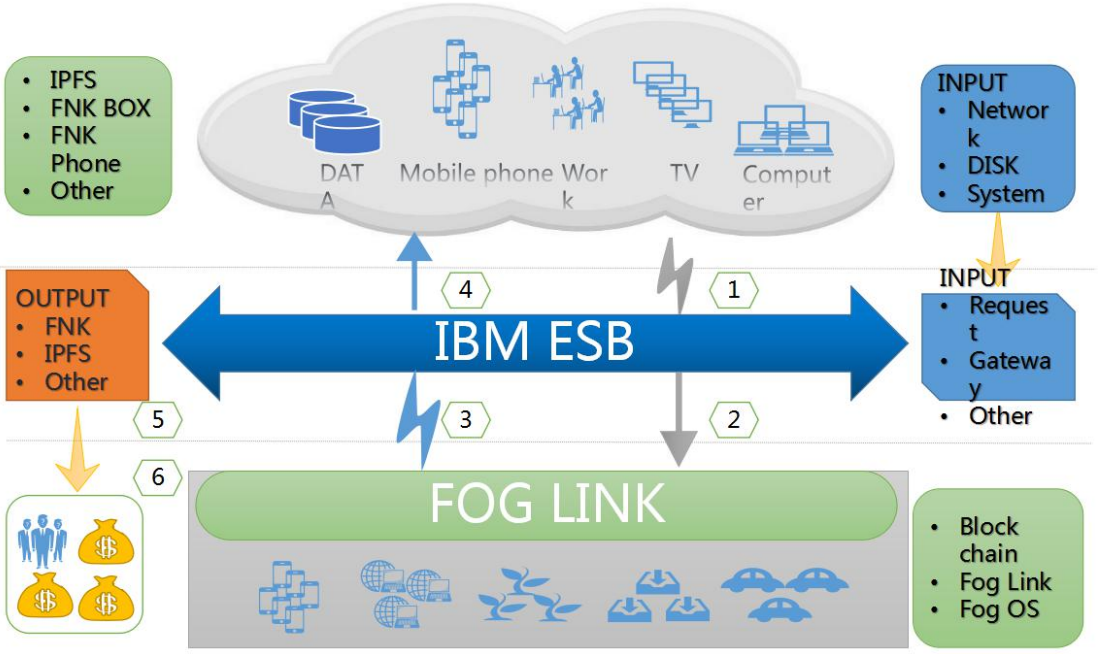
(3) Diver sified forms of equipment display, low requirements for the operating system and easy to transplant.

(4) operation near the end user to avoid delay and reduce network and bandwidth loss.

(5) low delay communication, not all communication should be routed through backbone network.

(6) implementation of management elements near the final node, including network measurement, control and configuration;

（7） reliability / availability / serviceability (RAS);



Combination of fog and block chain technology

Block chain technology can be understood as if we put the database into a hypothesis of books, read and write to the database can be seen as an accounting behavior, the principle of block chain technology is in a period of time to find the best accounting people, by the people to charge, and then all the other books of this page information to the whole system. This is equivalent to changing the database of all the records, to every other node of the whole network, so the block chain technique is also known as distributed books (Distributed Ledger).

Combined with the characteristics of fog computing and block chain, users can use FNK fog computing's device to submit specific disks and network resources, so as to get FNK digital assets.

2. Design principles of fog chain

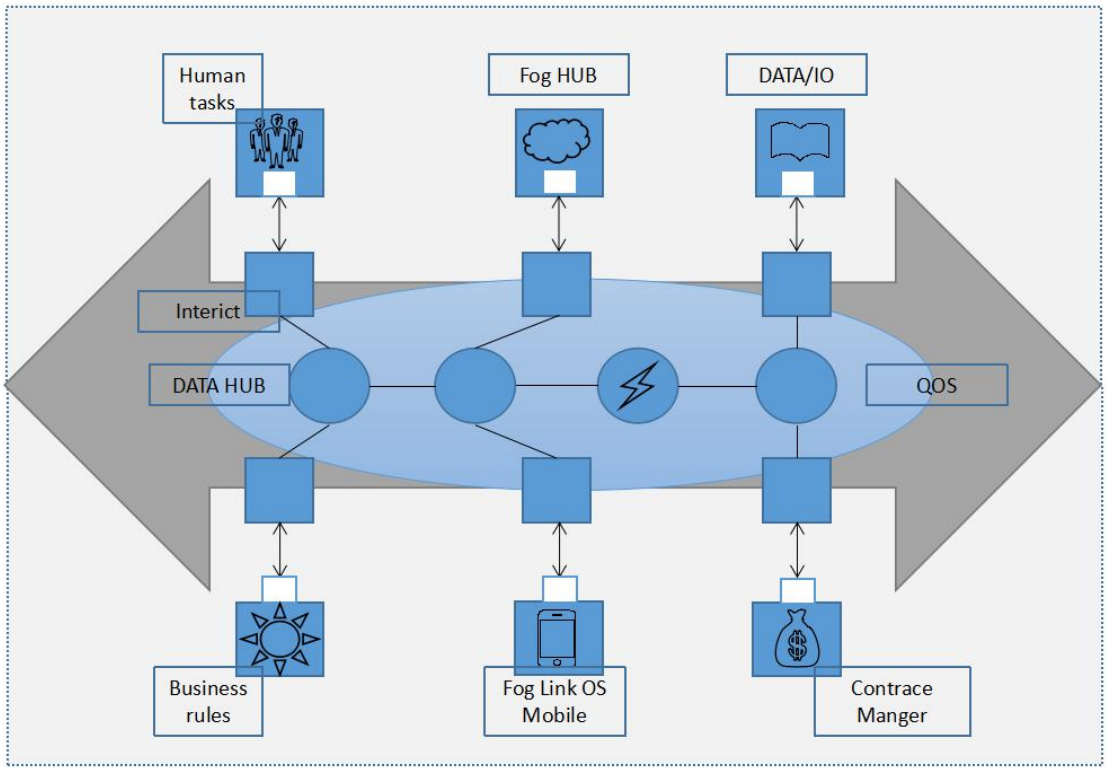
2.1. Modular design of fog chain

FNK system module coupling diagram

The initialization design of fog chain is built by modules, including contract management module A, contract management module B, transaction module, middleware module, input and output module and so on.

In the process of promoting application implementation, developers can use their own modules to develop software. The biggest feature of fog computing is local editing and fog ends.

2.2. The architecture of IBM ESB bus and FNK



The architecture of IBM ESB bus and FNK

In the area of block chain, fog chain is the first IBM ESB technology to realize centralization of distributed network nodes. IBM has three ESB products: WebSphere ESB (WESB), WebSphere Message Broker (. In the fog chain, the ESB bus is WMB, and the powerful processing speed and seamless network resource switching can make the FNK system not interfered by the stability of the fog computation, and then make the device more secure and stable.

In the center of the ESB bus, realizes to the center of the management, storage and transmission mechanism depends entirely on the data, in the fog in the chain through the use of ESB, but we are in the laboratory stage began with ESB to the center of the mechanism of the process test, standardization of computing nodes by mist, has demonstrated that through, can protect the miners and fog computing providers interests.

When a large number of devices are added to the fog chain, the safety and efficiency of ESB is obvious. In spite of this, the fog chain system architecture program also draws on the IPFS Inter Planetary File System, which is used for

persistent links of interest networks. In a population concentrated city, the operation efficiency and computing power return will be more prominent.

2.3. The network features of IPFS

The network features of IPFS

IPFS subverts the HTTP protocol, and transfers the value transmission to its own protocol through the decentralized network. In the value transmission process of IPFS, the FNK box stabilizes the computing system through IBM ESB, and then outputs more compliance values for IPFS.

2.4. Safety and performance of fog chain

WMB itself provides two levels of installation, a security management deployment, deployment of bar to Broker and WMB operation management commands access control; the other is a safe operation, involving access control including sending a message to the corresponding message flow, and information flow which can access resources and MQ non MQ resources, such as database system.

The bottom layer of WMB is developed by C++, which has greatly improved in performance compared with WESB. Similarly, at the bottom of FNK OS, C++ is also developed, which can cooperate well with WMB, and the number of messages that can be processed is between thousands to tens of thousands.

2.5. The systematization strategy of fog chain

FNK's system optimization benefits from IBM's ESB middleware solution. From the standpoint of IBM, ESB is not only a concept, but a middleware mode. It's not a product, but a new integrated application that coordinates resources and manipulates information.

In the process of using fog calculation to provide computing power for block chains, the diversification of device types and the ability of AI's independent judgement can't cope with the changes made by peripherals.

But fog chain is a product with ESB characteristics, and for a product with ESB class, management is also an important aspect. In the FNK fog calculation, it is necessary to use a number of lower energy consumption equipment to solve the contract management and stable circulation and all kinds of application scenarios. In this process, the IP address and the disk will have unpredictable instability, for example, when a service from an address switch to another address, when the structure is not changed, ESB products will provide a convenient way to adapt to this change. And fog chain is the use of this technology, in the fog calculation to adapt to the different environment and conditions of the transformation, from which to make the best choice.

WMB is an advanced version of ESB, which provides many powerful built-in nodes to support message routing, such as Filter nodes and Label nodes. In addition, Router nodes are introduced into the new version of WMB, which is almost the same as Router nodes in WESB. If we need to achieve dynamic routing,

we can use WSRR as the storage of services, WMB and WSRR have good integration. Through RegistryLookup and EndpointLookup, we can achieve dynamic routing in message flow.

3. Fog Link OS Solution

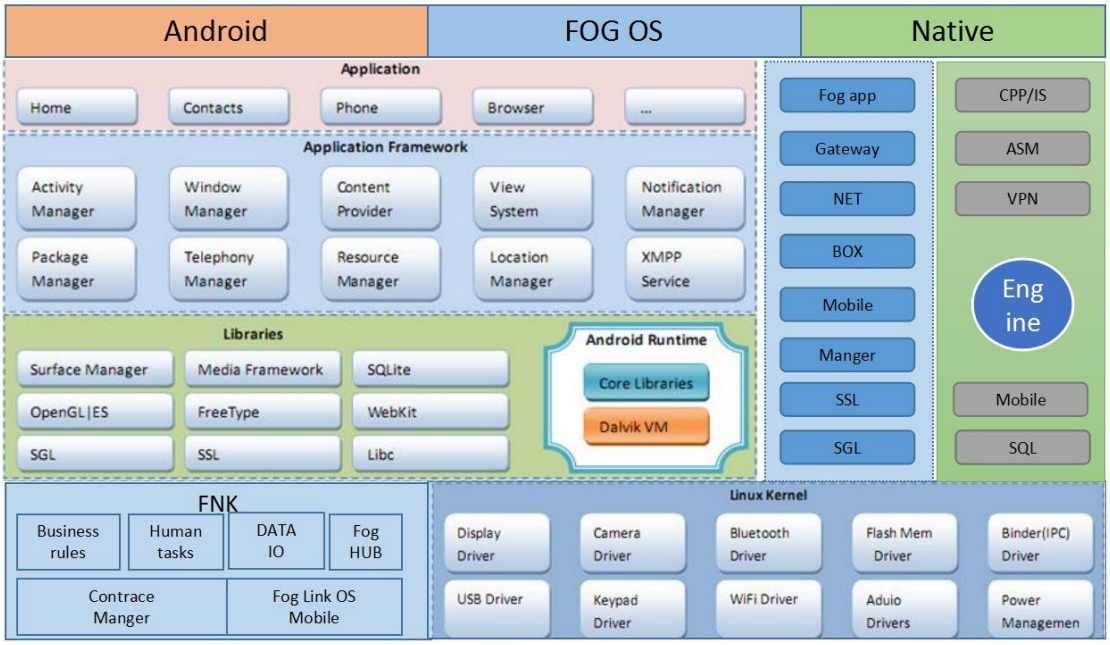
3.1. FNK's system architecture

System architecture design principles of Fog Link OS is based on practical and portable principle, FNK super node, file system IPFS (Inter Planetary star File System) and fog computing nodes three types of network nodes will be the best configuration in Fog Link OS, Fog Link in the OS system, using C++ language to ARM and for the preparation of Native matching, optimization of Caton Android system in the operation of the user experience, the use of all of the C++ language in the engine, the efficiency will be higher than JAVA.

In Fog Link OS system, independent adaptation is needed for different terminal devices. Although the workload of adaptation is increasing, the type and programmability of supporting devices are also necessary for block chain mobile phone operation system.

In the Fog Link OS CPU in the system operation efficiency of the device with C++ code to the ultimate optimization, make the input and output of the process in accordance with the transmission system of physics value, IBM ESB bus in the role of middleware also play a coordinating role of strong, make the system become more smooth and

efficient.



FNK's system architecture

The above is the system architecture diagram of the fog chain. The modular design in the map is highly compatible with Android through the common bottom layer with LINUX. It improves the computing efficiency for mobile phones, and allows more devices and chips to take part in it.

3.2. FNK OS's Code

In this code fragment, we compare the startup code of fog chain with Android. On startup process, Android and FNK OS are divided into two steps: process initialization and system Framework startup.

The following snippets show the difference between the two system startup and how the FNK OS is replaced by the Android.

AndroidSystem startup process	FogLink OS System startup process
①Linux init	*①Linux init*

```
service ueventd /sbin/ueventd
service logd /system/bin/logd
service logd-reinit /system/bin/logd --reinit
service healthd /sbin/healthd
service console /system/bin/sh
service adbd /sbin/adbd --root_seclabel=u:r:su:s0
service servicemanager /system/bin/servicemanager
service zygote /system/bin/app_process -Xzygote /system/bin --zygote --start-system-server
service vold /system/bin/vold
service netd /system/bin/netd
service ril-daemon /system/bin/rild
service surfaceflinger /system/bin/surfaceflinger
service drm /system/bin/drmserver
service media /system/bin/mediaserver
service defaultcrypto /system/bin/vdc --wait cryptfs mountdefaultencrypted
service encrypt /system/bin/vdc --wait cryptfs enablecrypto inplace default
service gatekeeperd /system/bin/gatekeeperd /data/misc/gatekeeper
service installd /system/bin/installd
service flash_recovery /system/bin/install-recovery.sh
service racoon /system/bin/racoon
service mtpd /system/bin/mtpd
service keystore /system/bin/keystore /data/misc/keystore
service dumpstate /system/bin/dumpstate -s
service mdnsd /system/bin/mdnsd
service afm_server /system/bin/afm_server
service uncrypt /system/bin/uncrypt
```

```
….
service foglink /system/bin/foglink
```

3.3. Fog chain system equipment

3.3.1. Foggy chain box

The FNK box can meet the protocol requirements of the IPFS transmission system, equipped with Gigabit NIC and USB3.1 interface. The device itself supports 1-5 bits, and the full load power consumption is no more than 45W.

In order to meet the requirements of large disk array, we designed the DEMO of the box according to the appearance of the disk array, built in FNK OS, and supported various types of disks.

From a practical point of view, FNK's disk array design saves users a lot of subsequent maintenance costs. When installing and using, it doesn't need to purchase the mobile hard disk alone, and then enters the pre installed RAID capacity logic after booting.

The box product of fog chain is a device equipped with interplanetary transmission

system. It provides functions of cloud disk and Media Center for the holder of the box, and also provides a part of capacity output for IPFS and network resources needed for Fog Link OS system operation. The FNK box is currently carried out at the same time as the system and hardware, and the next picture is the industrial design of the box and the partial interception of the effect

map.

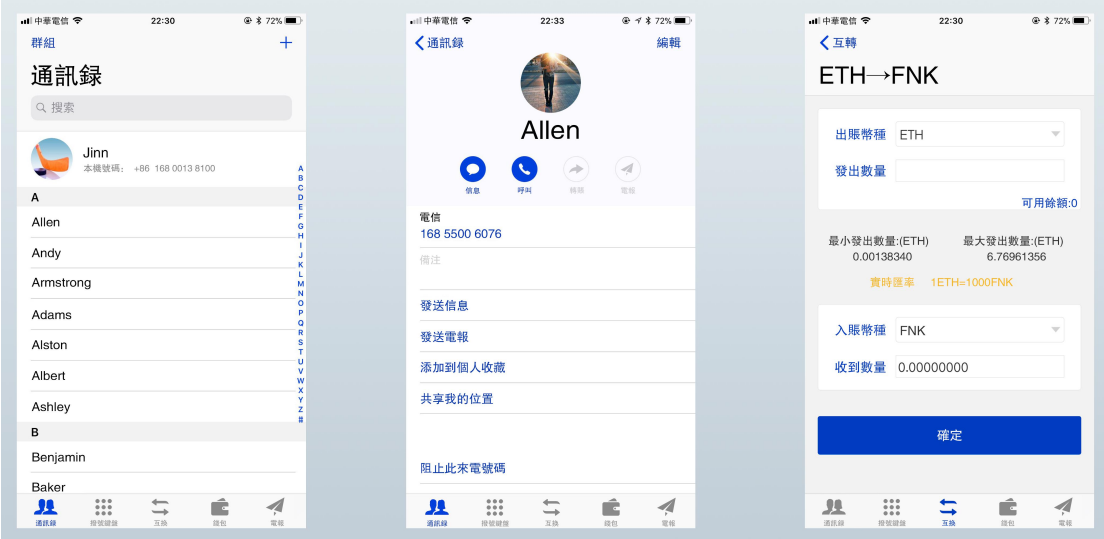
图：FNK 雾计算盒子 DEMO 图

3.3.2. Block chain mobile phone

Fog Link OS can be directly brushed into the mobile phone system after its adaptation and optimization. In the layout of mobile phone projects, our system has been able to run in HTC, Motorola and other mobile phones in 2014, and is highly compatible with Google Android.

We will continue to improve the UI and user experience, and strive to release the world's first block - chain cell phone, making a substantial step for the centralization of the industrial

layout.



Fog Link OS UI

The above is the screenshot of Fog Link OS on mobile phones, which is the deep transplantation of the first mobile operation system in the world. So in UI design, everything is conceived, and ultimately the actual R & D results are the standard.

3.4. fog chain open source program

In the decentralized chain industry, it is an open and harmonious way. We hope to open source code directly after FNK is launched, and also include the OS part of FNK.

Developers can easily participate in the construction and improvement of FNK. We provide a lot of Token support for software developers, game developers, device makers, fog computing contributors and other groups. All participants can get FNK candy based on their contributions.

3.5. Fog chain community

We will set up a fog chain community for enthusiasts, and the fogchain community will also support potential developers. At present, the number of idle terminals is very large and the operation system is not uniform. We really want to make use of idle equipment reutilization and divide the capacity according to the specification, so that the idle equipment can continue to reflect its value.

3.6. alliance organization

In the fog computing ecosystem, it is an ecological environment created by many

roles. Before that, we got in touch with IPFS official and promoted and co operated the IPFS technology agreement.

IBM and Open Fog have provided us with great help in technology, and we hope and expect more companies and individuals to join the SNK alliance.

3.7. Road Map

Since its establishment in 2014, the team is mainly committed to block chain hard equipment and IOT development in the field of fog computing. Through the team's FNK OS product, it released the world's first foggy based block chain cell phone product in 2018, and opened the product code.

3.8. Team profile

Bruce Song

- The Chinese Academy of Sciences, network security;
- The advanced IBM system architect;
- The State Key Laboratory of senior architect, big data expert;
- In distributed computing, parallel processing, image recognition, speech recognition, natural language understanding, deep learning, data mining technology has deep theoretical research and rich experience, has rich experience in the development of large data in telecommunications, electricity, finance, military, aerospace and other business areas;

Jinn

- The Tsinghua University MBA;
- Vice President - coolpad;
- Is Motorola (Motorola Inc) vice president;
- Deputy general manager of the company on communication;
- The NDAYS mobile phone system founder;
- It has rich experience in industrial design, circuit design, cell phone design, intelligent hardware design, language recognition, AI intelligence and so on. MOTO V3 series mobile phone leader;

Job

- The former Sony Ericsson Mobile Communications Ltd (Sony Ericsson) senior hardware engineer;
- The mobile new media & media founder;
- The telecom operators honest partner;
- Focus on mobile phone products and technology, in mobile games, mobile advertising, mobile payment and other fields for years of operation and promotion experience;

Fed Wu

- The Fog Link OS operating system founder;
- The Fota business senior architect
- Is reading palm reading technology and middleware technology architect;

- Senior engineer Qianxiang interactive mobile division is;
- The American media mobile software engineer;
- Focus on mobile advertising, new media operation, third party payment, operating system, mobile terminal equipment upgrading and other fields.

4. About this white paper

The book used to exchange only, which contains information or analysis constitute a purchase proposal or advice. This white paper does not constitute or should not be understood as the technical guidance and transaction provided, nor is it any form of contract or commitment.

Reference：

https://ipfs.io/

https://www.ibm.com/developerworks/cn

http://www.openfogconsortium.cn/

《OpenFog Architecture Overview》

Thanks：