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## KAIOS AND RELIANCE JIO PLATFORM'S UTILISATION OF ITS TECHNOLOGY

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### ABSTRACT

*KaiOS is one of the most popular Mobile OS in India. With about 150 Million users worldwide, it quickly gained market share as the preferred OS for feature phones. Its growth escalated by Reliance Jio Platform's feature smartphone, Hong-Kong based KaiOS technologies aims at global scalability amid 2020's year of digital transformation amid Coronavirus crisis. A deep dive into its technology shows how Mozilla Foundation's Firefox OS transforms web-based HTML applications into powerful tools for expanding the influence of the digital age. Reliance Jio, India's emerging telecommunication company, is credited with single-handedly advancing the reach of the internet in India. The underlying genius of using KaiOS allowed Reliance Jio to scale their ecosystem to reach the untapped market of Indian suburbs and low-income households of the Indian landscape.*

Keywords: [mobile operating system, operating system, KaiOS's features, KaiOS's challenges, Reliance Jio Platform, Development tools, Kai-Store, Socio-Economic divide]

### Introduction

KaiOS is based on the Mozilla Foundation's Firefox OS. It is developed by Hong-Kong based KaiOS Technologies, based in Kowloon, with TCL corporation holding its majority share. In 2016, using BG2 OS (Boot to gecko Os), an open-source community-driven fork of the Firefox OS (discontinued in 2016), the Kai OS was developed. It is designed for keypad based mobile phones and low-end specifications.

Google and Reliance Jio have both invested in the development of KaiOS and it has quickly become the third-largest operating system in the global market. KaiOS has shown considerable growth in the Indian feature phone market and with the Jio platforms ecosystem, it continues to evolve

and escalate the availability of 4G internet to several first-generation users in the Indian suburban and rural landscape

### Underlying technology

KaiOS is forked from the Mozilla foundation's Boot to Gecko OS, which was specifically developed for mobile. There are four major layers of B2G, the Gaia layer and the Gecko layer, the Gonk layer and the Jank layer. The UI is implemented over the Gaia layer while the Gecko layer serves as an interface to the underlying operating system. It works entirely using Open Web APIs.

The **Gaia** layer is implemented entirely using HTML, CSS and Javascript that

allows any modern web app to be implemented for it.

The **Gecko** layer includes a networking stack, graphics stack, a layout engine, a JS virtual machine and porting layers. This provides support for Gaia to use HTML, CSS and Javascript. It also ensures that APIs work on every OS.

The **Gonk** layer consists of a Linux based kernel (based on AOSP- Android Open Source Project), a userspace hardware abstraction layer (HAL). Gonk is a porting target of Gecko and allows Gecko to take full control of the interfaces of Gonk like the telephony stack and display frame buffer.

The **Jank** is a term used to the effect of slow/inefficient code operations in an app making the Ui laggy, unresponsive or blocked. This is highly avoided in the Gaia layer.

### **KaiOS Overview and Technology**

The KaiOs utilises the Gecko runtime to run HTML, CSS and Javascript to render web apps. Graphics API is used to paint rendered apps. Spidermonkey is the engine used to execute javascript and connected to C++ components using XPCConnect and WebIDL bindings. Applications and core processes communicate using only through IPC protocols defined by IPDL. File, memory management, threads and data structures etc. are provided through the XPCOM component object model.

**XPCOM** refers to a cross-platform object model developed by Mozilla foundation that

makes all of the functionality of Gecko available as components or reusable cross-platform libraries, that can be accessed using Gaia or web browser or scripted from any Mozilla application.

**Spidermonkey** is a Javascript engine written in C and C++ and is used in a lot of Mozilla applications.

### **KaiOS background and scale**

*Users:* KaiOS is already available on over 150 million mobile devices worldwide, with the majority of its growth being propelled by Reliance Jio platforms in India.  
*Scale:* The KaiOS has quickly become a powerhouse becoming the third most popular mobile operating system after Android and IOS.

*User access:* The KaiOS due to its unique platform has been a source of quick adoption for first-gen internet users in Latin America, Africa, India etc.

*Popular Apps:* KaiOS can power some of the most common and popular apps that utilise modern age internet speed and access. Some examples are Google Assistant, Youtube, WhatsApp etc.

### **KaiOS Achievements**

KaiOS offers a lot of Innovations and technological overhauls that have greatly transformed the mobile OS space. The untapped potential of feature mobile phones has been laid bare by the ease of use and functionality provided by KaiOS. The KaiOS team consists of over 300 people and has headquarters in the U.S, China, India and France. Google has invested over \$22 million in the development of KaiOs. The team has also won several awards like

“Changing Lives Award” at AfricaCom 2019 and the Best Mobile Technology Breakthrough at MWC Asia 2018. KaiOS has also been named as the Best Emerging Tech by Digital Trends at MWC Barcelona 2018. KaiOS has been named as Time’s best Inventions in the Social Good category for 2019. In its initial years, KaiOS was named as the Best Emerging Tech by Digital Trends at MWC Barcelona 2018.

JioPhone’s adoption of KaiOS has been a major propelling factor for its growth and has given KaiOS several more accolades to its name. JioPhone won the Nikkei’s product excellence award and Fortune’s Company Change the World Award.

### **Development Methodology and tools**

**Competition and Marketplace** - The KaiOS focuses on a completely different market segment targeting first-time internet users and low-income landscapes with an aim to provide access to modern apps and features available only on smartphone OS like Android or IOS.

The KaiOS marketplace works similar to Google Playstore or the App Store on IOS. Any developer can put their creation on the KaiStore. The KaiOS market share is only second to the most popular operating systems for mobile.

The competition lies on the lower end of the emerging KaiOS market. KaiOS gives the ease of development by allowing developers to use basic web technologies like

HTML, CSS and JavaScript to develop any apps.

With the rise of JioPhone, about 4.3% market share was captured by KaiOS in 2019 while nearly 3% was captured by IOS. The chart below illustrates these trends.

### **Development Tools:**

KaiOS provides several tools for the development of apps in its ecosystem. It provides an easy and uncluttered way to develop, deploy and maintain beautiful scalable apps on the KaiOS ecosystem.

**Simulator:** A KaiOS simulator to mimic hardware and environment for development.

**Design Guide:** Guidelines to create beautiful, intuitive and responsive apps on KaiOS.

**Debug Tools:** KaiOS apps can be debugged directly from any browser with Debug support, popular browsers include Google Chrome, Firefox, Safari etc.

### **Development Methodology:**

- Developing on KaiOS follows the same development methodology as any web-app. Any modern web development framework like react, VueJs or Angular can be used to develop a KaiOS application. Since the KaiOS apps run on relatively smaller screens, the KaiOS guidelines state that the apps need to be run on a screen size of 2.8 inches or 240\*320 pixels. This is also known as a QVGA resolution.

- To develop an app, a Firefox browser V59 newer is needed. Also recommended to use is a WEB-IDE provided by KaiOS official website. The Web-IDE provides all necessary tools for debugging and running the official app.
- The ADB or Android Debug Bridge can also be used on Windows or Mac environments for additional features and functionalities. NodeJs, a text editor and git are also necessary for optimal development experience.
- Using the design guidelines, any web app can be ported and modified to run on KaiOS. It is a simple process to follow with the most basic tools and technologies.
- There are two types of KaiOS apps, hosted and packaged. A packaged app is basically a zip file containing all app assets. A hosted app is similar to a website hosting, running from a domain.
- Both the hosted as well as a packaged app must contain a manifest file.

## Features

The key features of KaiOS include its massive ability to transform web apps into an interactive and dynamic experience on a form factor previously not dreamt of. KaiOS can access the 4G LTE bandwidth and can also access Web, rendering HTML5 pages with CSS and Javascript while also supporting Bluetooth, VOLTE and GPS! The KaiOS also works to improve the battery life of its devices to allow the devices to continue functioning longer and come out as true power-packed devices.

Over-the-air updates are also possible for KaiOS and all the features it packs can run on as low as **256 megabytes of ram**.

The KaiOS is being used by top manufacturers across the globe for feature phone development. Most notable out of these are Jio Platforms and HMD global, developing JioPhone and Nokia.

The market for feature phones is huge considering that several African, South-East Asian and Latin American countries have populations that are still considered to be first-gen internet users. The pocket-sized phones, affordable price range and a great deal of 21st-century functionality that keeps people connected have been a core in KaiOS ideology for its future path and market growth.

A highlight of the key features include:

- 4G Connectivity.
- VOLTE.
- GPS and Bluetooth.
- Support for cameras and sensors.
- File Transfer.
- App-store.
- Support for different video and audio formats.
- Support for payments.
- NFC support (Via hardware).
- Themes.
- Wallpapers.
- Developer support.
- Debugging tools.
- Supports all major apps like Facebook, Whatsapp, Youtube etc.
- Supports voice assistant through Google assistant.
- Support for Third-Party Apps.

- Wifi-Hotspot Tethering.

The KaiOS may need certain hardware installation for features such as NFC to provide full support to its whole range of functionalities. KaiOS also supports progressive web-apps and features like forge etc. through compatible hardware.

### **Specifications**

The KaiOS doesn't not require high-end hardware to run. The latest powerful mobile processor chipsets such as A13 bionic by Apple or Snapdragon 865 by Qualcomm. Neither does KaiOS require a hefty 6GB or 8GB of ram to function.

An optimal specification sheet for the KaiOS can be easily demonstrated by one of the most popular hardwares its being implemented on - the JioPhone.

### **JioPHone Specifications**

Screen - QVGA 240\*320 pixels

Ram - 512 Mb

Processor - Spreadtrum SC9820A

Storage - 4GB

Camera - 0.3 MP

Battery - 2000 Mah

The above specifications clearly reveal how KaiOS can function on low end machines, thereby decreasing cost to manufacture and strengthen its connection to consumers.

The bare minimum specifications for KaiOS can be as low as 256 MB of Ram, 1.3 Ghz processor, 512 Mb of storage etc. With specifications as low as these, KaiOS can quickly scale up to a wide variety of

hardware and enable an ecosystem to develop powerful and economically viable devices that propel economy and connectivity for the masses.

### **Reliance Jio Platforms - JioPhone**

Much of the credit of the rise of KaiOS goes to the mammoth scale of its growth on Reliance Jio Platform's JioPhone. Priced at just under \$10, the JioPhone quickly became the smartphone for the masses in India. It allowed KaiOS to become the second largest Operating system on mobile in Indian landscape right after Google's Android and before Apple's IOS. The popularity of JioPhone was largely due to its appeal to the Indian populace. KaiOS not only supported most major apps, but also allowed the first generation internet users (again propelled by Reliance Jio Platforms' own telecommunication network) to explore the never before explored realm of connectivity and power of communication. Using NFC, the JIO-Phone simplified payments by efficiently using KaiOS as a medium to deliver such a powerful tool on a relatively low end smart-feature-device.

The JioPhone was not only technologically disruptive but also a money maker! The KaiOS powered phone announcement gave RIL stock a bumper rise. So much so in fact, that the RIL stocks gained 2.5% after the night of announcement of the JioPhone closing in at ₹1,624.80. This was a record breaker ending a nearly decade long record of 2008 stocks of RIL.

At the 40th anniversary of Reliance's Annual General meet, the CEO of Mukesh Ambani revealed about 500 million mobile devices were still feature phones leaving them out of the digital revolution ongoing in India. The JioPhone was thus revealed targeted at this sector with the KaiOS powering all the necessary operations needed for a digital breakthrough for a nation.

### **Bridging the digital divide**

Reliance Jio Platforms had a simple three point plan to bridge the digital divide of India that arose from a socio-economic disparity fueled by lower prices and higher rural economy.

The above chart shows how the Indian Uber Rich, millionaires and billionaires, that comprise mere 1% of the total Indian population command over 77% of total Indian wealth. The rest 99% of the Indian population can lay its hands on only 23% of the total wealth with only 1% rise in its value compared to 73% for the Indian Uber Rich.

This created a huge problem for the Smartphone sector as the rapidly declining prices of smartphones were still not able to meet the critical economic value for the general masses of India.

That's where RIL came in with its ideology to bridge the digital and economic divide to power Indian digital revolution with a feature phone, packed with the power of a smart OS.

The 3 point plan of JIO platforms:

1. Connectivity - Through a data intensive, high coverage network.
2. Data Affordability - Through consumer focussed data plans at cheap rates.
3. Device Affordability - Through an effective charge of INR 0\* per device.

(\* 0 here states the effective price after an initial refundable payment of INR 1500, to be refunded in two years of use)

KaiOS has been a major game changer for JIO platforms to allow JioPhone specific features like on demand cable tv, Cinema App, inbuilt Voice Assistant and many others, allowing it to reign supreme in the feature phone segment and truly become a mobile operating system for the masses.

### **Future Path**

The KaiOS has an app store much like any other mobile OS. The Kai-Store, allows users to download third-party apps on any KaiOS enabled device. This launches furthermore venues to innovate and reach hordes of users previously untouched by the traditional smartphone market. As the hardware prices continue to fall, KaiOS is bound to use the advantage of a much powerful hardware to develop apps for its customers. The KaiOS team also plans on launching KaiOS on more feature phones in previously untapped markets of Africa and launching feature phones with customized and thematic versions of KaiOS much like different flavours of Linux OS or Android.

### **Conclusion**

The sheer refreshing take on traditional Mobile OS has been a means of technological disruption through KaiOS. It has allowed not only users but also developers to break free from a monotonicity of Google or Apple ecosystems of development into a fresh, dynamic and enthralling domain of firefox based development. With the world moving towards the need for a compact, compressed innovative model, KaiOS is the perfect example of an open WEB API model that innovates minimalism and redefines traditional web apps to function as a complete yet miniaturized version of their Desktop or SmartPhone counterparts.

This allows developers to develop apps for low end devices with minimum system requirements. As the hardware technology continues to evolve rapidly, KaiOS is bound to increase its capabilities to jam more complex apps with finer processing and tuning requirements to its QVGA screens and bare bones processor chips.

With Reliance JIO Platforms taking KaiOS at helm of its feature phone segment, KaiOS further has an opportunity to provide a customised experience on a hardware that it was built around. With many first time internet users now having a cost effective, cheap and powerful internet device with them, they too can start contributing to the digital revolution that covers the entire globe!

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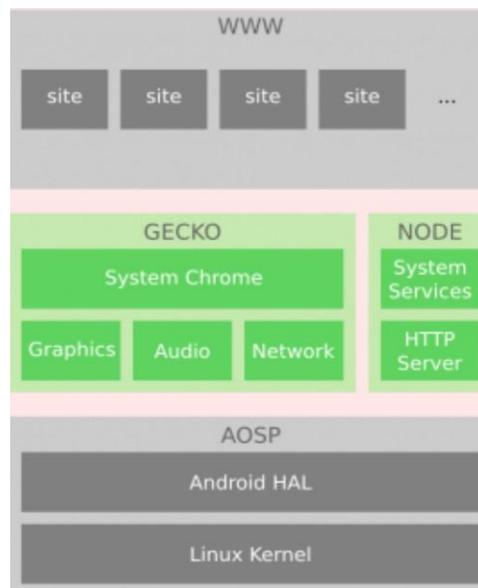


Fig 1.1 B2G OS architecture

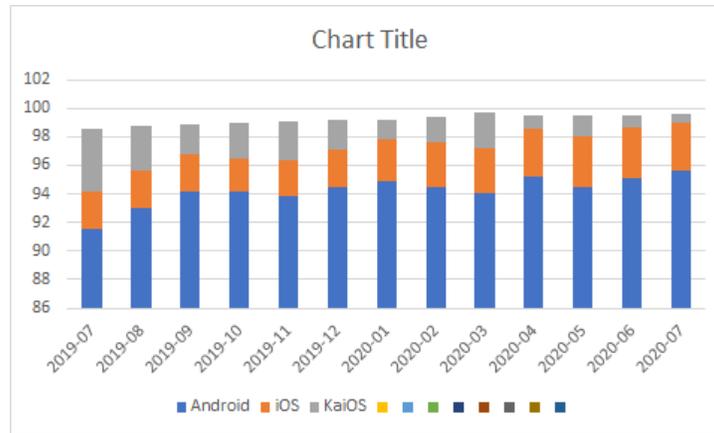
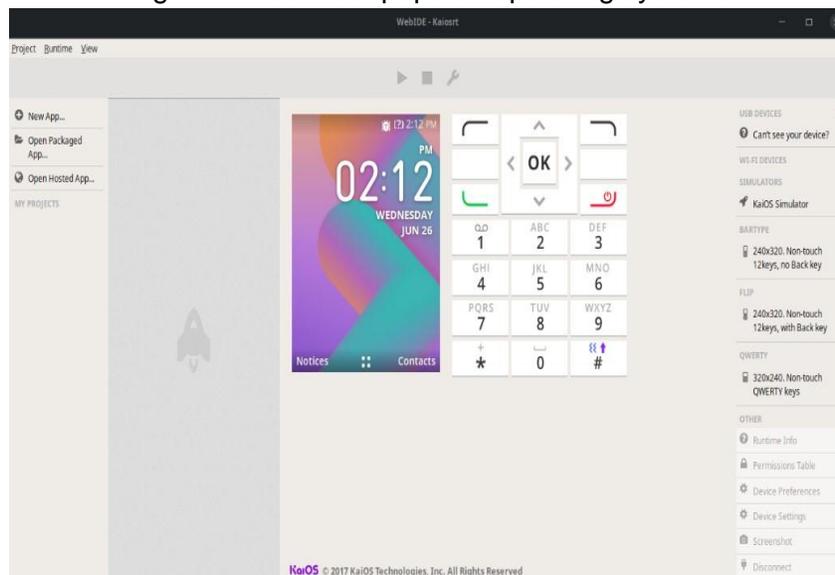


Fig 1.2 Three most popular Operating systems



A Kai OS simulator



Fig 1.3 A KaiOS enabled feature-phone



Fig 1.4 JioPhone by Reliance Jio Platforms

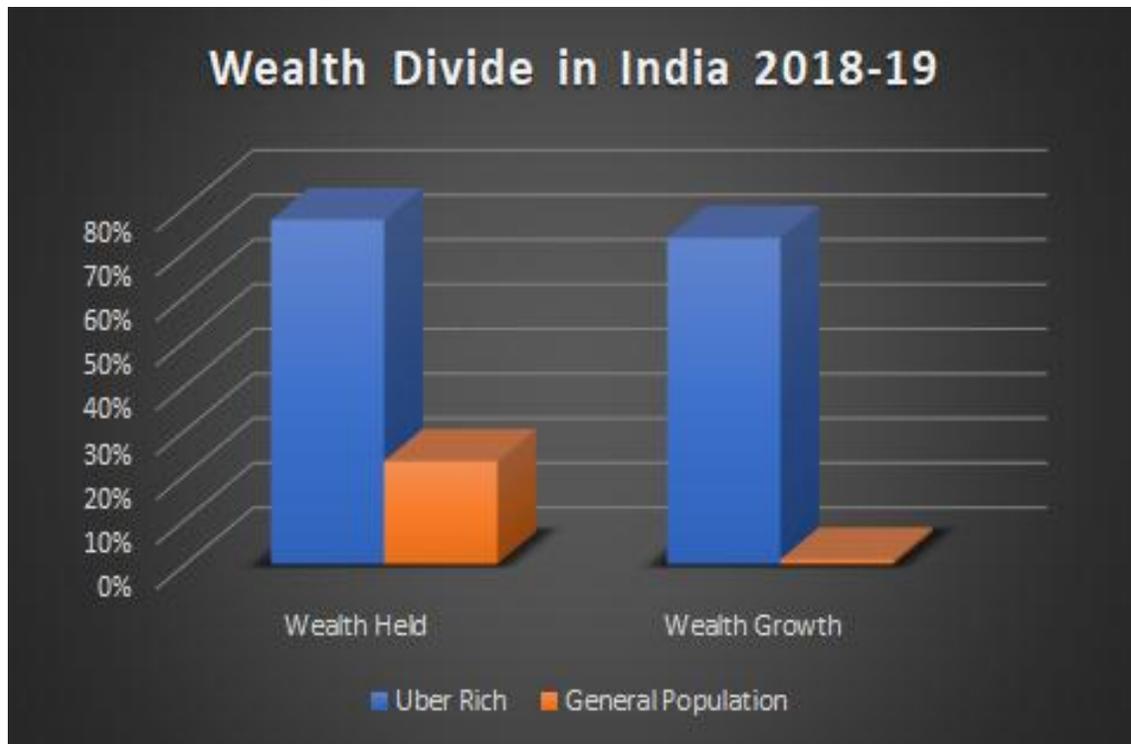


Fig 1.5 Indian Wealth Disparity for years 2018-19