



Kin3tic Mini

White Paper

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Introduction

The growth and future stability of our global economy depends on the ability of education systems around the world to prepare all students for career opportunities and help them attain higher levels of achievement. However, despite numerous efforts to improve educational standards, school systems around the world are struggling to meet the demands of 21st century learners and employers.

In both developed and developing nations, young people have become increasingly reliant on nascent technologies to connect, collaborate, learn, and create. Equally, employers have begun to seek out new skills to increase their competitiveness in a global marketplace. Education, meanwhile, has changed much less. With few exceptions, school systems have yet to revise the way they operate to reflect current

trends and technologies.

The underlying complexities that manacle educators around the world call for a bold and timely response — potent, low-cost innovations with global applicability. Solutions that allow poorer countries to leapfrog costly stages in the development and expansion of their education systems, while enabling schools all around the world to incorporate 21st century skills into demanding curricula.

What is the Kin3tic Mini?

The Kin3tic Mini is a technology education toolset that features a portable multi-host networked cluster of Raspberry Pi (RPi) nodes which emulates the design and operation of real world web technology stacks.

The architecture of the Kin3tic Mini segments the cluster into independent modular partitions that each perform dedicated networking and computing functions – i.e. Routing (LAN/WAN interfaces with NAT, DHCP, DNS, ACLs, and 802.11 wireless); Switching (Store-and-forward switching scheme, IEEE 802.3x Flow Control, and 802.1p QoS); Network Monitoring and Analysis (iPerf, Netflow and Sflow Data Analysis, and Packet Analysis using WireShark); and Computing (Web Server, Database, and Business Applications). The Routing layer provides convenient wireless access to the cluster through IEEE 802.11 Wireless technology, while the Computing partition provides central management for all nodes under a single pane of glass remotely via the K3 Cloud Dashboard, and locally via the *Docker Swarm* mode command line tool.

Network Design

The Kin3tic Mini follows a collapsed core network design that features functionary modular partitions.

Figure 1 below shows the overall topology.

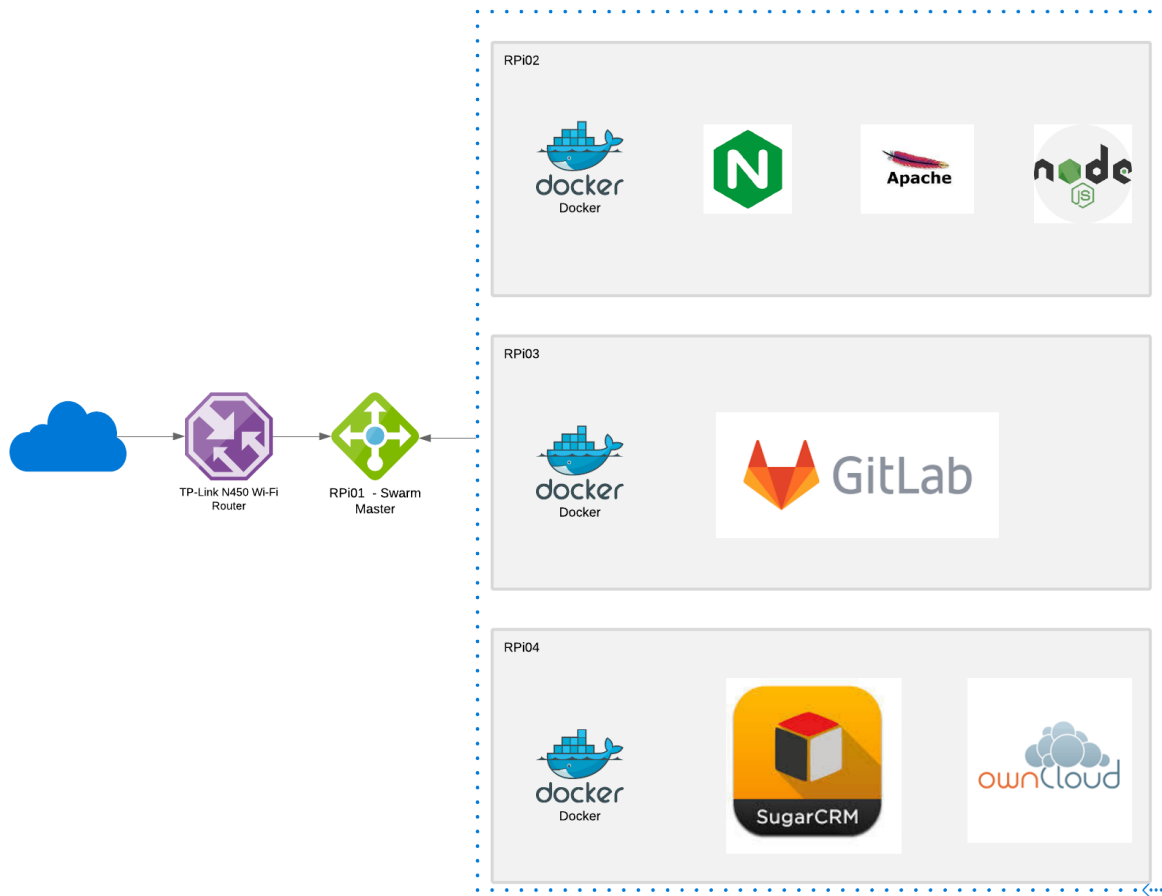


Figure 1

Figure 2 below shows a picture of the Kin3tic Mini in physical form.

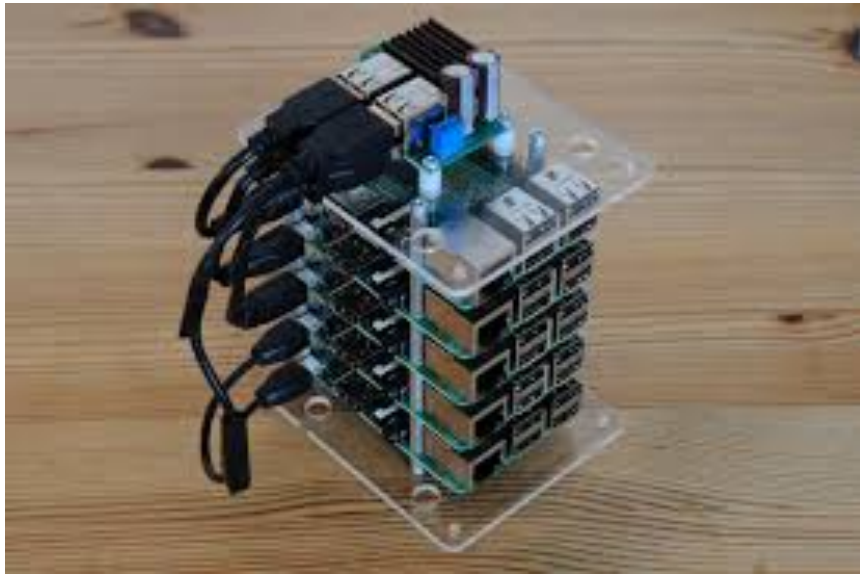


Figure 2 (a)



Figure 2 (b)

Deployment Architecture

Over-the-Air Configuration

Setting up and configuring a Raspberry Pi for the first time is tedious as it requires connecting a monitor via HDMI to access the administration console. The effort is exponentially increased when working with a cluster of Raspberry Pis. The Kin3tic Mini provides headless “over-the-air” access to Raspberry Pi nodes in the cluster for easy initial set-up and configuration.

Application Containerization

From OpenWRT to NGINX to MYSQL, everything on the Kin3tic Mini runs in containers.

Containerization allows fast development, efficient deployment of software and applications, and unprecedented scaling.

Instead of virtualizing the hardware stack, through Docker, the Kin3tic Mini virtualizes at the operating system level, with multiple containers running atop the OS kernel directly.

Containers also allow load balancing via a proxy. This creates high availability of applications on the Kin3tic Mini as multiple nodes simultaneously run a shared instance of the same application.

Cluster Management

K3 Cloud – the *K3 Cloud* provides a cloud based Kin3tic Mini management toolset that allows you to easily deploy, manage and maintain container environments on nodes in the cluster.

K3 Cloud gives you the tools (and the built-in knowledge of our experts) to keep your environments up. Because *K3 Cloud* has been designed from the ground up, it removes the risk of errors in complex command line strings which often create issues, outages or unpredictable results in deployments.

Swarm mode – containerization enables leveraging *swarm mode*, a clustering and scheduling tool for *Docker* containers. With *Swarm*, users can easily manage all the nodes in the Kin3tic Mini cluster locally as a single virtual system.

Why Use the Raspberry Pi?

The Raspberry Pi provides a low cost, easy to manage, and highly flexible hardware solution. It is also backed by a global community of users that is widely available across various forums on the internet.

The introduction of wireless connectivity and a boost in performance over its previous iteration made the Raspberry Pi 3 Model B the perfect choice for the Kin3tic Mini.

Extensibility

The Kin3tic Mini features built-in extensibility. Learners may choose to add more rpi0x nodes to extend functionality, or to leverage load balancing technologies and optimize network performance. Adding a 5, 8 or 16 port D-Link switch between the TP Link router and the RPi0x nodes doubles or triples the number of nodes that can be added to the Computing Partition. Additionally, given the default maximum throughput on the Raspberry Pi 3 Model B over

Ethernet is 100 Mbps, extending the Kin3tic Mini may cause material degradation in network performance. To circumvent this limitation, a USB 3.0 Gigabit adapter can be used to significantly increase throughput on the node uplinks.

Other Use Cases

The Kin3tic Mini has potential for use in various settings across the world – including in rural environments where internet access and reliable electricity supply are sparse. Tutorials, guides, and the requisite software packages can be provided via a USB drive to circumvent lack of internet access. Although those software packages will quickly go out of date, the Kin3tic Mini will continue to operate normally. The Kin3tic Mini can be powered via a Solar-powered multi-USB port power bank, removing the need for reliable electricity supply.

In addition, running specialized applications on the Kin3tic Mini can provide immense value to workers or small businesses stationed in areas with limited or no internet connectivity. Database applications running in the Computing Partition can be used to collect research or customer data in the field. That data can then be synchronized to servers in the corporate data center at a later time. Minimal copies of parts of an organization's intranet, or internal applications, can be run locally on the Kin3tic Mini to provide remote posts access to mission critical resources.

Useful Links

Product Website – <https://kin3tic.io>

Documentation – <https://docs.kin3tic.io>

Learning Hub – <https://learn.kin3tic.io>

K3 Cloud Dashboard – <https://cloud.kin3tic.io>