

Genode OS on the PinePhone FOSDEM 2023



Norman Feske
<norman.feske@genode-labs.com>



Outline

1. Background
2. Smartphones today
3. Genode on the Phone
4. Where we are, where we go



1. Background
2. Smartphones today
3. Genode on the Phone
4. Where we are, where we go



Background

- Self-funded company in Dresden / Germany
- Highly *secure operating-system technology*
- Idea in 2003, prototype in 2006, company founded in 2008

Team

- Tight-knit group of 10 people
- Open-source community
- Genodians.org (<https://genodians.org>)

Business model

- Commercial licensing and support
- Contracted research and open-source development



Genode Operating System Framework

- Construction kit for special-purpose operating systems
- Designed for mixed criticality and dependability



Genode Operating System Framework

- Construction kit for special-purpose operating systems
- Designed for mixed criticality and dependability
- **Attack surface reduced by 99%**

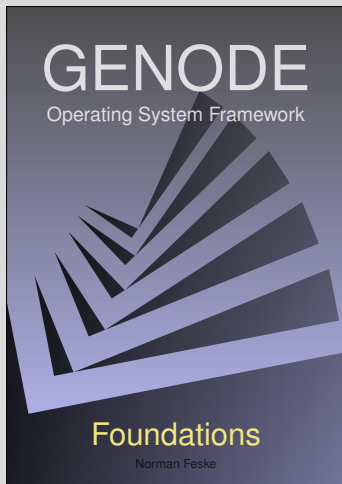


Genode Operating System Framework

- Construction kit for special-purpose operating systems
- Designed for mixed criticality and dependability
- **Attack surface reduced by 99%**
- Scales from embedded systems to general-purpose computing
- Integration of existing OSes (virtualization)
- Hundreds of ready-to-use components



The Book “Genode Foundations”



<https://genode.org/documentation/genode-foundations-22-05.pdf>



Genode-based Sculpt OS



Genode-based Sculpt OS

The screenshot displays a Genode OS desktop environment with several windows and components:

- Settings Window:** Shows configuration for a virtual machine with XML code. Key elements include:
 - `<input label="ps2"/>`
 - `<input label="usb"/>`
 - `<output>`
 - `<chरणop>`
 - `<romap>`
 - `<!--key name="KEY_CAPSLOCK" to="KEY_ESC"/>`
 - `<key name="KEY_F11" to="KEY_RESTART"/>`
 - `<key name="KEY_F12" to="KEY_DASHBOARD"/>`
 - `<key name="KEY_LEFTMETA" to="KEY_SCREEN"/>`
 - `<include name="buslock_romap"/>`
 - `</romap>`
 - `<accelerate max="50" sensitivity="1000" -->`
 - `<button-scroll>`
 - `<input name="ps2"/>`
 - `<vertical button="BTN_MIDDLE" speed="percent"="10"/>`
 - `<horizontal button="BTN_MIDDLE" speed="percent"="10"/>`
 - `</button-scroll>`
 - `</accelerate>`
 - `<input name="usb"/>`
 - `</romap>`
 - `<odid>`
 - `<key name="KEY_LEFTSHIFT"/>`
 - `<key name="KEY_RIGHTSHIFT"/>`
- Files Window:** Shows a file explorer with a table of files:

Name	Size	Type	Date
boot		Folder	
depot		Folder	
lost-found		Folder	
public		Folder	
recall		Folder	
- Terminal Window:** Shows the output of `cat /etc/passwd`:


```
root:x:0:0:root:/:/bin/sh
bin:x:1:1:bin:/sbin:/bin/false
daemon:x:2:2:daemon:/:/bin/false
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
```
- Component Inspector:** A central menu lists various components:
 - usb-1-7.3.fs
 - themed wm
 - Real-time clock
 - system clock
 - usb-1-7 part block
 - usb-1-7.3.fs
 - q15 textedit
 - Hardware
 - nic drv
 - nic router
 - Goa updated to Genode 20.02
 - March 2 2020 by Norman Peske
 - Now that Genode 20.02 is out of the door, it's a good time to update Goa to the match the most recent Genode version. Continue...
 - Exploring the ARMv8 system level - Virtualization
 - noux-system
 - Remove
 - 72.737 MiB / 76.0 MiB
 - 728 / 1000 caps
 - sticks blue backdrop
 - uplink labels wired domain="uplink"/>
 - domain names="uplink"/>
 - depot <crat domain="default" tcp-ports="1000" udp-ports="1000" icmp-ids="1000"/>
 - <crat domain="vm" tcp-ports="1000" udp-ports="1000" icmp-ids="1000"/>
 - <rule forward port="69" domain="vm" to="10.0.1.2"/>
 - <domain name="vm" interface="10.0.1.1/24">
 - <dhcp-server ip_first="10.0.1.2" ip_last="10.0.1.200" dns_server_from="uplink"/>
 - <tcp dst="0.0.0.0/0">
 - <permit-any domain="uplink"/>
 - </tcp>
 - </rule>
 - </domain name="10.0.1.0/24">
- File Manager:** Shows a file named `ram.fs` with a size of 728 / 1000 caps.



Outline

1. Background
2. Smartphones today
3. Genode on the Phone
4. Where we are, where we go



Dependency from smartphones is omnipresent.



Dependency from smartphones is omnipresent.

Smartphones need constant medication.

Curation of Apps, Security updates, Follow fashion



Dependency from smartphones is omnipresent.

Smartphones need constant medication.

Curation of Apps, Security updates, Follow fashion

Two corporations dominate.



Prospects



Prospects

1. Participation in (digital) society
2. Enjoying the utility value of smartphones



Prospects

1. Participation in (digital) society
2. Enjoying the utility value of smartphones
3. **Digital Autonomy**



1. Participation in (digital) society
2. Enjoying the utility value of smartphones
3. **Digital Autonomy**
 - ▶ Dependability → *no changes without user consent*
 - ▶ Dignity → *respect user attention, no Ads, no tracking*
 - ▶ Privacy of communications
 - ▶ Protection of personal data



1. Participation in (digital) society
2. Enjoying the utility value of smartphones
3. **Digital Autonomy**
 - ▶ Dependability → *no changes without user consent*
 - ▶ Dignity → *respect user attention, no Ads, no tracking*
 - ▶ Privacy of communications
 - ▶ Protection of personal data
4. Sustainability → *environmental footprint, learned skills*



Open Hardware?




Open Hardware?

Pinephone by Pine64

- Open-Source-friendly
(public documentation, schematics)
- Targeting the Linux community
(mainline kernel, diverse distributions)
- Well-understood 64-bit ARM SoC
- Readily available
<https://www.pine64.org>

Home / Smartphones / PINEPHONE – Beta Edition Linux SmartPhone



**PINEPHONE –
Beta Edition
Linux
SmartPhone**

Community price: \$149.99
(Retail price: \$249)



Open Source is not enough



Complexity defeats autonomy.

Linux distributions are impossible to assess.

We need to be faithful in an incomprehensible software stack.

No cure for security-update treadmill in sight.

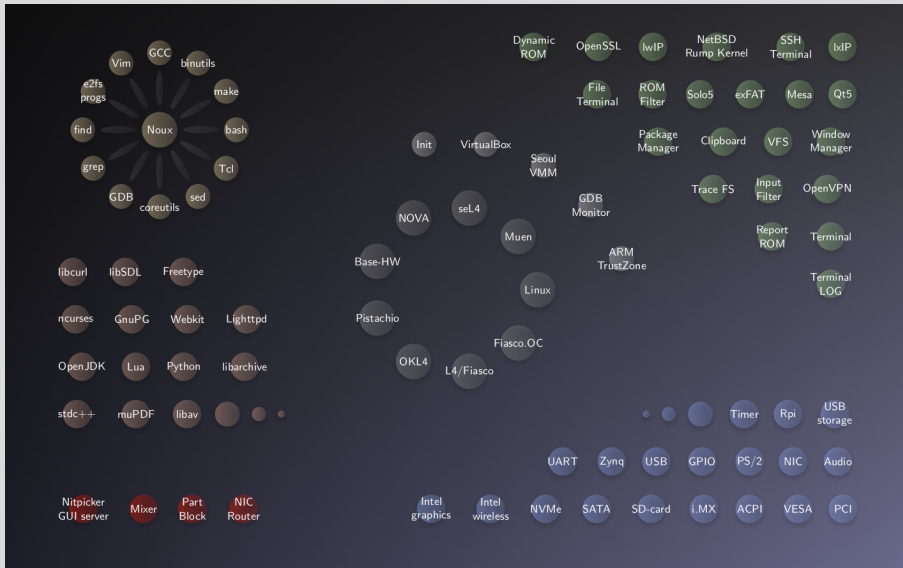


Outline

1. Background
2. Smartphones today
3. Genode on the Phone
4. Where we are, where we go

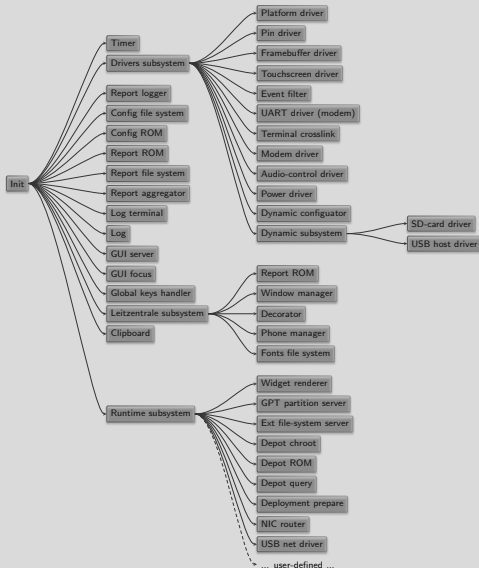


Genode OS Framework





Component-based mobile OS





Appliance role

Rich functionality



Appliance role

- Clear relation to physical features
- Ultimate control
- Dependability
- Low complexity, low friction
- Fixed function, foster familiarity

Rich functionality

- Expandable
- Rich user experience, great variety
- Updateable, customizable
- High complexity
- Provided by 3rd parties
- May not be trustworthy



Appliance role

- Clear relation to physical features
- Ultimate control
- Dependability
- Low complexity, low friction
- Fixed function, foster familiarity

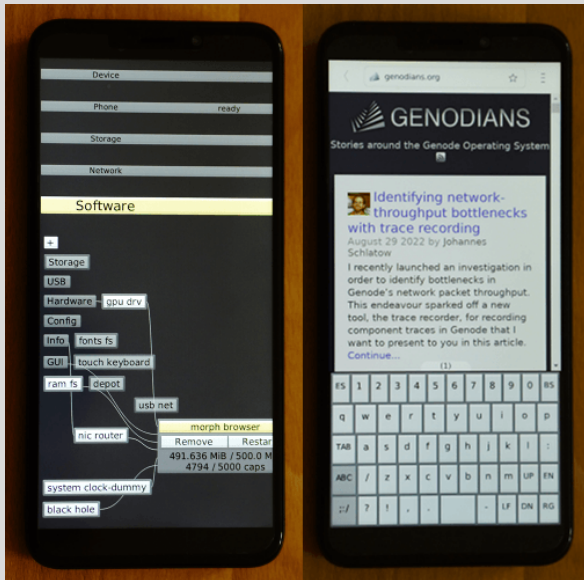
Rich functionality

- Expandable
- Rich user experience, great variety
- Updateable, customizable
- High complexity
- Provided by 3rd parties
- May not be trustworthy

Chasing a compromise between contradicting goals?



Mobile user interface - Split design



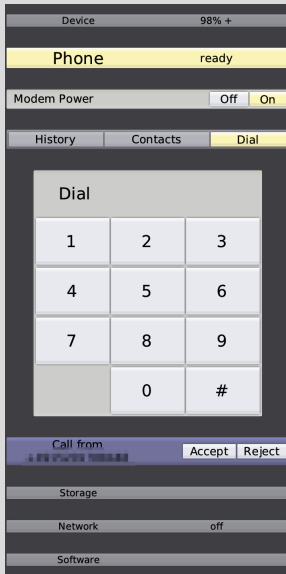


Mobile user interface - Home screen

Device	99% +
Phone	ready
Storage	
Network	mobile
Software	



Mobile user interface - Phone section





Mobile user interface - Software section

The screenshot displays a mobile user interface with the following sections:

- System Status:**
 - Device: 93%
 - Phone: ready
 - Storage
 - Network: mobile
- Software Section:**
 - Runtime | Options | Status
 - Storage: mmcblk0 | 1.fs | depot
 - USB
 - Hardware: gpu drv
 - Config
 - Info: fonts fs
 - GUI: touch keyboard (highlighted)
 - Remove | Restart
 - 14.592 MiB / 18.0 MiB
 - 344 / 400 caps
 - screenshot
 - ram fs
 - nic router | usb net
 - system clock-dummy
 - black hole



Live Demo



Outline

1. Background
2. Smartphones today
3. Genode on the Phone
4. Where we are, where we go



Eating our own dog food

Today

- Telephony
- Mobile data connectivity
- Package management, system update
- Device controls
battery, brightness, volume, mic
- Chromium-based Morph web browser
- Support for POSIX, OpenGL, Qt5



Eating our own dog food

Today

- Telephony
- Mobile data connectivity
- Package management, system update
- Device controls
battery, brightness, volume, mic
- Chromium-based Morph web browser
- Support for POSIX, OpenGL, Qt5

Immediate steps

- Completion of core phone functionality
- Performance, responsiveness
- Power efficiency, prolonged standby
- Encrypted storage, WireGuard VPN

Later this year

- GPS, Open-Street-Maps client
- Application SDK



First system image for the PinePhone

GENODIANS
Stories around the Genode Operating System

Authors

- Norman Feske
Genode Labs
- Michael Grunditz
- Christian Helmuth
Genode Labs
- Johannes Schlatow
Genode Labs
- Martin Stein
Genode Labs
- Sebastian Sumpf
Genode Labs
- Josef Söntgen
Genode Labs

External Links

- Genode OS project
- Genode at GitHub
- Join genodians.org
- Discuss at reddit
- Mailing list
- IRC

First system image of mobile Sculpt OS
February 1 2023 by Norman Feske
At FOSDEM 2023, I'm going to introduce the mobile version of Sculpt OS at the "FOSS on mobile" developer room - the perfect opportunity to kick off a first public field test. [Continue...](#)

Genode and RISC OS continued
January 18 2023 by Michael Grunditz
I am a RISC OS user and I love RISC OS. [Continue...](#)

Mobile user interface, not in the face!
January 5 2023 by Norman Feske
When approaching the user interface for a Genode-based phone, we started with the vague idea to mirror time-tested user-interface paradigms established in the worlds of Android and iOS, but we ultimately diverged from this beaten track. Instead, we took the opportunity to reflect the unique security architecture of our operating system at the user-interface level, giving the user an extremely strong sense of control over the device. This article presents our rationale and the initial scope of functionality. [Continue...](#)

Getting Fujitsu U7411 up and running: Network Boot
November 24 2022 by Christian Helmuth

<https://genodians.org>



Thank you

Genode OS Framework

<https://genode.org>

Genodians.org community blog

<https://genodians.org>

Genode Labs GmbH

<https://www.genode-labs.com>