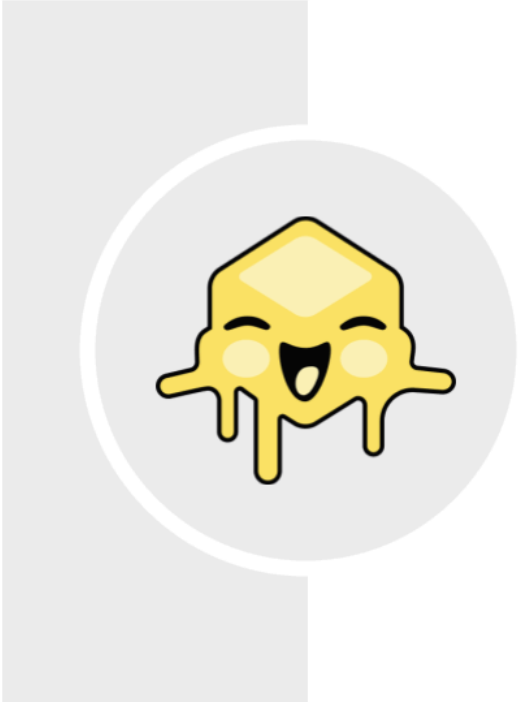


Butter Box

Life without internet made smoother

RCBox+ExtendEast - Final Report

FOR PUBLIC

Guardian Project (Oliver+Coady, Inc)

April 2026

Executive Summary

This report covers our ***second*** major deliverable for the RCBox “Extend East” program running from December 2025 through the end of March 2026. The first project deliverable was focused on Objective 1, which was to onboard and develop an overall workplan for the project with our regional partners. This also included user research and threat modeling, all which were successfully completed and reported on in January 2026. This work helped guide the rest of the program to a successful completion.

This deliverable report covers the outcomes and outputs of the remaining Objectives 2 through 6, all which were successfully completed. Details of each Objective, Deliverable and Outcome are provided in our “Objectives & Outcomes” table below.

The major technical highlights achieved were a complete overhaul of the “portal” user interface and admin panel, the successful coexistence and communication between multiple RCBox instances, the addition of support for fully offline delay-tolerant secure messaging (DeltaChat!) between one or more of those boxes, and the successful test of Wifi HaLow radios with IP routing to extend the physical range and number of RCBox instances for viable communication.

Through our collaboration with the regional partner, we successfully tuned the solution to better meet their needs and threat models, while collaborating to produce new localized documentation and content packs.

Overall key achievements included:

- **User Interface & Localization:** A new portal UI was implemented for easier customization, better privacy control, and documentation and content packs were localized for the regional context.
- **Network & Connectivity:** Support for multiple boxes on shared networks with automatic DNS resolution was added, alongside successful integration of encrypted delay-tolerant messaging services (DeltaChat+MadMail).
- **System Stability:** A new Debian foundation improved stability for simultaneous users and an updated database option improved the message board scalability and performance.
- **Maintenance & Security:** New methods for offline updates and administrative management were established, and a comprehensive tamper resistance guide was developed to protect the ecosystem.
- **Research & Collaboration:** Testing confirmed the viability of long-range wireless networks, while local partners provided ongoing feedback and testing support.

In summary, this rapid four month sprint supported a major step forward for the capabilities, security, and relevance of the RCBox project for the Eastern European context and threat model. We are on the cusp of shipping all of this new functionality and documentation as part of a major new release, and deeply appreciate the support from this funding that got us to this point.

Objectives & Outcomes

Objective	Deliverable	Outcome
Obj 1: Develop a workplan for the project, in collaboration with regional partners	a) Carry out onboarding and planning sessions with the primary project partner, including at an in-person gathering in Paris; b) Develop a roadmap for the work planned over the course of the project; c) Carry out initial on-the-ground user research supported by the partner org no anisation's volunteer network; d) Complete a comprehensive threat-modeling assessment tailored to the target region;	Completed Onboarding work plan development and threat modeling were successfully completed in January 2026. This work to help guide the rest of the program to a successful completion.
Obj 2: Introduce improved customization of RCBox firmware and instances to better fit the needs and contexts of local partners	a) Complete necessary software development to facilitate improved customization for visible UX elements; b) Complete necessary software development to facilitate improved customization for technical elements such as wireless network names and public/locked-down status;	Completed A completely new implementation of the portal user interface was completed, allowing for greater customization and control of privacy and security settings.
Obj 3: Ensure that RCBox software, content, and documentation is	a) Localize core RCBox software and documentation into local	Completed Review and new localization of

localized into target regional languages as required, and that region-specific content is made available to users;	target languages; b) Curate and make available region-relevant content packs, app stores and map files available for download and use;	interfaces. Documentation and content packs were completed. This included updating and localizing our user-facing documentation as well as curating a brand new content pack app store relevant for the local area.
Obj 4: Expand the range and capacity of one or more instances of the RCBox;	a) Engage in software and hardware development to allow single instances of RCBoxes to support more users, and operate with improved stability; b) Integrate RCBox support for a new delay-tolerant encrypted messenger; c) Documentation on using boxes with external wireless networking hardware is published, and straightforward to implement; d) The capability to link multiple boxes through local and long range wireless networks is researched and published as “advanced” documentation;	Completed The ability for multiple boxes to exist on a shared wide area or local area network was completed, including support for customized unique host names, and ensuring automatic DNS name resolution. The delay tolerant messaging support was successfully integrated and shown to work on single and multiple boxes effectively. It can also be used in a highly asynchronous manner by a large number of users. The new Debian foundation for the boxes have also provided for greater stability and support for more simultaneous users. This includes support for the message board feature to have a more efficient database. Key research was completed in testing new options for long-range ip-based wireless networks and shown that they could be used if successfully deployed
Obj 5: Improve the ability for RCBox instances to be sustained and secured;	a) Improve and clarify the process for updating firmware and updating content packs; b) Improve documentation to support partners to take a more active role in maintaining the instances they manage;	Completed A new method for updating boxes offline using the Debian package system and the content pack approach was documented, allowing for boxes to be updated without completely reflashing the firmware.

		A new administrative portal feature was completed to allow easier management of boxes by the communities that deploy them
Obj 6: Ensure that software is maintained, improved and updated to close vulnerabilities, and improve efficiency and reliability;	a) Release core debian and package system update; and b) Release core messaging service update.	Completed Multiple releases of the box were completed, which included the latest software releases of the core system and messaging services. In addition, the entire build system was overhauled supporting more regular ongoing releases
Partner Reports	a) Usability Testing 1 & 2	Completed The local partner was heavily involved throughout the project, providing weekly feedback, testing, updates and responses to surveys, as well as supporting the localization efforts
Conferences	a) SplinterCon, Paris b) ConnectionLabs, Prague	Our development team was able to meet our regional partner in-person in Paris and also attended a three-day ConnectionLabs meetup in Prague to discuss offline solutions
Additional Resources	a) Locking down the box	In response to an identified need from our local partners and their desire to lock-down the hardware. We developed a comprehensive user guide outlining best practices for protecting both the hardware and software components of the RCBox ecosystem. This document has been incorporated into the doc site.

Objective Status

Objective 1: **Develop a work plan for the project in collaboration with regional partners**

Objective 1 was completed on January 15, 2026, and submitted in the Deliverable I report.

The four-month RCBox+ExtendEast Project launched on December 15, 2025, in partnership with a regional organization in Eastern Europe. Early in the project, members of the development team met with partner representatives in person at SplinterCon in Paris. This engagement was critical to establishing trust, shared understanding, and a foundation for effective coordination throughout the project. Secure communication channels were established via Signal, alongside shared asynchronous working documents to support ongoing collaboration.

Through four collaborative work sessions and initial user research, the teams identified nine distinct RCBox use cases relevant to the regional context, each presenting unique operational and safety considerations. Given the heightened risks associated with deploying uncertified devices in repressive environments, research findings emphasize that RCBox deployments in Eastern Europe must prioritize the security and safety of both hosts and users.

User research and threat modeling surfaced three primary risks:

1. **Discovery**, where RCBox devices could be located and hosts identified through triangulation or physical detection;
2. **Confiscation**, in which devices could be seized by authorities, potentially exposing associated individuals; and
3. **Malicious Content**, including the risk of bad actors undermining trust and safety through disinformation, hate speech, or compromised content.

Through user research conversations with partners, we identified nine total uses of the RCBox technology in our target region. Four were deemed as priority: **news distribution**, **private communication**, **public anonymous sharing**, and **app and media distribution.**

1. **News Distribution:** Citizens are empowered to have a secure news source with at least minimal information and local updates. The RCBox setup can serve as a news source by providing access to internet content via radio channels or RSS feeds. For reference, The True Story (https://classic.thetruestory.news) is a trusted project that works to aggregate news for this Eastern European context.
2. **Private Communication:** Citizens are empowered to combat restrictions and blockages. The RCBox setup can operate as a communication alternative for individuals to exchange messages with people they know in private one-to-one and group chats/threads. For multi-box setups spanning large distances,

text-based communication is sufficient. Specific beneficiaries and situations include:

   a. Citizens, organizers and correspondents **during complicated situations** like public events, natural disasters and other situations with risks of losing communications.
   b. Citizens and students in public spaces, like campuses, social centers, hacker spaces and independent cultural centers—**as local infrastructure for communication in public spaces**.
   c. Organizers and correspondents **when other communication tools are blocked or damaged**—as an emergency signal or communication channel to connect with office staff.

3. **Public Anonymous Sharing:** Citizens are empowered to share and access information that is not provided by the government, especially during times of humanitarian crisis. For example, during a war-induced crisis, a RCBox setup can facilitate information sharing about missing people. For this case, communication can happen in the form of public anonymous posts.
4. **App and Media Distribution:** RCBox can empower students, cyber activists and radio fans to share information that cannot be exchanged or accessed over public wifi or campus networks—making it easier to distribute games, music and apps. For example, RCBox can be used to distribute VPN apps which have been banned from app stores and are difficult to get.

These use cases guided ongoing design and development efforts, with continued emphasis on persona-based, context-aware deliverables that reduce harm and align with real-world constraints.

Work completed under Deliverable 1 includes the development of a collaborative project workplan; onboarding and planning sessions with regional partners, including in-person coordination in Paris; creation of a project roadmap; initial user research supported by partner volunteer networks; and completion of a comprehensive, region-specific threat modeling assessment. Together, these efforts established a strong foundation for informed, responsible development throughout the remainder of the project.

Objective 2: **Introduce improved customization of RCBox firmware and instances to better fit the needs and contexts of local partners**

A continual goal of the RCBox is to find improved ways for local deployments and partners to customize their boxes and make their deployments relevant to the use context. Under this project, a major concern with our regional partner was the ability for adversaries to locate and tamper with the box itself. With these concerns in mind we

focused on ways to improve the box security within the software and hardware infrastructure. We completed new designs for administrative setup, and shared first as an interactive prototype with partners for initial UX review and feedback. Insights provided by our partners were taken into consideration. Then, once implemented the partners were able to test the new Admin Setup Wizard in March and provide feedback under the second phase of Usability Testing. New features allow significant improved ability to customize and secure the box instance.

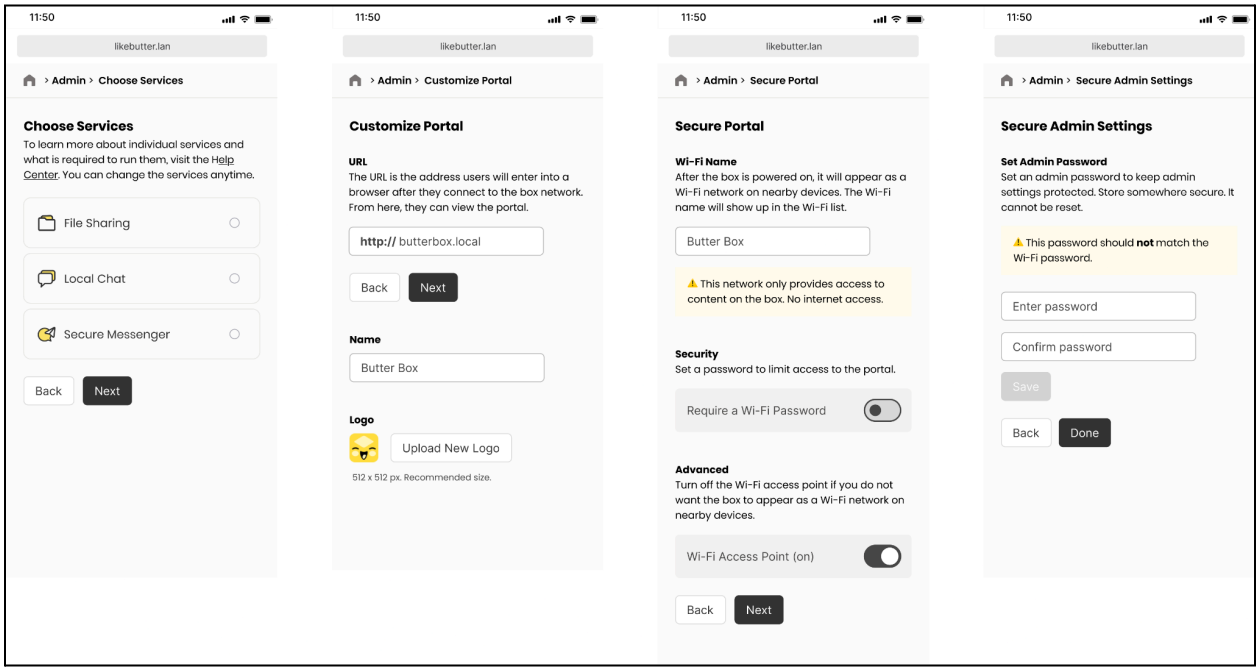
🛠️Admin Portal Updates

New Administrative Portal designs completed to offer:

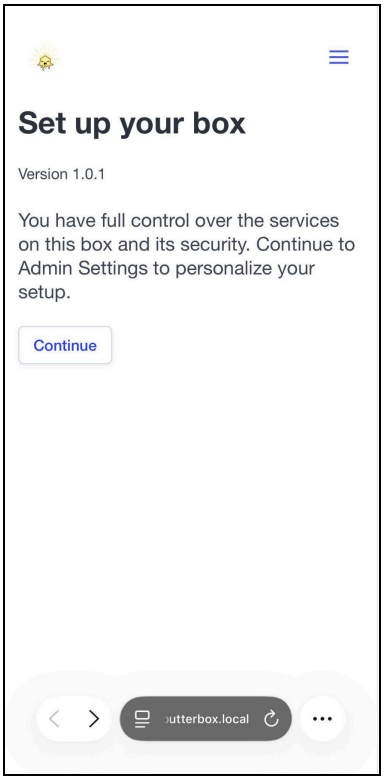
- Improved setup wizard to configure and control available services
- New options to secure the box and wifi hotspot with appropriate passwords and access controls
- Configure name and domain of box (both to enable multibox setups and to better identify and/or hide the box in public places)
- Ability to customize the box with name and logo
- Ability to choose which services the box operator wants accessible to users (connectors)
- Implemented a quick way to share access to the box using a QR code. This function is outside the setup wizard but is found under admin settings.

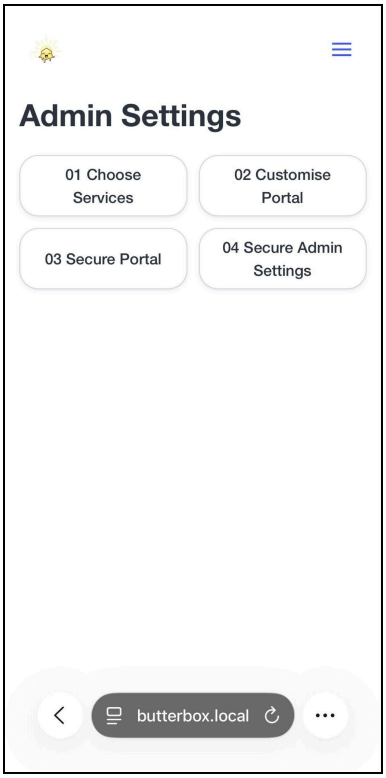
Full Onboarding and Admin Screen Designs (Figma):
https://www.figma.com/design/V4V7Un21tkyPQAIyGVxyMs/ExtendEast--Q1-2026-?node-id=0-1

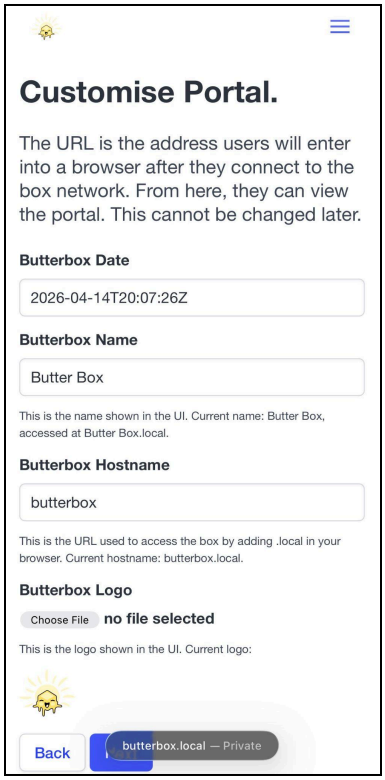
Subset of Design Mockups for Admin Settings:


11:50
likebutter.lan
Admin › Choose Services
Choose Services
To learn more about individual services and what is required to run them, visit the Help Center. You can change the services anytime.
File Sharing
Local Chat
Secure Messenger
Back
Next
11:50
likebutter.lan
Admin › Customize Portal
Customize Portal
URL
The URL is the address users will enter into a browser after they connect to the box network. From here, they can view the portal.
http:// butterbox.local
Back
Next
Name
Butter Box
Logo
Upload New Logo
512 x 512 px. Recommended size.
11:50
likebutter.lan
Admin › Secure Portal
Secure Portal
Wi-Fi Name
After the box is powered on, it will appear as a Wi-Fi network on nearby devices. The Wi-Fi name will show up in the Wi-Fi list.
Butter Box
This network only provides access to content on the box. No internet access.
Security
Set a password to limit access to the portal.
Require a Wi-Fi Password
Advanced
Turn off the Wi-Fi access point if you do not want the box to appear as a Wi-Fi network on nearby devices.
Wi-Fi Access Point (on)
Back
Next
11:50
likebutter.lan
Admin › Secure Admin Settings
Secure Admin Settings
Set Admin Password
Set an admin password to keep admin settings protected. Store somewhere secure. It cannot be reset.
This password should not match the Wi-Fi password.
Enter password
Confirm password
Save
Back
Done

A few Admin Settings and Setup Wizard Screenshots from in Production:





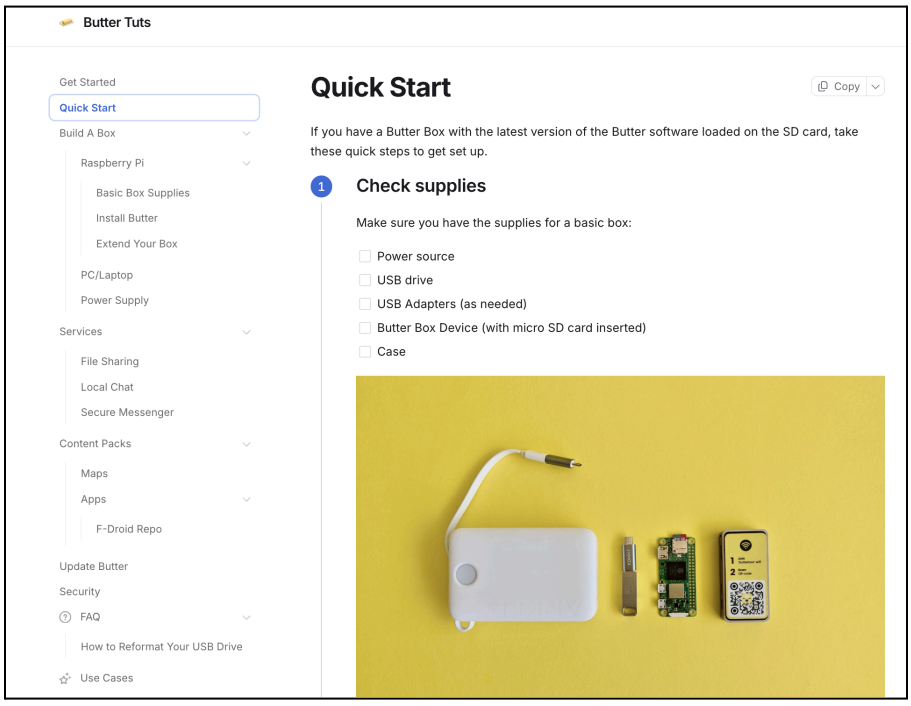


Objective 3: **Ensure that RCBox software, content, and documentation is localized into target regional languages as required, and that region-specific content is made available to users.**

The scope of this new phase of work focused on a completely new region, Eastern Europe. As a result, it was essential for our team to develop a strong understanding of the local context, needs, and constraints. This was achieved by working in close collaboration with our local partners, through a series of interactions that included online user research sessions, digital surveys, testing rounds, and ongoing weekly calls to provide updates, track activities, and receive feedback. The information gathered helped us create tailored localized content and the development of additional features to better support the specific needs of users in the region. A localized documentation site, a new and improved customizable and localized RCBox portal page, and custom content pack were three major achievements under this objective.

🧈 End-User Documentation site updates and reorganization

The core documentation site structure and flow was reviewed, updated, and improved. The new version breaks down all the content into simplified sections with an improved UI hierarchy with easy-to-navigate menus designed to help users explore all that the RCBox ecosystem has to offer without feeling overwhelmed, allowing users to access specific information faster.



**The new documentation site features navigation menus and content broken down into sections.*

A series of images, links to additional content, step-by-step instructions and even instructional videos were added to ensure all users, even those without technical backgrounds will be able to follow the user guides and build, test, troubleshoot, and deploy RCBox ecosystems on their own.

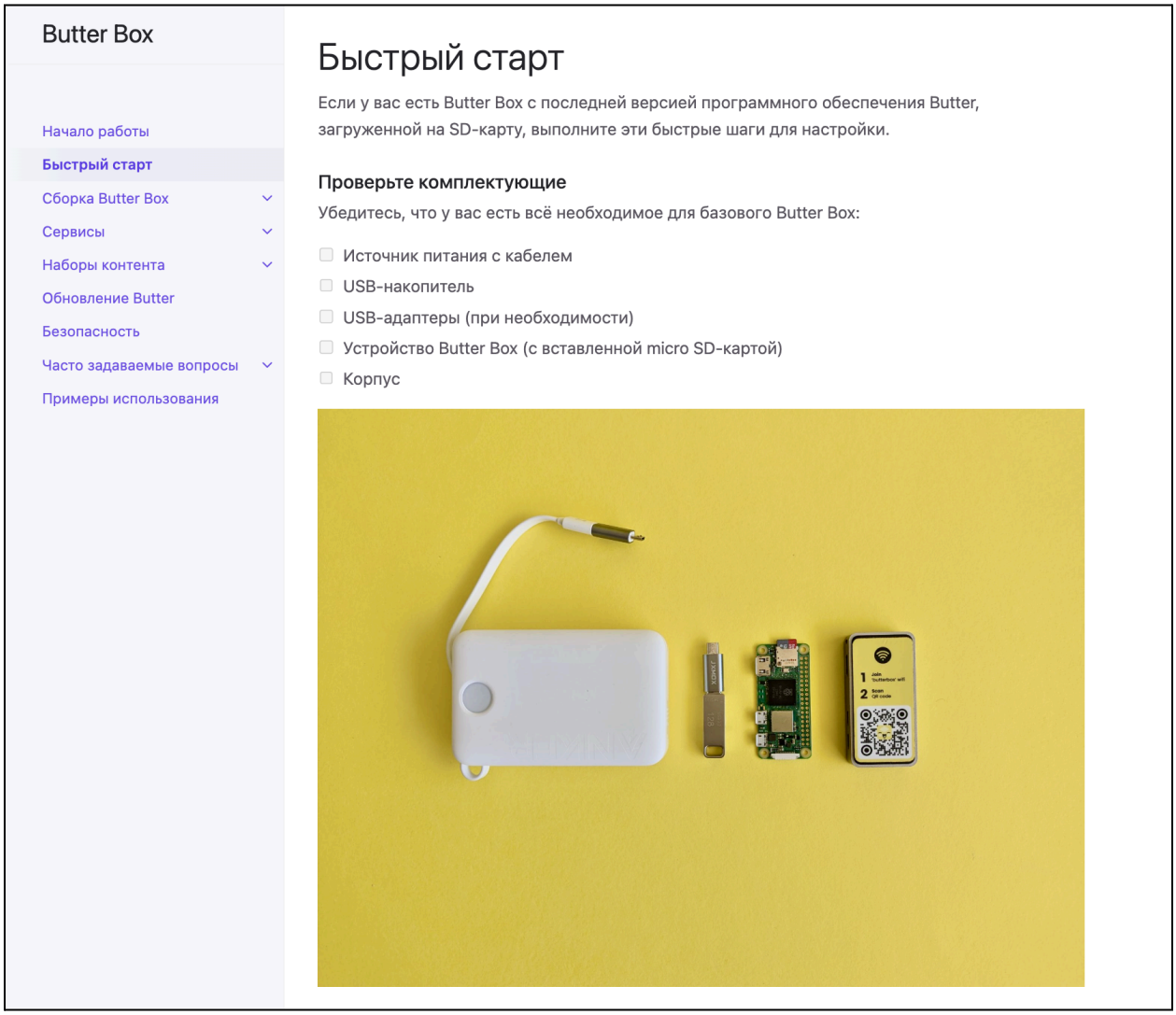
Delta Chat was included as a Secure Messenger feature to the RCBox ecosystem under this round of work. The improved version includes content about the Delta Chat integration: https://docs.likebutter.app/services/secure-messenger

- **Updated English Documentation:** docs.likebutter.app
- **Source:** https://github.com/guardianproject/butter-docs-site

🧈Localized RU Documentation Site

A very important part of the project was the localization of the documentation site for the region in the scope. Completed by our local partners, it included the translation of the site into Russian with subtle adjustments to adapt the content to the local context.

We recognize some images are not yet localized on the documentation site and have devised a plan for images, and videos to better handle localization in the future.



**The localized documentation site*

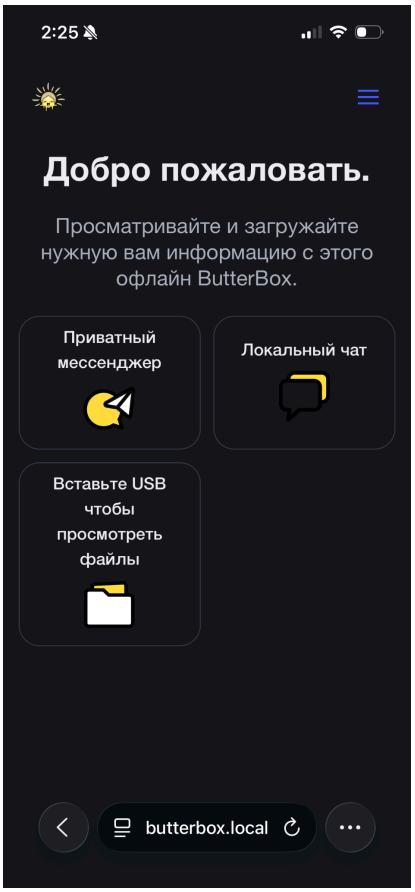
- **Source Code:** https://github.com/guardianproject/butter-docs-site/tree/locale_ru
- **Live localized into RU documentation site:** https://guardianproject.github.io/butter-docs-site/
- **This version of the documentation site has also been made available as a downloadable content pack for offline viewing and distribution:** https://github.com/guardianproject/butter-docs-site/releases/tag/0.0.2-locale-ru

🧈Localized User Interface

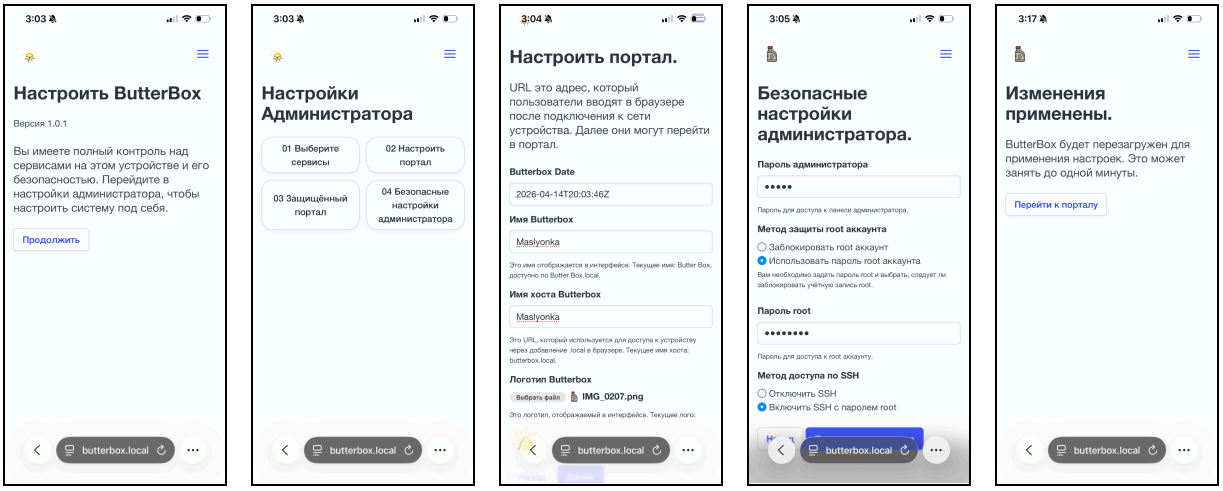
We are thrilled to announce that the RCBox ecosystem user interface, including the administrative setup wizard, was fully localized into Russian by local partners as part of this project! The translation process was conducted after partners had hands-on experience testing the RCBox system independently, ensuring familiarity with its functionality and improving the accuracy and contextual relevance of the translations. We plan to include a language switcher in the portal in the near future.

The localization work for the RCBox project was done through Weblate. Managing localization through Weblate has been a strategic decision that significantly strengthens the project's scalability and sustainability. By centralizing translations on a collaborative platform, the team can efficiently update existing localizations and rapidly expand into additional regions using the same workflow. This approach reduces duplication of effort, improves consistency across languages, and enables ongoing contributions from local partners, ensuring that the system remains adaptable and responsive to evolving user needs.

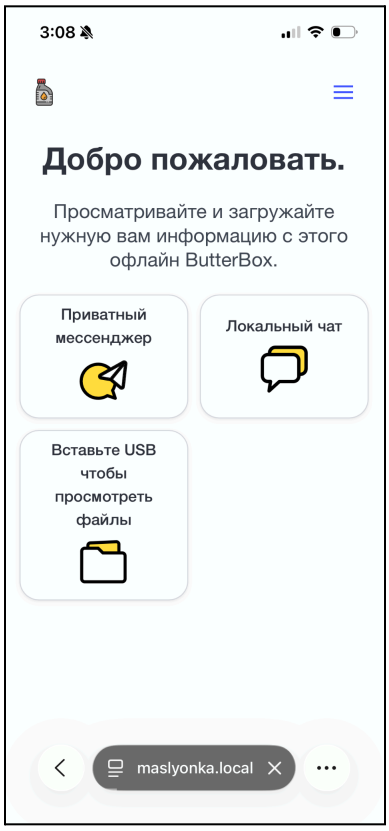
Localization platform: https://hosted.weblate.org/translate/sr2/-/ru/



**The Russian version of the RCBox portal interface, displayed on an iPhone device using the Dark Mode setting.*



*Localized Admin Settings Wizard



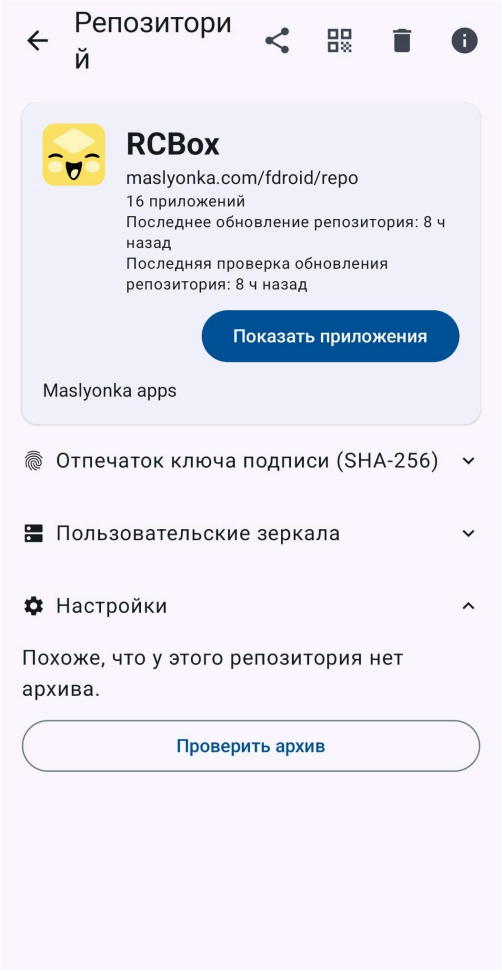
Sample of a customized User Interface featuring a new logo, customized URL, and using the device's default language.

📦Localized, Curated App Store & Content Pack

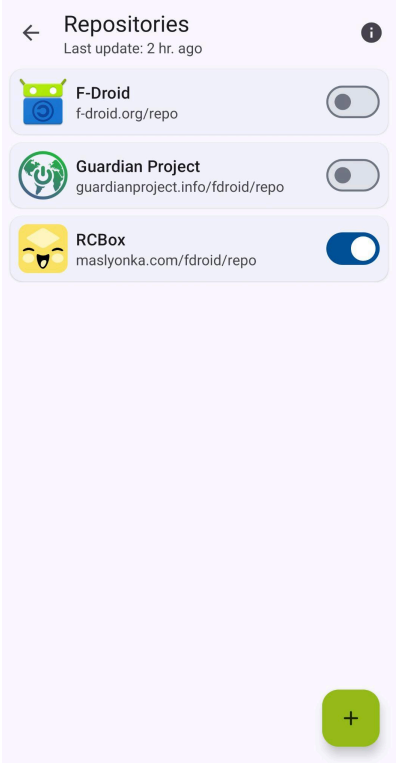
Alongside the development of new features and context-driven design improvements, a key objective of this project was to produce a set of localized resources tailored to the region, guided and co-created with the expertise of local partners. This included an offline app store with essential tools such as a document viewer, flashlight, calculator, circumvention tools, encrypted messaging applications, secure browsers, a calendar, an audio recorder, a camera app, and a QR/barcode scanner, all sourced from F-Droid. In addition, VPNs tested and recommended by the local partner, sourced outside of the F-Droid repository, were incorporated into these resources.

All those materials have been fully translated and are now available in two formats:

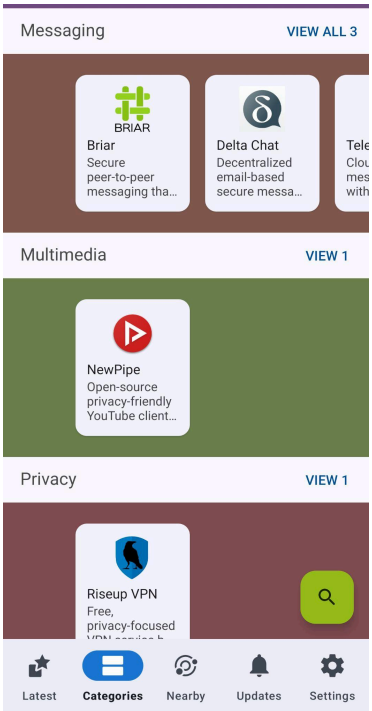
- An **F-Droid Repository:** https://guardianproject.dev/butter/contentpack-circumvention



**The localized Maslyonka F-Droid repository.*

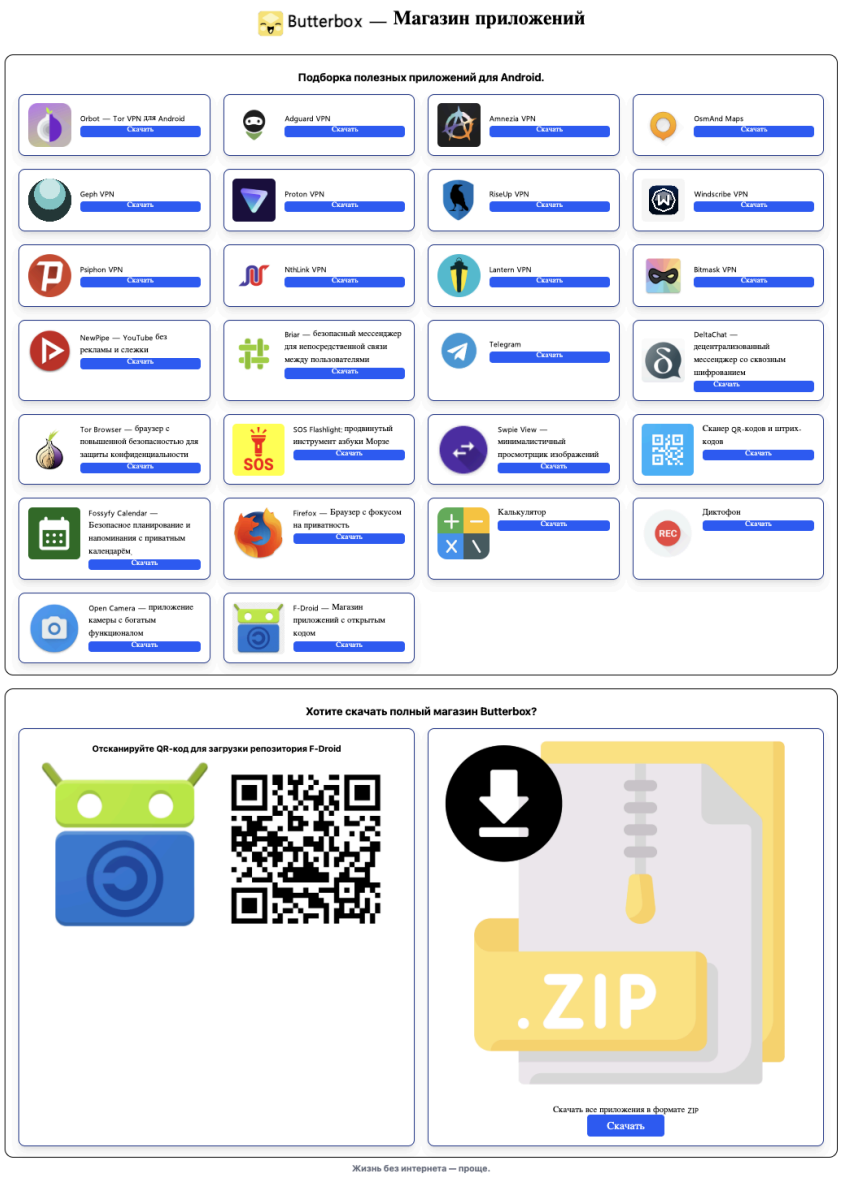


Once the Maslyonka repository is added to a user's F-Droid client, users gain access to a curated catalog of applications that can be browsed, searched, and selectively installed based on their needs. F-Droid also enables users to receive updates for installed apps directly from the repository, ensuring they have access to the latest secure versions while maintaining control over which applications are installed on their device.



A view of the Maslyonka F-Droid repo displaying the apps in it by categories.

- A **Content Pack** file that, when transferred to a USB drive and connected to the RCBox, deploys a local web interface allowing users to browse and download apps from any browser without requiring Internet access.

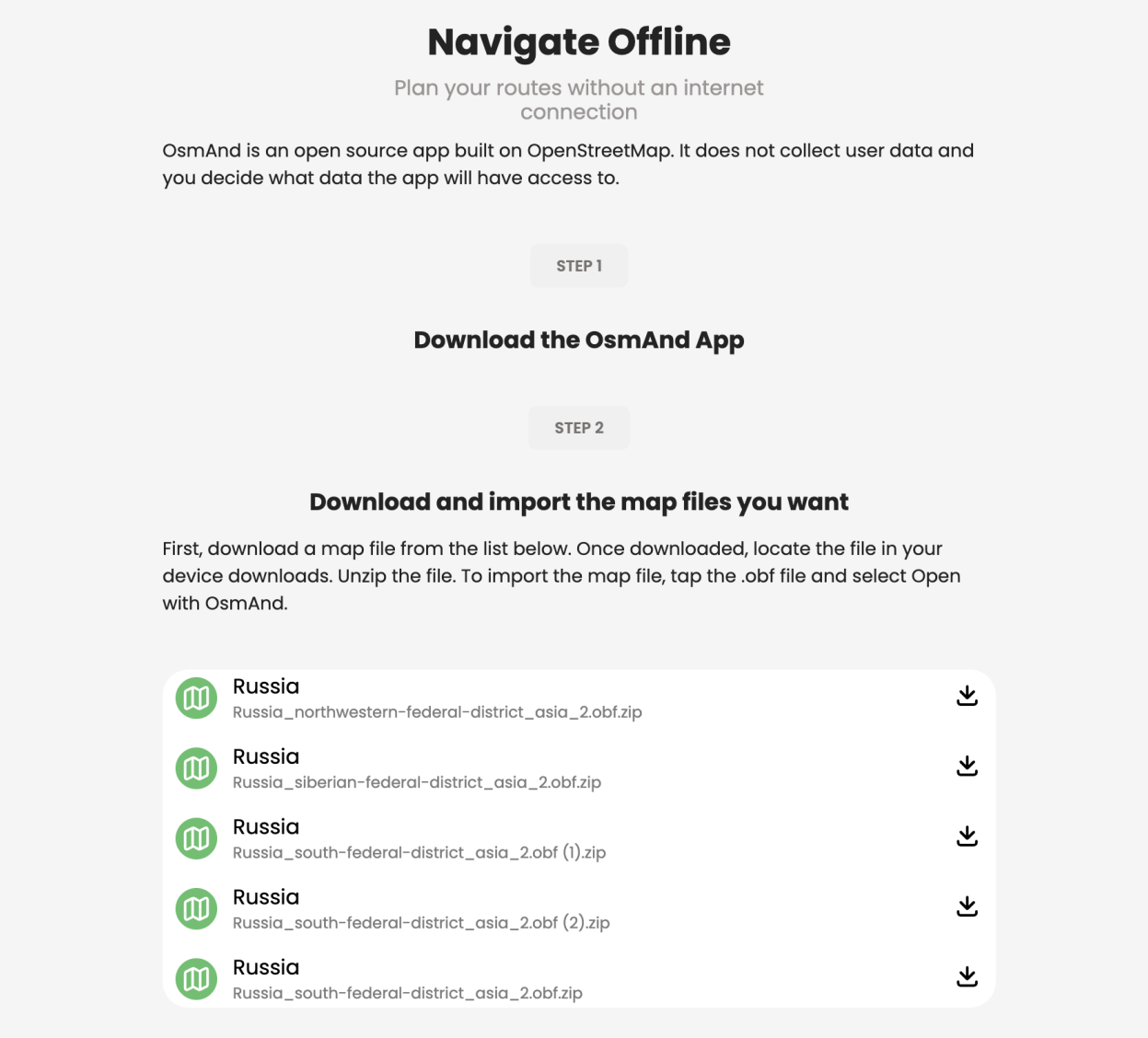


**The App Store Content Pack includes a menu of apps that can be downloaded individually, an F-Droid repository that can be added to the user's device by scanning the QR Code from F-Droid and a downloadable zip file with all the app APKs.*

Added localized Maps (RU)

A localized content pack, including maps from different regions in the scope, was created. We also included the OpenStreetMaps “OSMAnd APK” application in the map portal as requested by our local partners.

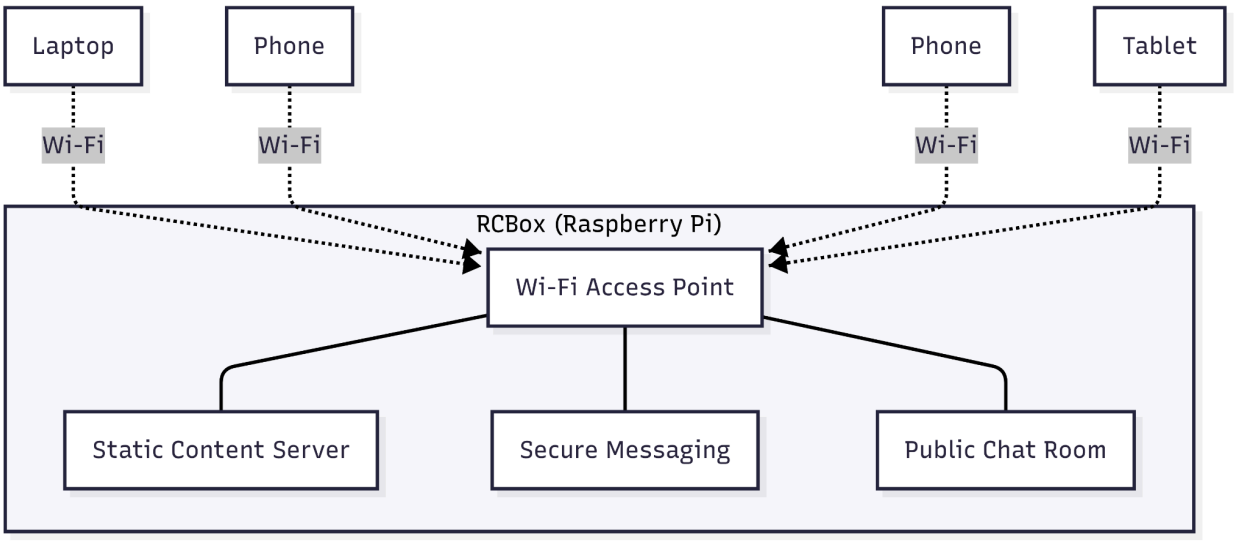
- **Source:** https://github.com/guardianproject/butter-docs-site/blob/locale_ru/content-packs/maps.md
- **Web:** https://guardianproject.github.io/butter-docs-site/content-packs/maps.html



Objective 4: **Expand the range and capacity of one or more instances of the RCBox**

As mentioned above, Eastern Europe is a new area of focus for the RCBox project. Thus, accurately identifying the user needs, concerns and functionality of the box was a driving force for this work. Early in the project we leveraged the lived experience of our regional partners and worked alongside them to understand the main use cases relevant to the region, and how that might impact deployment and network design. Our project hinged on exploration of possible solutions as part of extending the useful range and capacity of the Box and our partners were keen to understand how LoRa and HaLow radio might be solutions as part of it.

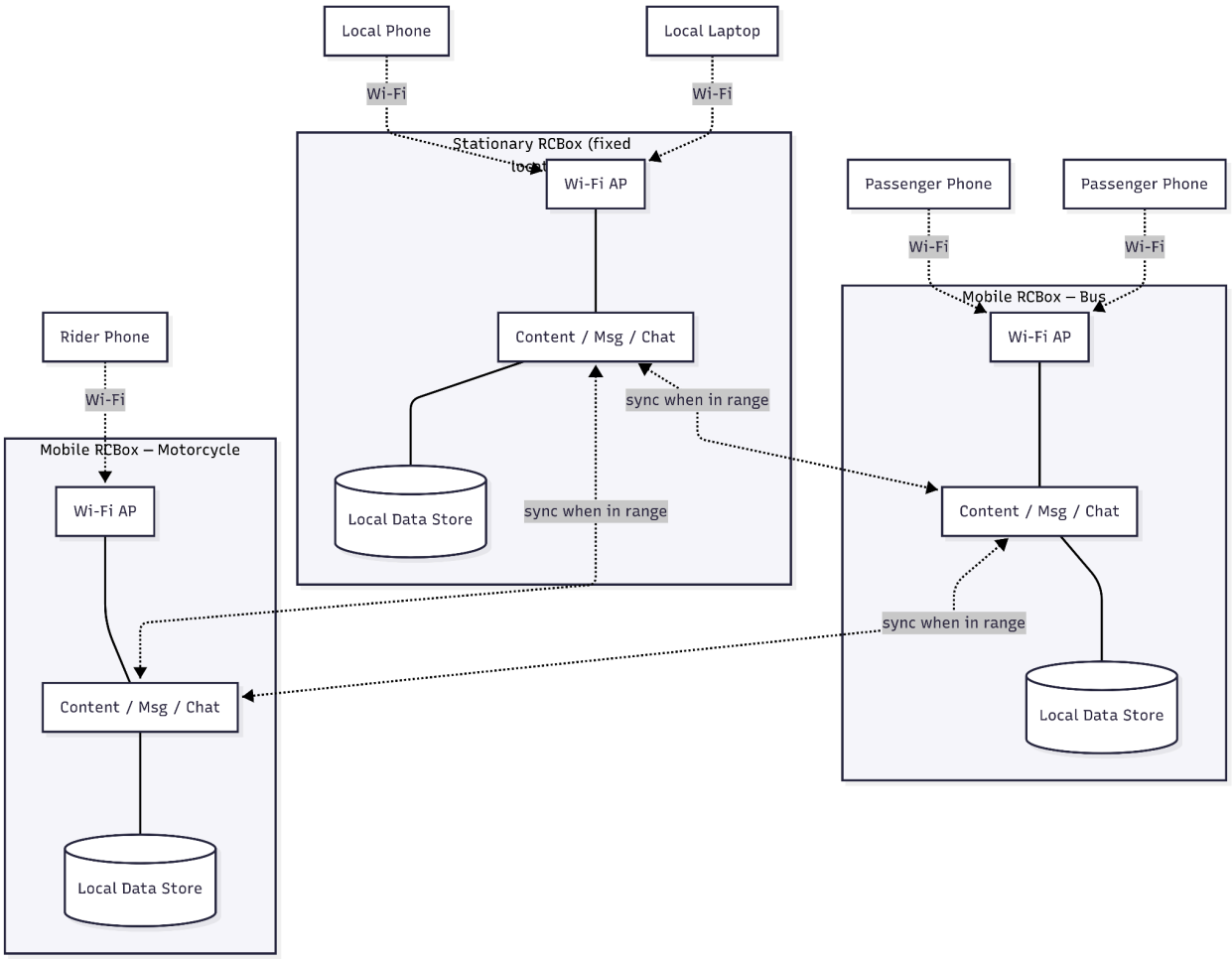
The diagram below shows our pre-existing approach of multiple users on different devices **connecting to one RCBox**. This model has been used for digital security training events and offline content distribution in Southern Africa and Latin America.



Through working with our partners, we identified new user stories that helped us outline the necessary new capabilities and configurations to support them. This then mapped to our development cycles for this round of work.

We also identified three deployment environments, namely the **“microdistrict”** (aka neighborhood), the **“campus residence”** (living space for students), and **“independent cultural and social centers”** (where people of all kinds gather). Having these environments better defined helped us more clearly consider the networking solutions that could work within them.

The diagram below shows an example of how a combination of stationary and mobile RCBox instances could support the "field or event location" configuration, with opportunistic communication and syncing between the boxes when possible.



🚚 Connecting Technical Development with User Needs

RCBox can deliver value in both single-node and multi-node deployments. Through the technical scope of work, we've established a proof of concept for multi-box setups that map to several viable use cases. The table below summarizes the highest-priority user needs identified in user research and outlines how those needs are supported by different RCBox configurations.

User Story	Capability	Scope	Status
Anya places a box in the electricity closet of a cultural center to serve news via RSS.	News Source	Mostly possible through content packs	We developed a sample "content pack podcast" project to demonstrate how this

			could be built by our partners: https://guardianproject.dev/butter/contentpack-sample-podcast
Oleg places a box in his residence building to serve banned VPN apps and to serve as a communication post (for private communication).	App and Media Distribution	Already possible through content packs, and public chats	Implemented through new curated content pack for circumvention tools: https://guardianproject.dev/butter/contentpack-circumvention
Mo places a box inside his laundromat as an inconspicuous private relay of communication.	Private Communication	Delta Chat from a Single box Exploration of multi-box	Implemented through support for secure messaging
Valentina sets a box up for her district as a communication post and community information board.	Public Anonymous Sharing	Already possible but need to make sure hosts are aware of moderation needs	Implemented through support for local chat Could improve the documentation to highlight the functionality.
Other	Learning materials for building and hosting a box need to be made available offline.	Already possible through content packs mirroring of the documentation site on the RCBox	Implemented via customized content pack of the documentation site: https://github.com/guardianproject/butter-docs-site/releases/tag/0.0.2-locale-ru

Multibox Capabilities: Resilient Communication

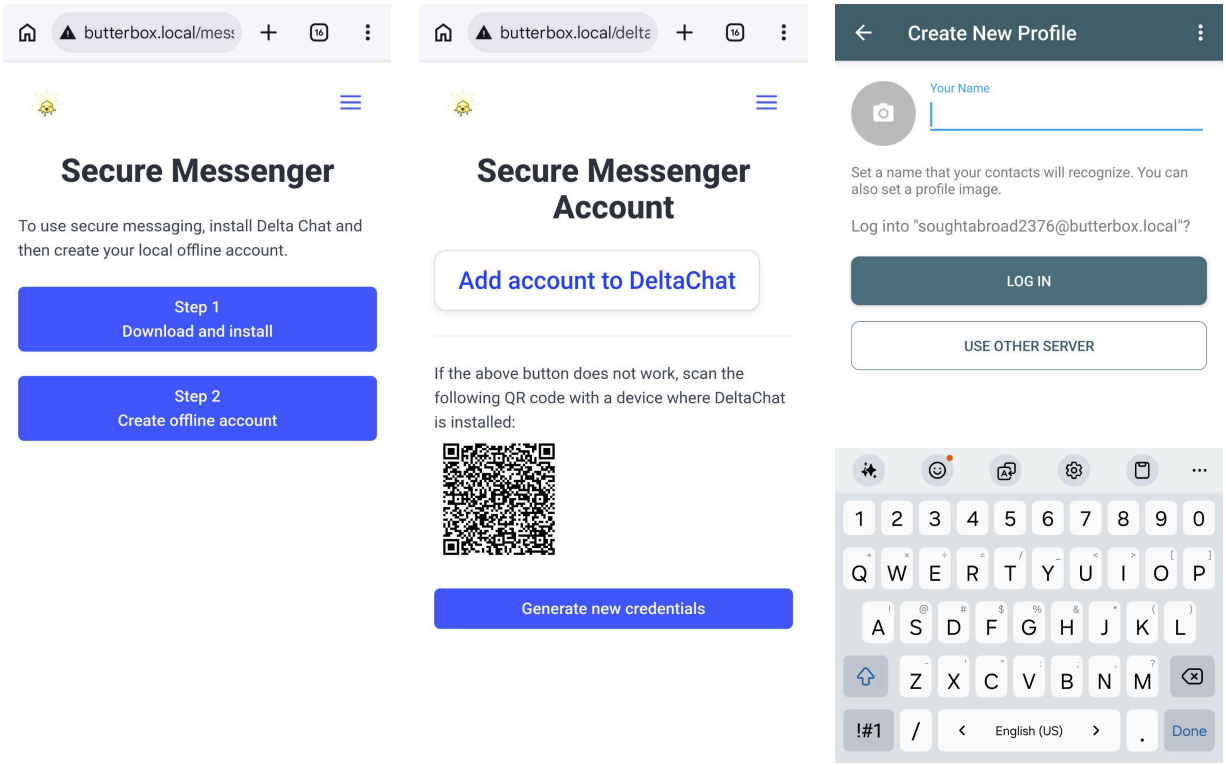
A **single RCBox** can function like a local post office. When a user connects to the box's network, their Delta Chat app can send outgoing messages and sync to receive new ones.

In a **multi-box configuration**, boxes can be spaced approximately 500 meters apart, forming a distributed network across a district or city. When properly configured, messages can propagate from box to box, extending communication range without reliance on centralized infrastructure.

Scalability constraints: The system can grow to a certain size, but there are two main constraints. First, each new node (or box) must be manually added to a system file that tracks all connections, this takes up disk space and becomes cumbersome as you add more. Second, and more importantly, there's no automatic setup. Every connection between boxes must be configured by hand, meaning someone needs to manually tell each box how to find and talk to the others. Each box also needs its own IP address and must be able to recognize other boxes by name. As the network grows, this manual work becomes the biggest bottleneck, not the technology itself.

🧈 Support for a new delay-tolerant encrypted messenger

Feature development was conducted to facilitate the operation of a local chatmail relay server independent of DNS, utilizing self-signed certificates, alongside an exploration of mechanisms for automated account provisioning. This functionality was successfully integrated as a core component of the RCBox, with easy account setup using the new administrative setup wizard. Support for automated onboarding and account generation has been incorporated into the portal interface, providing users with a QR code for seamless scanning or a direct link to instantly provision and configure their accounts on the local instance with the DeltaChat application installed on their device.



**The Delta Chat set up screens*

The “delay tolerant” aspect of this is an important step forward. While we previously supported the browser-based public chat supported by Convene/Dendrite server, that requires the user to be actively connected to the RCBox instance to send, receive and view messages. This has a negative impact on scalability (many open clients), and user experience (no way to read messages offline or send messages to be queued for later). Through integration of DeltaChat and ChatMail (via “MadMail” software), the RCBox now fully supports users sending secure messages through a delay-tolerant “sync” experience. This allows many more users to connect, and provides for a much improved user experience for core secure messaging functionality.

Multibox Messaging

The capability for multiple boxes to exist on a shared network was implemented and tested, facilitating seamless communication between users with accounts/identities on DIFFERENT RCBox instances via the **secure messaging** feature (DeltaChat + MadMail).

This functionality was successfully integrated and tested on both Raspberry Pi 3 and 4 hardware platforms, ensuring robust performance across single and multi-box instances.

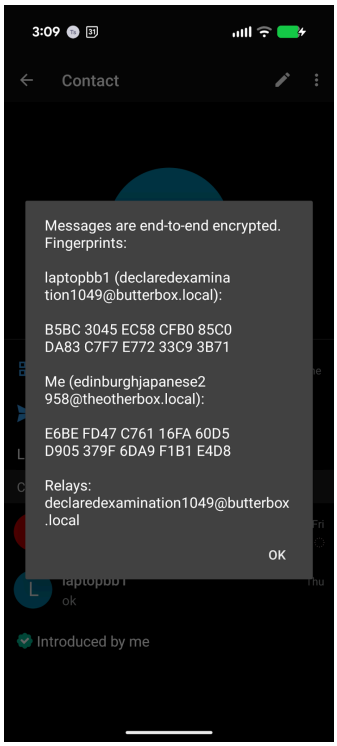
Extensive testing and debugging were conducted to ensure support for dynamic mDNS name resolution, allowing each box to configure its own unique hostname through the new administrative portal interface. This means a user with the identity "jack@butterbox.local" can securely communicate with another user "jane@theotherbox.local" - with messages being delivered between those boxes when possible, not requiring a permanent connection.

To support this capability, we published documentation on how to implement this: "*Multi-box Delta Chat setup: This document details the requirements and setup needed to allow exchanging messages between Delta Chat instances running on different boxes connected together over LAN. This requires a few configuration changes.*"

Info: https://guardianproject.dev/butter/churn/src/branch/main/docs/multibox.md

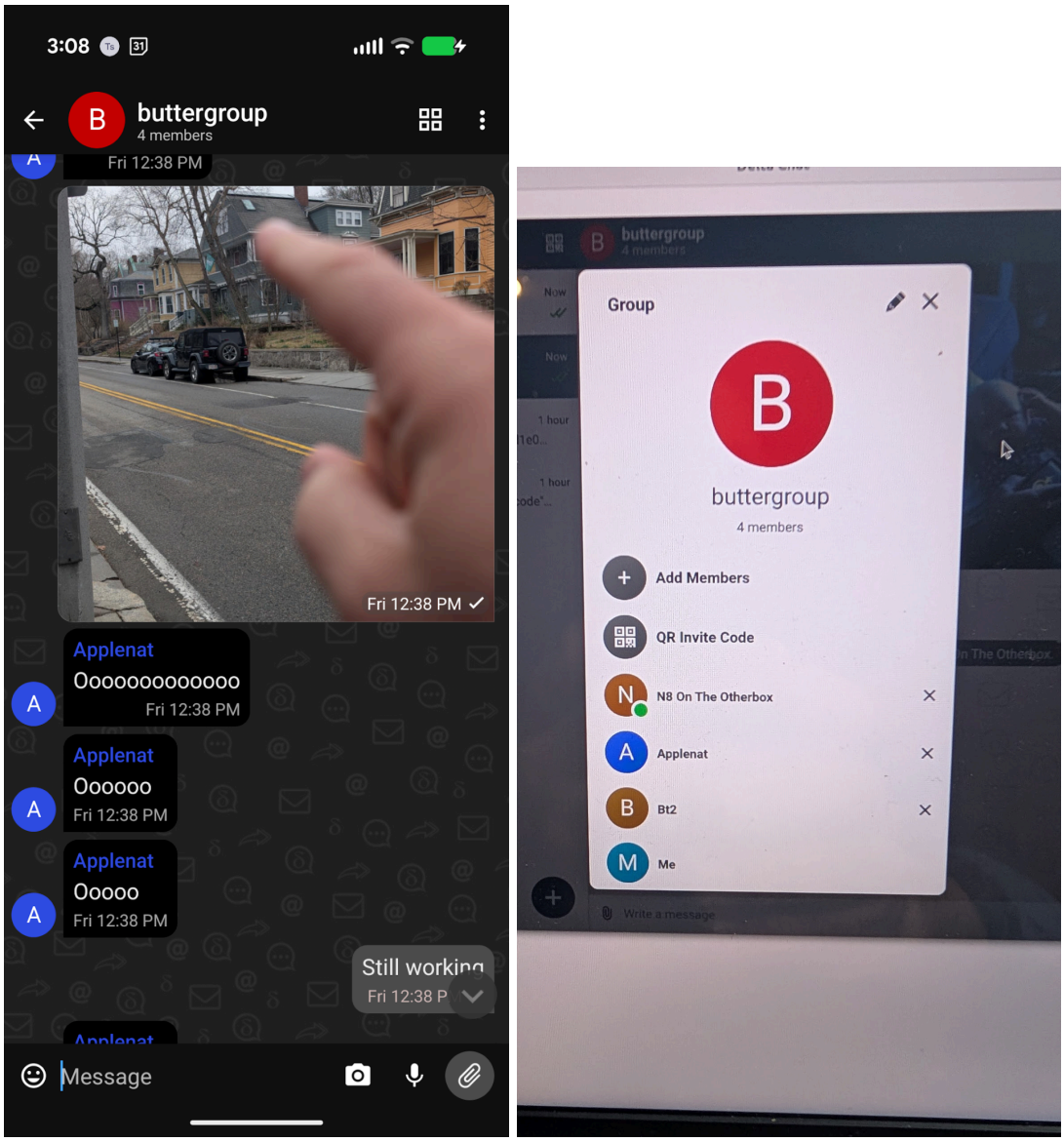
Proof of Success

"Delay Tolerant Messenger" - DeltaChat Screenshot showing a chat session between two different RCBox instances (butterbox.local and theotherbox.local):



The screenshot below illustrates a successful transmission via DeltaChat. The photo was captured and queued at the specified location with the RCBox positioned in a third-floor

window. Upon the user's return to the WiFi hotspot's range, the message and attachment were automatically dispatched to a group spanning two interconnected RCBox instances:

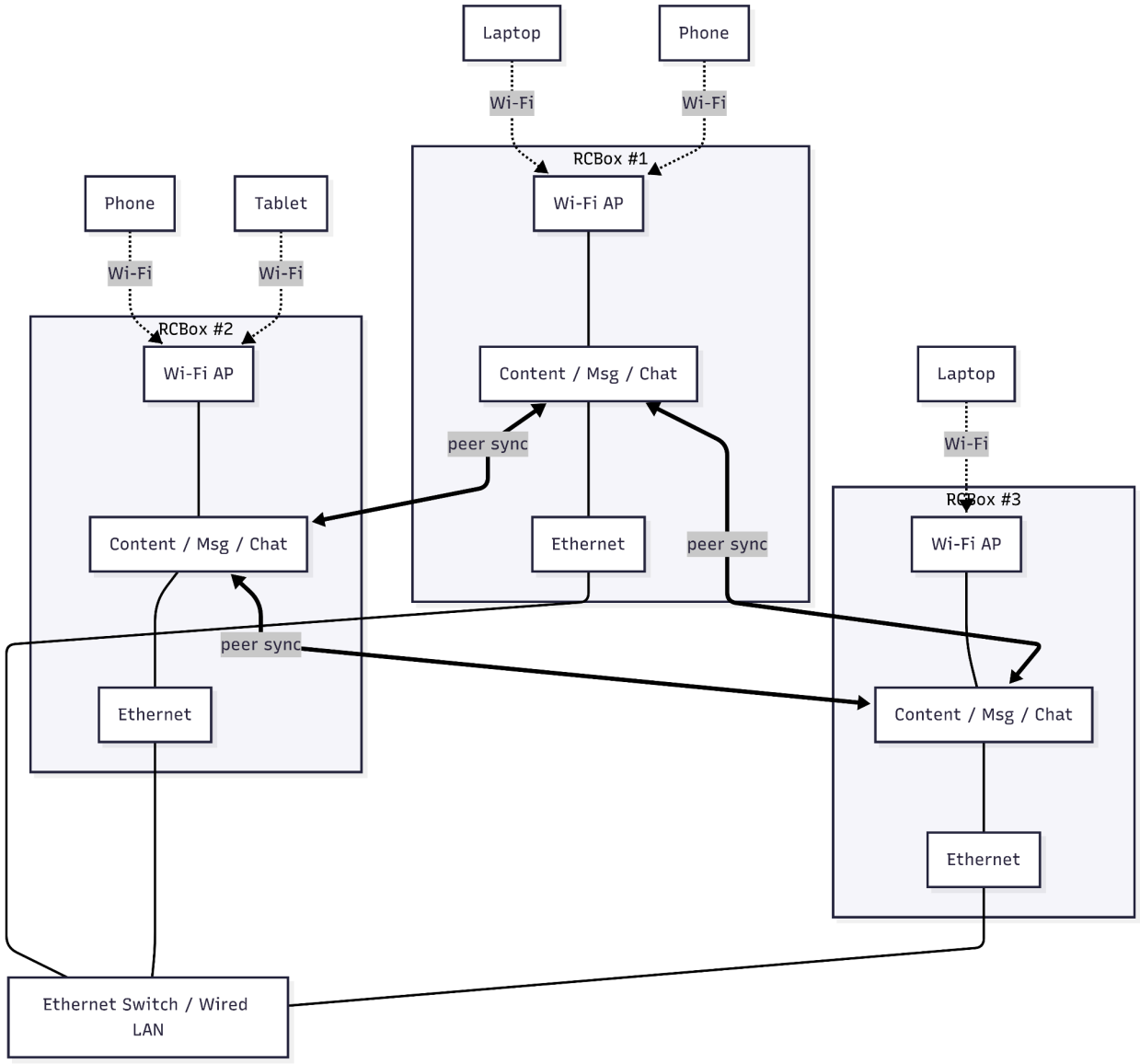


Furthermore, the portal now facilitates the seamless and rapid provisioning of secure messaging accounts. Through the administrative interface, users can instantly generate new identities with a single click; these accounts are then easily integrated into any DeltaChat client by scanning a QR code or selecting the setup link. This streamlined onboarding process, which also supports direct configuration via link or copy-and-paste, significantly reduces friction for users on the local instance.

📦The capability to link multiple boxes through local and long range wireless networks

MultiBox Local Network

The diagram below shows a multi-RCBox deployment configuration using a basic ethernet wired LAN network. Each RCBox uses the ethernet LAN as a “backhaul” connection between them, while still acting as an independent hotspot. This configuration can be used in the “campus residence” and the “cultural and social center” contexts, since both traditionally have large scale wired LAN networks. In addition, we have seen city-wide LAN networks built in places like Cuba for their “StreetNet” system, with the cost and complexity to build large LAN networks using Cat-5 ethernet to be fairly simple.



Long Range Wireless: LoRa vs Wifi HaLow research

Using the application of user research coupled with our technical explorations into long range wireless solutions, our team focused on comparing two available technologies: LoRa and WiFi HaLow. The findings were that with our current focus on IP based protocols such as HTTP and SMTP, using an IP-based network is the most ideal and compatible solution. This means WiFI HaLow is best suited for the current configuration and capabilities of RCBox.

Using HaLow, the RCBox is best deployed within a **500m radius of the next box** and can connect with others (sending DeltaChat messages for instance) using Wifi HaLow radios with IP routing to extend the physical range and number of nodes for viable communication. Therefore, one could support the “microdistrict” and/or “field or event location” deployment of RCBoxes to share content and send encrypted messages.

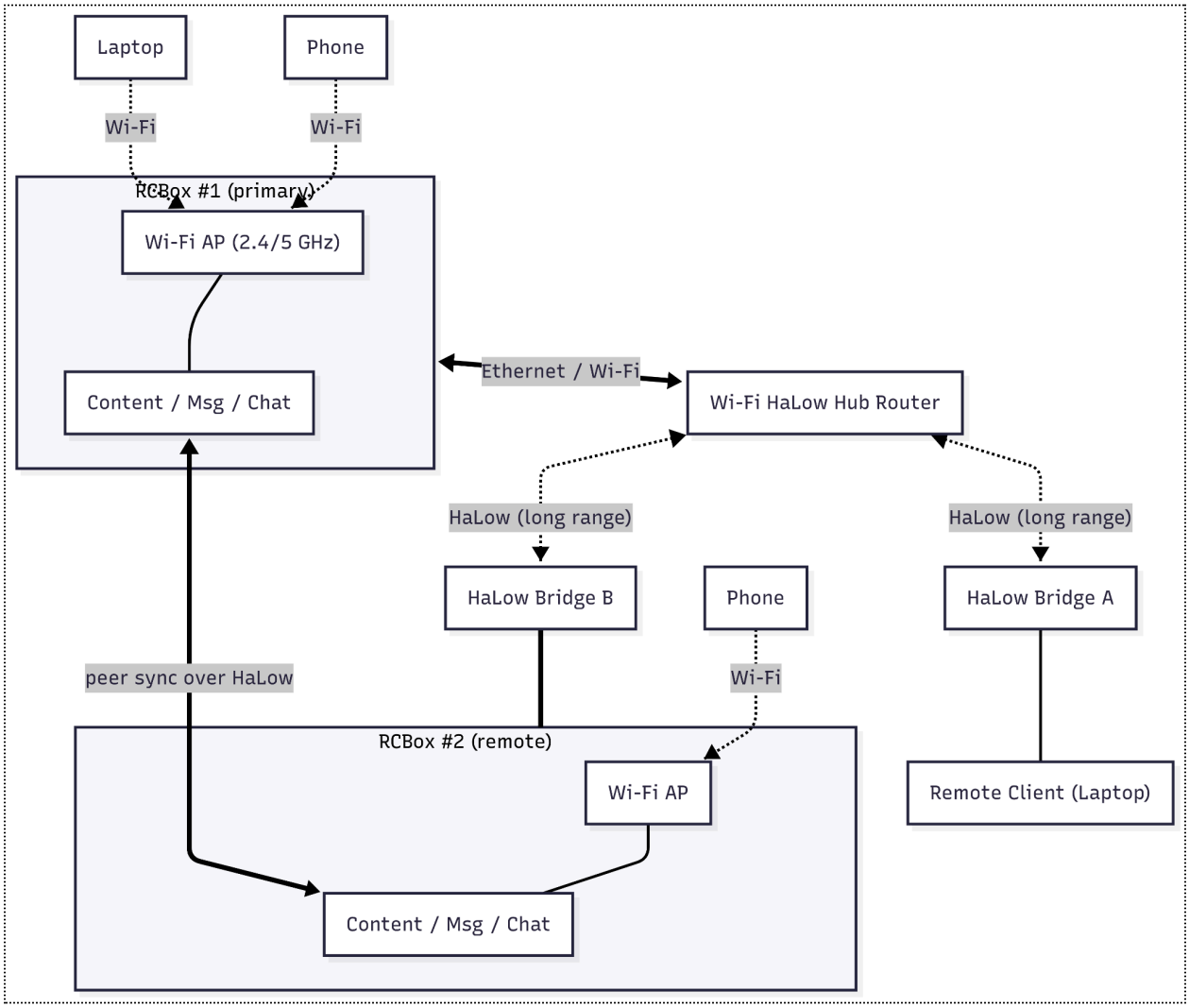
You can read the full public findings from our technical team here, or see a summary below:

https://www.sr2.uk/posts/2026-butter-box-connectivity

LoRa has superior range and the equipment may be more widely available at a cheaper price, but the throughput is low enough that it requires protocols that have been specifically designed with these slow speeds and high latency in mind. Even transmitting low resolution images over these kinds of links would tie them up for minutes at a time. If you need to get smaller amounts of data over greater distances then it’s definitely a great technology but for the Butter Box it does not compliment any existing functionality.

WiFi HaLow may allow a Butter Box deployment to spread across a school campus, refugee camp, or evacuation centre with less equipment required for a rapid deployment. Updates provided to one Butter Box could make their way through a network of Butter Boxes at reasonable speeds. We believe that in a less dense environment, with fewer devices competing for that radio spectrum, the performance would be more reliable however we were not able to fully explore this. For many deployments though, the current cost of the hardware may be prohibitive. We are hopeful that the price of this will come down as Morse Micro moves from the evaluation kits towards production quality implementations.

Below is a diagram showing a Long Range MultiBox (LRMB!) deployment using Wifi HaLow hubs and bridges, with a diverse set of RCBoxes and clients.



Objective 5: **Improve the ability for RCBox instances to be sustained and secured**

As we continue to develop and expand the functionality and customizations of the RCBox ecosystem, we must continue to strengthen the sustainability and security of RCBox deployments, to ensure reliable, long-term use in diverse and high-risk environments. A

major improvement under this objective was the move to debian. This allows support for other architectures and makes software easier to update and maintain.

📦Improved and clarified the process of updating firmware and updating content packs:

Transition from .lan to .local

During development of the RCBox, we identified limitations with our initial use of the .lan domain particularly around reliable hostname resolution and certificate handling across different devices and environments. The .lan domain is not universally supported, often requiring manual configuration or relying on inconsistent device behavior. Many users experienced friction when trying to connect and we had to help troubleshoot the issue with documentation and training, making deployments less predictable.

To address this, we transitioned to using the .local domain. Unlike .lan, .local is automatically resolved using multicast DNS (mDNS) through widely supported protocols such as Bonjour and Avahi. This allows devices on the same network to discover the RCBox by hostname without additional setup. As a result, users can connect more seamlessly, and features that rely on consistent hostname resolution, such as secure communication tools like DeltaChat, function more reliably.

This change reduces configuration overhead, improves cross-device compatibility, and creates a more intuitive and resilient user experience, particularly in offline or constrained network environments where simplicity and reliability are critical.

📦Debian-based Content Pack Upgrades

RCBoxes run Debian OS and can be upgraded using apt update and apt upgrade commands. However, since they are often expected to operate in areas without Internet connectivity, the following instructions detail how to create and use a content pack to allow local offline upgrades.

This new capability allows the box to perform updates by just replacing the content pack on storage, and without needing to reset the box or re-flash its SD card.

Testing was carried out successfully of the proposed new update system, where software is updated by creating and then using a Debian mirror as a content pack. A set of instructions on how to create and use the update content pack has been published and is available at:
https://guardianproject.dev/butter/churn/src/branch/new_portal_changes/debian.md

🧈Improve documentation to support partners to take a more active role in maintaining the instances they manage

During our initial conversations with the regional partner it became apparent they were concerned with tampering of devices. As the RCBox is both hardware and software, and based on the preferred use case for the context some boxes may be left unattended intentionally. There are measures which can be taken to help prevent device tampering and help secure the Box. A comprehensive user guide outlining best practices for protecting both the hardware and software components of the RCBox ecosystem (Tamper Resistant Guide) is now available on the RCBox documentation site and can be updated when new solutions become available (https://docs.likebutter.app/security).

Objective 6: **Ensure that software is maintained, improved and updated to close vulnerabilities, and improve efficiency and reliability.**

Bug fixes and new releases

Since December, we have completed multiple RCBox image releases, each delivering enhanced functionality and user interface improvements. This work was completed building on our new Debian-based foundation and modern firmware build image. All of the repositories and code can be found at: https://guardianproject.dev/butter

Recent releases introduced three key upgrades: a localized Russian (RU) landing page (portal) option, an updated Admin Setup Wizard with expanded Settings, and improved DeltaChat configuration.

We also migrated our image hosting from Dropbox to a more reliable self-hosted platform and redesigned our release website to make file selection clearer and more intuitive for users.

All firmware images are now available for download at https://files.sr2.uk/d/52bd8561a10d4d83be7b/?p=%2F&mode=list.

Additional bug fixes and improvements during this phase of work include:

- The team has set up automated builds of the components included within the RCBox: the web UI, matrix server (dendrite), keanu-weblite (matrix web client), as well as the butterbox images themselves, with the goal of building images in a reproducible way. This lays the foundation for introducing customizable elements within the UI.

- Fixed a timing bug where a Raspberry Pi would reboot continuously after applying admin changes in the portal.
- Updated to the latest maintained release of Dendrite (Matrix Server), Convene (Matrix Client), and MadMail (DeltaChat Chatmail Relay).

Closing

What's next for the RCBox?

The last few months have been an intense time of new partnerships, rapid development, and complex research. We are proud of all that we accomplished in this time, and are looking forward to sharing it more widely. As always, there is more to do, some of which you can find below.

- **Complete full release of new version, website and documentation**
  - Move to tag a major release version of the software and release new images
  - Ensure website and documentation is fully updated with latest links, resources and guides
  - Fully integrate localized content into main docs site, and integrate more deeply in primary website
  - Promote the new releases publicly

- **Expanded Hardware Support**
  - Through other funding of the RCBox work, we have been exploring expanding support beyond Raspberry Pi devices. This is facilitated by our transition from the Raspbian OS foundation to Debian.
  - We have had early success with support for AMD64/Intel devices, which means ANY OLD PC can be an RCBox. Given rising costs of memory chips and devices generally, we are very happy to support sustainable reuse of old laptops and PCs in the near future.
  - This also means it is likely easier to support RPI clone devices, such as OrangePi and BananaPi that are cheaper and available in some parts of the world, but more testing will be required.

- **Engage in Usability, Security and Accessibility Audits and Improvements**
  - Engagement in audit processes is a requirement and valued experience for any project. Through existing relationships and resources, we will ensure the new work completed is built to benefit users and not cause unexpected harm or difficulties.

- **Continue to connect with communities and partners**
  - Continue to support our Eastern European partners as they continue to test, deploy and rollout RCBox in their communities

- Participate at RightsCon, DRIF
- Outreach to existing user communities to migrate to new releases
- Find ways to cross-promote with DeltaChat, F-Droid, Convene partners
- Continue our work with UNDP and others to support humanitarian applications