RIPPLING

Password Management

Ensure security for your company. Safely manage and share your team's passwords with RPass.

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RPass makes your company more secure

Passwords are the cornerstone of your IT security, and RPass ensures that your data is secured by our enterprise-grade cryptography and technology standards.

Store passwords in a zero-knowledge vault

RPass encrypts passwords before they even leave the user's device, and Rippling itself never has access to the decryption keys. So Rippling has zero knowledge of the unencrypted passwords.

Share passwords securely

RPass eliminates password sharing on Post-Its, email, chat sessions, and other insecure methods. Users safely share passwords directly from the RPass software, which transfers them from client to client using secure encrypted communication.

Automatically grant and revoke company vault access by role

Passwords can easily be leaked when an employee leaves a company or changes roles without having their password manager access shut off. Because RPass is tightly integrated with Rippling's HR and onboarding/offboarding system, employees that leave or change roles will automatically be unable to open the company vault.

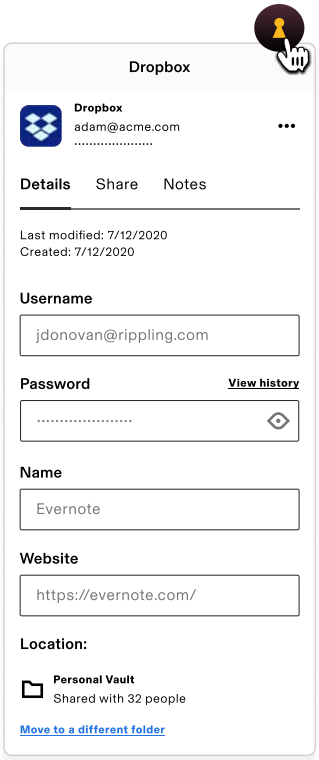
Encourage strong passwords

Users often prefer short, simple passwords so that they can easily remember them. Since users no longer need to remember passwords, they can use longer, more complex ones and store them in a protected RPass vault. RPass is available directly in their browser, so passwords travel with users wherever they go.

Protect against phishing

The most common data breaches occur when employees enter passwords on phishing sites that look and act similarly to official sites. RPass only fills passwords into the same website domain from which they were saved, so employees can't inadvertently enter passwords on a phishing site. Similarly, RPass won't fill passwords on insecure HTTP sites.

Any employee can share any passwords with other coworkers via RPass.



RPass security overview

A (somewhat) non-technical overview of our security design.

Individual password management

RPass is a password vault—a private, encrypted storage solution that uses a personalized master key to encrypt and decrypt data. With RPass, saved passwords are stored safely on Rippling's servers to make them available via the cloud. Based on a user's password, a master key is created along with the vault. This master key is the only thing that can unlock stored passwords.

Team password management

RPass also provides enterprise-grade password sharing via password vaults. You can create, share, and remove employee passwords and access to vaults. The company vault is protected with a key. Rippling uses public key cryptography to transfer the company vault key to a new employee in a way that prevents Rippling from learning it.

Public key cryptography has been around for decades, so it's a reliable way to share private data in encrypted form. This standard is how RPass customers are able to share passwords within their company while still maintaining privacy. Every user creates their own private key when they join an RPass-enabled company, but the RPass administrator controls access to the company vault.

Using RPass, a business can manage user accounts but still allow employees to have their own private keys and easily share passwords within the corporate environment. Data is still encrypted and protected by Rippling's servers in the same way as an individual account, but only administrators are able to add and remove accounts to maintain the integrity of corporate data.

Security is at the heart of what rippling does

- All data is transferred using 256-bit TLS encryption—the state of the art used by banks and governments
- Military-grade AES encryption protects your data at rest
- We follow industry best practices for defense in depth: data is encrypted with multiple keys, keys are rotated regularly, and sensitive data uses end-to-end encryption

A strong team enables strong security

- We keep our team up to date on the latest security practices with regular security and privacy awareness training
- New features go through extensive testing and peer review with a rigorous software development lifecycle
- Administrator access requires a strong password with two-factor authentication, and separation of duties is built into sensitive tasks
- Security teams work around the clock to protect your data and respond to threats

Tested and trusted

- We work with independent third parties as well as external researchers who regularly assess our site for vulnerabilities
- All data is hosted and processed in an SSAE 16 SOC 2 compliant data center, with 24/7 physical security
- We proactively identify and fix issues with a bug bounty program

Rippling makes your whole organization more secure

- Easily enable two-factor authentication for all of your services
- Quickly remove access for ex-employees
- Use Rippling's hardware management for sophisticated endpoint protection
- Download audit logs of Rippling app access

RPass security principles

RPass is a zero-knowledge password manager, meaning its technology is based on the highest level of data encryption while still protecting your privacy by having no access to your sensitive information. In an age where privacy is a major concern for consumers, providing an unparalleled data protection application while still maintaining privacy is one of Rippling's biggest priorities.

True end-to-end encryption

All communication between client devices and Rippling servers is encrypted with t he latest 256-bit cryptography standards.

Private password ignorance

Rippling never has access to your data. You maintain your private master keys and passwords, and we store them in encrypted form without having access to decrypted versions.

Reliability

Your passwords are always available regardless of your location or device. All you need is access to the internet.

Brute-force attack protection

Even if an attacker is able to steal your encrypted data on a local storage device, our service detects brute-force password attacks and limits login attempts, which stops an attacker from guessing your password.

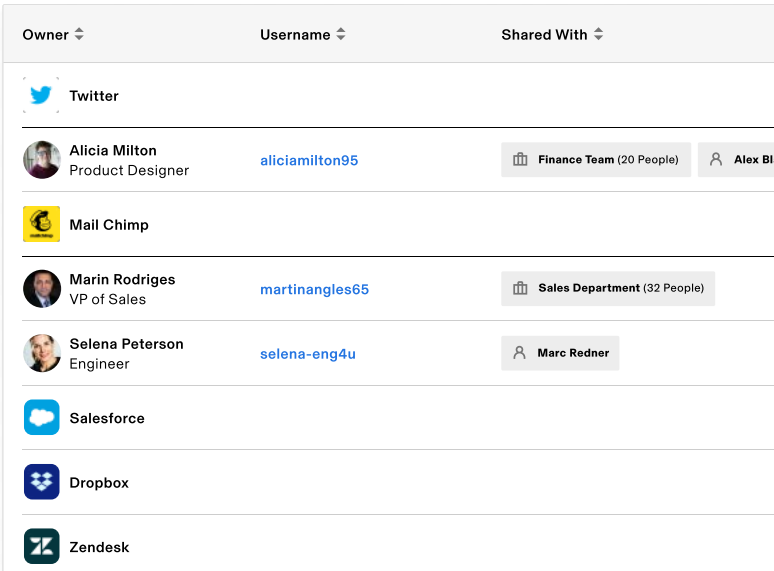
Centralized organization for better resource management

Rippling provides a centralized administration dashboard for easy management of corporate accounts. Whether you add or delete an account, it's a no-hassle, one-step process that keeps your password storage access organized.

Security best practices

Rippling keeps its security standards up to date with the latest best practices and cryptography technology to protect against common password attacks.

> Administrators have full visibility and control over the passwords that employees store in their company vault but not the passwords stored in personal vaults.



Encryption fundamentals

Hashing

To understand the way Rippling safely stores your data, you must understand the basics of hashing.

Hashing produces a deterministic, non-reversible, and mostly unique "fingerprint" of data. Just as it's very unlikely that two different people have the same fingerprint, it's very unlikely that two different input values produce the same hashed value. And given a hashed value, it's very hard to determine the original data that produced the hash.

Using a security hashing algorithm, you hash a value that is later stored in a database. When a user enters a value, it's compared against the hashed value stored in the database. If the string is the same, you know that the user has entered a correct value.

One common use of hashing is to store login credentials for authentication. Rather than storing your password in plain text or using a two-way encryption standard (similar to symmetric encryption described below), a site stores a hash of your password, which makes it a one-way encrypted value.

When you input a password to log in, the site does a hash of your submitted password and compares it to the hash stored in its database. If the hashes match, then by the deterministic and mostly unique properties described above, you must have input the same password that was used to generate the original hash. If a hacker gets access to the database, they can read the hash of your password, but by the non-reversible property described above, the hacker would not be able to calculate the actual password easily given the hash.

With a secure hash algorithm, the only way to determine the actual password is to try hashing billions of guesses until the right hash value is produced. This is called a brute-force approach.

Symmetric encryption

Symmetric encryption is a two-way encryption process where the same key is used to encrypt and decrypt values. Unlike asymmetric encryption where a public and private key are used, symmetric encryption uses the same key for both actions. If an attacker has access to encrypted data but not the decryption key, brute-force attacks using billions of guesses are needed to decrypt the data.

Some common symmetric encryption algorithms are 3DES (old), AES128, AES192, AES256, and Blowfish. RPass uses AES256, which is the algorithm certified by the U.S. military for encryption of top secret information.

Slower can be better

We're used to thinking that faster is better, but cryptography is one area where some algorithms are intentionally slow. For instance, you don't want hashing to be too fast, otherwise it would be easy for an attacker to reverse your hashes by testing several guesses very quickly.

Many hashing algorithms actually run data through multiple hashes to make it slower. PBKDF2 with SHA256 is an algorithm used extensively in RPass that lets you specify how many rounds of SHA256 hashing to run. More rounds make it slower for the user but also harder for attackers to crack by brute force.

Public-private key encryption

Public-private key encryption (also called asymmetric encryption) is a two-way process where different keys are used for encryption (private key) and decryption (public key).

Let's suppose Bob wants to send a message to Alice. Bob wants to store the message on Rippling's server so Alice can retrieve it later, but Bob doesn't want Rippling to be able to read the message. Alice first creates a private key and a public key. Alice shares her public key freely, but keeps her private key to herself. Bob encrypts his message using Alice's public key, so that only someone with Alice's private key can decrypt it. Bob then stores the encrypted message on Rippling's server.

Since Rippling doesn't have Alice's private key, Rippling can't read the message. But when Alice retrieves the encrypted message later, she can then decrypt it with her private key and read the message. This is why asymmetric encryption using public and private keys has become a standard for users who must communicate on a network filled with people who could be eavesdropping. Regardless of visibility, a message is only accessible using a safely stored private key.

Some common asymmetric encryption algorithms are RSA and ECDH. RPass uses RSA.

Salting and initialization vectors

It's best not to store just a hash of a password, but rather to store a random value (called a "salt") in combination with it.

To check if an input password is correct, the system gets the salt value used for a user, hashes the submitted password with that salt, and compares it to the stored salted hash value.

There are advantages to using a salt:

- If two users have identical passwords, they'll still have different salted hashed passwords because of the randomness of the salt. If an attacker gets access to your database, they won't be able to identify identical passwords between users
- This method also avoids precomputation using a "rainbow table" with hashed values of common passwords. A rainbow table allows an attacker to quickly ascertain if any users stored in the database use common passwords

For symmetric encryption, there's a similar concept of an initialization vector, which is random data used to start the encryption. As with hashing, the encrypted data and the initialization vector are stored in the database.

To decrypt data, the encrypted data, the key, and the initialization vector that was used during encryption are needed. Similar to hashing, the advantages of using an initialization vector are mainly that it's harder to tell if two encrypted values came from the same plaintext value or share similar bytes in the plaintext.

RPass security design

The security and privacy of your data are our highest priorities, and our comprehensive approach shows it.

About the master password and key

Each user has a 256-bit master key built from the user's password and other data. This master key is created only on the user's device and is never sent to Rippling's servers. It's used to encrypt important data on those servers so Rippling can't decrypt any usernames or passwords.

No Rippling employee is ever able to see a user's data, and a hacker would need to brute-force an attack—a process that would take years with current encryption algorithms.

When you first use RPass, the following algorithm creates a master key using your personal password:

On the user's device

```
1. hash1 ← PBKDF2(email, version_id, 1)
2. hash2 ← PBKDF2(password, hash1, 10000)
3. Send hash2 to Rippling's server
```

On the Rippling server

```
4. hash3 ← PBKDF2(hash2, server_token, 100)
5. Return hash3 to the client
```

On the user's device

```
6. master_key ← PBKDF2(password, hash3, 10000)
```

Definitions for reference:

> `PBKDF2(password, salt, iterations):` will represent PBKDF2 with SHA256 HMAC
>
> `email:` a user's email in lowercase
>
> `password:` a user's password, normalized with NFKD
>
> `version_id:` a short, non-secret string
>
> `server_token:` a 256-bit random value stored for each user on Rippling's server. Because this never leaves Rippling's servers, users have to ping the servers to convert a password into a master key.

Because unlocking private data requires the master key in addition to Rippling server connectivity, hackers are unable to brute-force a password offline. Any detection of a brute-force attack from Rippling servers will result in rate limits on the connection. This prevents a hacker from effectively running billions of possible password values in a reasonable amount of time.

Personal vault

Each RPass user receives a personal vault. The following steps describe how a username and password are encrypted in a personal RPass vault:

On the user's device

```
1. data ← '{"username":"AzureDiamond",
   "password":"hunter2"}'
2. iv ← rand_bits(96)
3. item_key ← new AES256 key
4. encrypted_data ← AES256GCM_encrypt
   (data, item_key, iv)
5. item_key_iv ← rand_bits(96)
6. encrypted_item_key ← AES256GCM encrypt
   (item_key, master_key, item_key_iv)
```

These fields are then stored on the server:

```
(encrypted_data, iv, encrypted_item_key,
item_key_iv)
```

Metadata fields are stored unencrypted, such as a GUID item id, created_at, updated_at, url, encryption_version, etc.

`rand_bits:` generates random bits using a cryptographic pseudo random number generator

`AES256GCM encrypt(data, key, iv):` encrypts the data with the given key and initialization vector or nonce using AES256 in Galois/Counter Mode

Company vault

Company vault items are encrypted with a 256-bit company key that is unique to each company. Like the master key, the company key is never stored in plaintext on Rippling's servers. The encryption of company vault items functions identically to the personal vault item encryption above, except using "company_key" in place of "master_key."

Sharing a company key

In order for all employees in a company to have the same company key, it must be shared with new hires. The following steps explain this process:

When a new hire opens RPass for the first time, their client does the following:

```
1. private_key, public_key) ← new 2048-
   bit RSA key pair
2. iv ← rand_bits(96)
3. encrypted_private_key ← AES256GCM_
   encrypt(private_key, master_key, iv)
```

The new hire's public and encrypted private keys (public_key, encrypted_private_key, iv) are stored on the server.

When another user within the same company opens RPass, the other user saves a copy of the company key that is encrypted specifically for the new hire:

```
1. encrypted_company_key_for_new_hire ← RSA_
   OAEP_encrypt(company_key, public_key)
```

The employee then saves (encrypted_company_key_for_new_hire) on the server.

The next time the new hire opens RPass, the stored data retrieved from other employees is passed to the new hire along with the company key. The process is as follows:

```
1. private_key ← AES256GCM_decrypt (encrypted_
   private_key, master_key, iv)
2. company_key ← RSA_OAEP_decrypt (encrypted_
   company_key_for_new_hire, private_key)
```

Upgrading encryption options

As computing power improves, encryption algorithms are no longer safe from brute-force attacks. RPass uses a system that allows it to upgrade to the latest encryption standards as newer cryptography technology is released.

Each encrypted item has an encryption_version ID stored with it, so encryption algorithms can be upgraded as needed while still being able to decrypt older items. Any new items will always be saved with the updated encryption version. RPass also has a mechanism to force older data to be re-saved with newer encryption when the user accesses it.

Server communication

Rippling uses double encryption to save and transmit data. Data is never transferred in plaintext. Data is encrypted on a user's device, then TLS encryption is used to transfer it to a Rippling server. This double layer of encryption decreases the risk that a man-in-the-middle can read protected data.

Two-factor authentication

Multi-factor authentication (often called two-factor authentication) requires multiple independent credentials to successfully log into a system. RPass allows administrators to require two-factor authentication for their employees to access their RPass vaults. That way, even if an attacker has access to a user's password and encrypted data, decryption is still impossible without the second authentication factor.

Use of Web Crypto

RPass uses the Web Crypto API for implementations of the above encryption algorithms. Web Crypto is up to 10 times faster than JavaScript implementations used in other password manager browser extensions. Web Crypto allows RPass to get cryptographically strong random values from the underlying operating system and can also take advantage of hardware support that provides an even greater level of security.

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Rippling helps businesses manage every employee system—their payroll, benefits, computers, apps, and more—all in a single, modern platform.

By connecting every system in a company to one employee system of record, businesses can automate all the manual work they normally have to do to make employee changes. Take onboarding, for example. With Rippling, you can set up a new employees' payroll, health insurance, laptop, and apps like Gmail and Slack—all in just 90 seconds.