scimd

SCIM provisioning for software that never got it

SCIMD

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Joiners, movers, leavers

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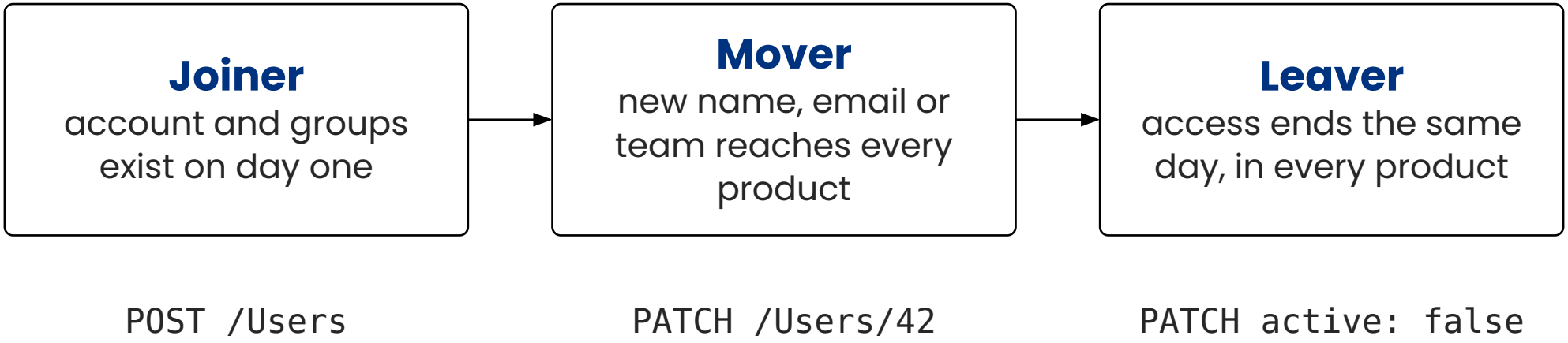

SCIM 2.0, defined in RFC 7643 and RFC 7644, is how an identity provider pushes these changes to a product. Entra ID, Okta and authentik are examples of IdPs that act as SCIM clients.

Products without SCIM

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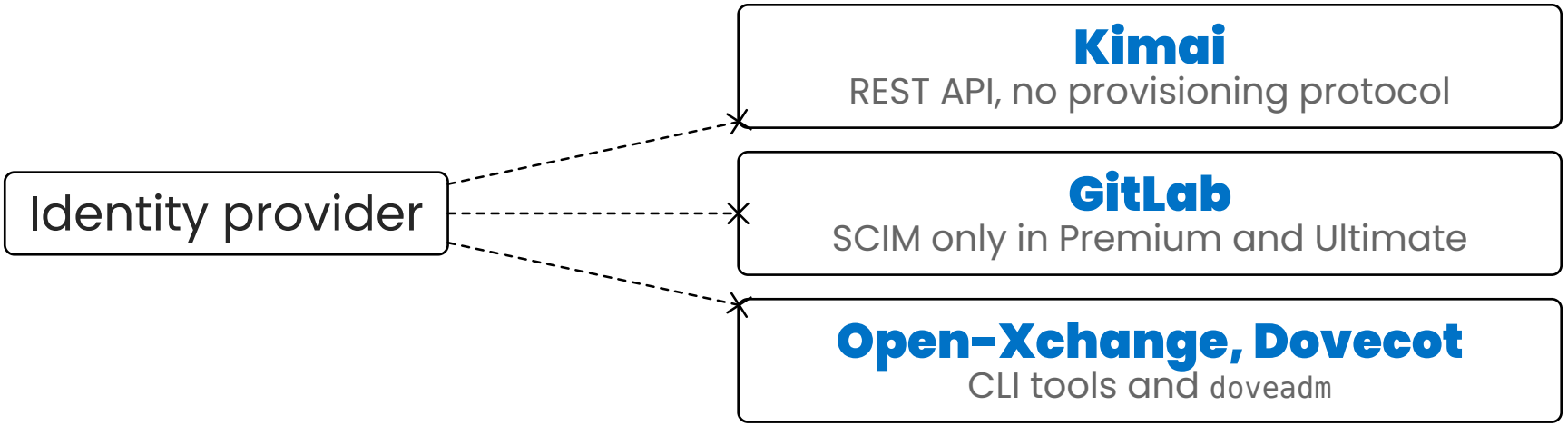

Without SCIM, people fall back to onboarding tickets and manual renames. Offboarding misses a product, and accounts keep working after the person has left.

We can automate every one of these products. None of them speaks SCIM.

What SCIM is

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- **RFC 7643** defines the schema: resources, attributes, extensions.
- **RFC 7644** defines the protocol: REST, JSON, `application/scim+json`.
- The IdP is the client. The product, or a sidecar in front of it, is the service provider.
- RFC 7643 predefines `User` and `Group`. A provider may add its own resource types.

`GET /Users?filter=...`	search
`POST /Users`	create
`GET /Users/{id}`	read
`PUT /Users/{id}`	replace
`PATCH /Users/{id}`	update
`DELETE /Users/{id}`	delete
`POST /Bulk`	batch
`POST /.search`	search via body
`GET /ServiceProviderConfig`	features
`GET /ResourceTypes`	resource types
`GET /Schemas`	attributes

A provisioning run

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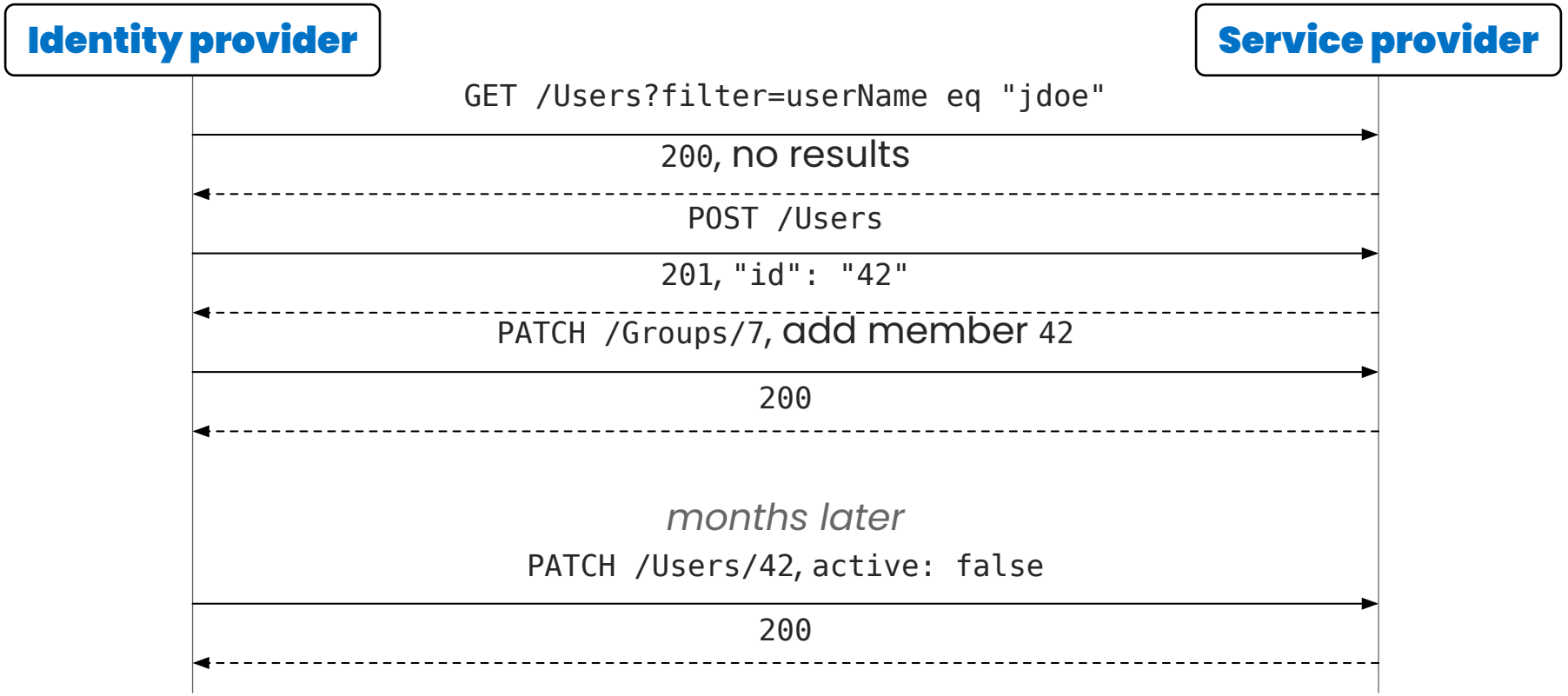

Before it creates an account, the IdP searches for it.

A user

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```
{
  "schemas": ["urn:ietf:params:scim:schemas:core:2.0:User"],
  "id": "42",
  "externalId": "b1e5c9d2-7f3a-4c1e-9a6b-2d8f0e4c7a15",
  "userName": "jdoe",
  "displayName": "Jane Doe",
  "active": true,
  "emails": [{ "value": "jane.doe@example.com", "type": "work", "primary": true }],
  "groups": [{ "value": "7", "display": "Engineering" }]
}
```

- `id` belongs to the provider, `externalId` to the IdP.
- Most IdPs deprovision with `active: false`, some with `DELETE`.

A PATCH

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```
{
  "schemas": ["urn:ietf:params:scim:api:messages:2.0:PatchOp"],
  "Operations": [
    { "op": "replace", "path": "active", "value": false },
    { "op": "replace", "path": "emails[type eq \"work\"].value",
      "value": "jane@example.org" },
    { "op": "add", "value": { "title": "CTO" } }
  ]
}
```

- Three operations, three path styles, and all three are legal.
- `path` is optional for `add` and `replace`, so a provider has to accept both forms.

Filters, discovery and errors

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```
userName eq "jdoe"
emails[type eq "work" and value co "@example.com"]
meta.lastModified gt "2026-01-01T00:00:00Z" and not (active eq false)
```

- Attribute names are case-insensitive. String values are too, unless the schema marks the attribute `caseExact`.
- `/ServiceProviderConfig`, `/ResourceTypes` and `/Schemas` tell the IdP what it may send.

```
{
  "schemas": ["urn:…:messages:2.0:Error"],
  "status": "400",
  "scimType": "invalidValue",
  "detail": "Kimai cannot rename a user"
}
```

Put SCIM next to the product

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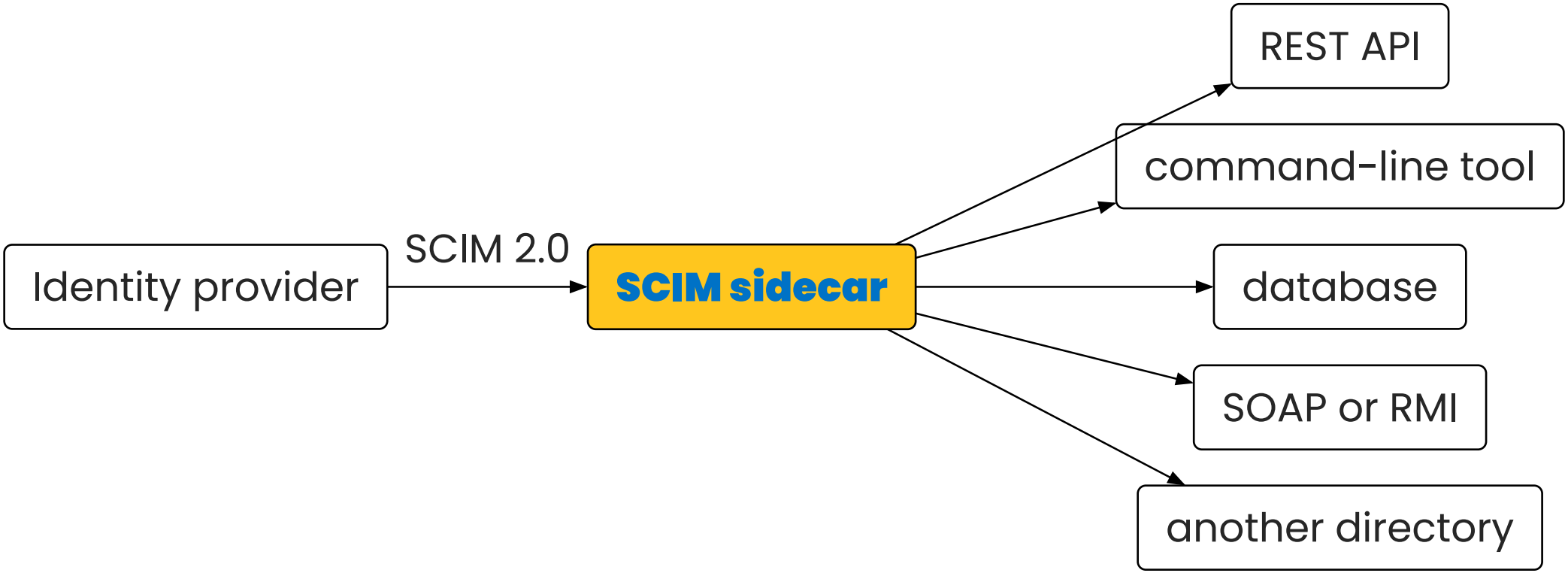

The IdP sees one standard SCIM endpoint. The sidecar uses whatever interface the product has.

What a sidecar has to do

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The same for every product

- resource schemas and discovery
- filter parsing and matching
- reading PATCH operations
- paging and the `ListResponse` envelope
- Bulk with `bulkId` references
- bearer tokens and content negotiation
- RFC 7644 error documents

Different for every product

- map attributes onto the product's fields
- call the product
- handle what the product cannot do

scimd implements the left column once.

Four crates

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`scimd-types`	the data model, the `Error` a service answers with, the `Resource` trait
`scimd-core`	the registry, dispatch, Bulk, discovery, filters, SCIM metrics
`scimd`	actix-web routes and middleware, mountable into an existing app
`scimd-server`	the daemon: sockets, signals, config, `/health`, `/metrics`

Only `scimd` and `scimd-server` know about a web framework, and only `scimd-server` knows about a process. A host that mounts scimd into its own server compiles none of the daemon.

Defining a resource

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```rust
#[derive(Serialize, Deserialize, Clone)]
struct Device {
    id: Option<Uuid>,
    #[serde(rename = "displayName")]
    display_name: String,
    #[serde(rename = "serialNumber")]
    serial_number: String,
    #[serde(rename = "urn:…:Device")]
    lease: Option<Lease>,
    // schemas, meta
}
```

RFC 7643 treats `User` and `Group` as two resource types among many. scimd does too.

```rust
impl Resource for Device {
    type Id = Uuid;
    const RESOURCE_TYPE: &'static str = "Device";
    const ENDPOINT: &'static str = "/Devices";
    const SCHEMA: &'static str =
        "urn:example:params:scim:schemas:Device";

    fn schema() -> Schema {
        Schema::new(Self::SCHEMA, "Device", "", vec![
            Attributes::new("displayName", "string")
                .required(),
            Attributes::new("serialNumber", "string")
                .required()
                .case_exact(),
        ])
    }
    fn extensions() -> Vec<Extension> {
        vec![Extension::optional(Lease::schema())]
    }
    // id(), meta(), set_meta(): one line each
}
```

Writing the service

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```rust
#[async_trait]
pub trait ResourceService<R: Resource>: Send + Sync {
    async fn list(&self, _filter: FilterQuery) -> Result<ListResponse<R>> {
        Err(Error::MethodNotImplemented)
    }
    async fn create(&self, _resource: R) -> Result<R> { /* 501 */ }
    async fn get(&self, _id: R::Id) -> Result<R> { /* 501 */ }
    async fn replace(&self, _id: R::Id, _resource: R) -> Result<R> { /* 501 */ }
    async fn patch(&self, _id: R::Id, _op: PatchOp) -> Result<ValOrEmpty<R>> { /* 501 */ }
    async fn delete(&self, _id: R::Id) -> Result<()> { /* 501 */ }
}
```

- Every method defaults to `501 Not Implemented`. Override the ones the product supports.
- `R::Id` is the resource's own id type: a `String` for `User`, a `Uuid` for `Device`.

Register it

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```rust
let args = scimd_server::parse_args();
let scim = scimd::ScimBuilder::new()
    .register::<Device, _>(DeviceService::default())
    .with_filter(true, None)
    .with_bulk(true, Some(50), Some(1024 * 1024));

let app = scimd::AppBuilder::new(scim)
    .bearer_token(dotenvy::var("EXAMPLE_SERVICE_BEARER_TOKEN").ok())
    .with_metrics(true)
    .build();

scimd_server::Server::new(app).args(args).run().await?;
```

- `/v2/Devices` exists, and discovery describes `Device` and `Lease`.
- `/ServiceProviderConfig` advertises filter and bulk because the builder enabled them.

Filtering

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```rust
async fn list(&self, query: FilterQuery) -> scimd::Result<ListResponse<Device>> {
    let devices = self.devices().values().cloned().collect();
    scimd::filter::list_response(devices, &query)
}
```

- `list_response` parses the filter, matches it against each resource and pages the result.
- The parser implements the whole grammar of RFC 7644 section 3.4.2.2, `valuePath` brackets included. A parse error answers `400 invalidFilter` with the position where parsing failed.
- Matching honours `caseExact` from the schema, so `serialNumber` compares exactly.
- The AST is public. A backend with its own query language, SQL or LDAP, walks it and filters at the source.

What else scimd handles

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- PATCH bodies parsed into a typed `PatchOp`
- Bulk with `bulkId` references, `failOnErrors` and size limits
- `POST /.search` for one resource type or all of them
- schema extensions, advertised in discovery and added to `schemas` for you
- bearer token authentication and `application/scim+json` negotiation
- RFC 7644 error documents from one `Error` enum
- Prometheus metrics per SCIM operation, not only per HTTP request
- mounting into an existing actix-web app with `configure()`

Bulk with `bulkId`

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```
{
  "schemas": ["urn:ietf:params:scim:api:messages:2.0:BulkRequest"],
  "failOnErrors": 1,
  "Operations": [
    { "method": "POST", "path": "/Devices", "bulkId": "laptop",
      "data": { "schemas": ["urn:example:params:scim:schemas:Device"],
                "displayName": "Jane's laptop", "serialNumber": "C02XK1" } },
    { "method": "PUT", "path": "/Devices/bulkId:laptop",
      "data": { "schemas": ["urn:example:params:scim:schemas:Device"],
                "displayName": "Jane's laptop", "serialNumber": "C02XK1",
                "urn:example:params:scim:schemas:extension:lease:Device":
                  { "leasedUntil": "2027-09-30T00:00:00Z" } } }
  ]
}
```

- Each operation reports its own status. `failOnErrors` sets how many failures stop the batch.
- `bulkId` resolves in request order, so define it before you use it.

Metrics per SCIM operation

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Metric	Labels
`scimd_http_requests_total`	`endpoint`, `method`, `status`
`scimd_http_request_duration_seconds`	`endpoint`, `method`, `status`
`scimd_scim_operations_total`	`resource_type`, `operation`, `source`, `outcome`
`scimd_scim_operation_duration_seconds`	`resource_type`, `operation`
`scimd_bulk_operations_per_request`	
`scimd_registered_resource_types`	

Every label comes from a closed set. `endpoint` is the route pattern (`/v2/Users/{id}`), never a concrete id, so no client request can create a new time series.

Mount into an existing server

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```
let core = scimd::ScimBuilder::new()
    .register::<scimd::models::User, _>(UserService::new())
    .base_path("/scim/v2");
let scim = scimd::AppBuilder::new(core).bearer_token(Some(token)).build();
let scim_routes = scim.configure();

HttpServer::new(move || {
    App::new()
        .service(my_existing_api())
        .configure(scim_routes.clone())
})
```

- `base_path` moves the routes, `meta.location` and the discovery links together.
- Authentication and `Accept` negotiation apply only inside the mount.

Ignoring the filter

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- Before it creates `jdoe`, an IdP asks `GET /Users?filter=userName eq "jdoe"`.
- A provider that ignores `filter` answers with every user it has.
- An IdP that takes the first result now links `jdoe` to someone else's account.

scimd advertises filtering as off by default. While it is off, scimd refuses any request that carries a filter with `invalidFilter`, before the service sees it.

A `400` is better than a wrong answer, because the client cannot detect a wrong answer.

Easy to get wrong

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- `schemas` has to list every schema the body carries. Forget the enterprise extension's URN and IdPs reject the body. scimd adds the URN of every populated extension.
- `USERNAME eq "JDoe"` has to match `"userName": "jdoe"`.
- A missing attribute is not an error. `title eq "CTO"` is false for a user without a title.
- Filters come from the network, and deep nesting means deep recursion. scimd caps the length before it parses and the depth while it parses.

Unsupported attributes and changes

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- IdPs send attributes the product has no field for. Drop those and log them. Failing the whole PATCH would stop provisioning over a field nobody stores.
- Refuse a change the product cannot make. Ignoring a rename leaves the IdP believing it happened.
- Some IdPs deprovision with `DELETE`, some with `active: false`. Either one has to end the person's access.
- `/ServiceProviderConfig` should advertise only what the service implements.

kimaid

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- Kimai is an open source time tracker with a REST API for users and teams, and no SCIM.
- kimaid runs next to Kimai and talks to that API with an API token.
- SCIM `/Users` are Kimai users. SCIM `/Groups` are Kimai teams.

```
let scim = scimd::ScimBuilder::new()
    .register::<scimd::models::User, _>(users::Users::new(kimai.clone(), defaults))
    .register::<scimd::models::Group, _>(groups::Groups::new(kimai))
    .with_filter(true, None)
    .with_patch(true);
```

The rest is configuration: Kimai's URL and API token, the SCIM bearer token and defaults for new users.

What Kimai can’t do

- **No delete endpoint.** `DELETE` deactivates, the same as `active: false`. Repeating it changes nothing.
- **No username in the edit form.** A rename answers `400 invalidValue`.
- **Nowhere to store `externalId`.** The IdP finds users again with `userName eq`.
- **No paging or filtering.** kimaid hands the whole collection to `list_response`.

```
async fn delete(&self, id: String) -> Result<()> {
    let id = map::parse_id(&id)?;
    let (_, mut form) = self.form_for(id).await?;
    if !form.enabled {
        return Ok(());
    }
    form.enabled = false;
    self.kimai.patch_user(id, &form).await?;
    Ok(())
}
```

kimaid's PATCH handler

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```
for operation in &op.operations {
    match operation.attr().as_str() {
        "username" => {
            map::refuse_rename(&current.username, operation.str_value().unwrap_or_default())?;
        }
        "active" => set(&mut form.enabled, operation.bool_value()),
        "emails" => set(&mut form.email, operation.email_address()),
        "displayname" => form.alias = patch::scalar(operation),
        "timezone" => set(&mut form.timezone, operation.str_value()),
        // title, preferredlanguage and locale follow the same pattern.
        // An identity provider sends attributes Kimai has no field for.
        other => tracing::debug!("ignoring patch on '{other}' for user {id}"),
    }
}
```

- `attr()` strips the schema URN, `valuePath` brackets and sub-attributes, and lowercases the result.

Auditing through the sidecar

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- Okta's user import pages through `GET /Users` and `GET /Groups` and compares the result with its own directory.
- For the audit, the sidecar only needs `list`. kimaid's is two lines.
- Kimai has nowhere to store `externalId`, so the IdP matches on `userName`.

In Kimai	In the IdP	Finding
`mmuster`, active	no such person	created by hand, outside provisioning
`jdoe`, active	left in June	access that should have ended
`asmith`, no team	in Engineering	membership drifted

The IdP finds accounts that someone created by hand or that provisioning missed.

Demo: kimaid in front of Kimai

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1. `GET /v2/ServiceProviderConfig` and `GET /v2/ResourceTypes`
2. `POST /v2/Users` creates `jdoe`
3. `PATCH /v2/Groups/7` adds `jdoe` to team Engineering
4. `jdoe` appears in Kimai's user list, in Engineering
5. `PATCH active: false` deactivates `jdoe` in Kimai
6. `PATCH userName` answers `400 invalidValue`

If the demo fails, the next three slides show steps 1 to 3, 5 and 6.

Demo: discovery

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```
curl -H "Authorization: Bearer $TOKEN" http://127.0.0.1:5001/v2/ResourceTypes
```


```
{
  "schemas": ["urn:ietf:params:scim:api:messages:2.0:ListResponse"],
  "totalResults": 2,
  "Resources": [
    { "id": "Group", "name": "Group", "endpoint": "/Groups",
      "schema": "urn:ietf:params:scim:schemas:core:2.0:Group" },
    { "id": "User", "name": "User", "endpoint": "/Users",
      "schema": "urn:ietf:params:scim:schemas:core:2.0:User",
      "schemaExtensions": [{
        "schema": "urn:ietf:params:scim:schemas:extension:enterprise:2.0:User",
        "required": false }] }
  ]
}
```

Demo: create and add to a team

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```
curl -X POST -H "Authorization: Bearer $TOKEN" -H "Content-Type: application/scim+json" \
  http://127.0.0.1:5001/v2/Users -d '{
    "schemas": ["urn:ietf:params:scim:schemas:core:2.0:User"],
    "userName": "jdoe", "displayName": "Jane Doe",
    "emails": [{ "value": "jane.doe@example.com", "primary": true }] }'
```

```
{
  "schemas": ["urn:ietf:params:scim:schemas:core:2.0:User"],
  "id": "42", "userName": "jdoe", "displayName": "Jane Doe", "active": true,
  "preferredLanguage": "de", "locale": "de_DE", "timezone": "Europe/Berlin",
  "emails": [{ "value": "jane.doe@example.com", "type": "work", "primary": true }],
  "meta": { "resourceType": "User", "location": "/v2/Users/42" }
}
```

The User schema marks `groups` read-only, so membership changes go through the group:

```
curl -X PATCH ... http://127.0.0.1:5001/v2/Groups/7 -d '{ ..., "Operations": [
    { "op": "add", "path": "members", "value": [{ "value": "42" }] }] }'
```

Demo: deactivate and rename

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```
curl -X PATCH -H "Authorization: Bearer $TOKEN" -H "Content-Type: application/scim+json" \
  http://127.0.0.1:5001/v2/Users/42 -d '{
    "schemas": ["urn:ietf:params:scim:api:messages:2.0:PatchOp"],
    "Operations": [{ "op": "replace", "path": "active", "value": false }] }'
```

```
{ "id": "42", "userName": "jdoe", "active": false, ... }
```

```
curl -X PATCH ... -d '{ ..., "Operations": [
    { "op": "replace", "path": "userName", "value": "jane" }] }'
```

```
{
  "schemas": ["urn:ietf:params:scim:api:messages:2.0:Error"],
  "status": "400", "scimType": "invalidValue",
  "detail": "Kimai cannot rename a user: 'jdoe' cannot become 'jane'"
}
```

Renaming a mailbox

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- Dovecot names a mailbox after the address. After an address change, the next login creates a new, empty mailbox, and the old mail stays behind.
- An admin has to move the mailbox before that first login:

```
doveadm kick "oldname@example.org"      # on every frontend
mv /var/lib/imap/example.org/private/oldname /var/lib/imap/example.org/private/newname
```

- `doveadm kick` only disconnects sessions on its own host. Skip one frontend and a session there survives the rename.

doveadmd

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- doveadmd is a SCIM sidecar on the mail backend. It lists and reads users and renames mailboxes on `PUT` and `PATCH`.
- The kicks go to every frontend over the doveadm HTTP API. The move is a local `rename(2)`, which is atomic and keeps file ownership.
- The order is fixed: kick the old and the new address everywhere, rename, kick again, check that nothing reappeared.
- SQLite maps the SCIM `id` to the mailbox's current address. An unknown `id` on `PUT` is mapped to the address it carries, so doveadmd works against an existing mail store.

Checks before the rename

- Renaming onto an existing mailbox is a `409`. doveadmd never merges mail.
- A `userName` and primary email that disagree are a `400`.
- An unsafe address is a `400` from `Address::parse`.
- `POST` and `DELETE` answer `501`. Provisioning does not delete mail.
- doveadmd writes a journal row before the first kick. `dry_run` touches no mail.

```rust
pub struct Address {
    localpart: String,
    domain: String,
}

impl Address {
    /// Refuses `/`, `\`, a leading dot, controls.
    pub fn parse(address: &str) -> Result<Self>;
    /// `<root>/<domain>/private/<localpart>`
    pub fn path(&self, root: &Path) -> PathBuf;
}
```

Creating and deleting mailboxes

```rust
#[derive(Serialize, Deserialize, Clone)]
struct MailUser {
    #[serde(flatten)]
    user: User,
    #[serde(rename = "urn:…:mailbox:User")]
    mailbox: Option<Mailbox>,
}

impl Resource for MailUser {
    // User's endpoint and schema, plus:
    fn extensions() -> Vec<Extension> {
        let mut extensions = User::extensions();
        extensions.push(
            Extension::optional(Mailbox::schema()));
        extensions
    }
}
```

`POST`	creates the mailbox
`active: false`	suspends it
`DELETE`	removes it
`…:quota`	sets its quota

doveadmd only renames. A draft in `example/src/mail.rs` covers the rest of the lifecycle without a new resource type: the mailbox follows the user.

Mailboxes in `example`

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```
curl -X POST ... http://127.0.0.1:5000/v2/Users -d '{
    "schemas": ["urn:ietf:params:scim:schemas:core:2.0:User"], "userName": "jdoe",
    "urn:example:params:scim:schemas:extension:mailbox:User": { "quota": 1024 } }'
curl -X PATCH ... http://127.0.0.1:5000/v2/Users/$ID -d '{ ..., "Operations": [
    { "op": "replace", "value": { "active": false } }] }'
curl -X PATCH ... http://127.0.0.1:5000/v2/Users/$ID -d '{ ..., "Operations": [
    { "op": "replace", "path": "urn:example:params:scim:schemas:extension:mailbox:User:quota",
      "value": 2048 }] }'
curl -X DELETE ... http://127.0.0.1:5000/v2/Users/$ID
```

```
INFO example::mail: created mailbox for jdoe
INFO example::mail: suspended mailbox of jdoe
INFO example::mail: deleted mailbox of jdoe
```

- The create response lists the mailbox URN in `schemas`. scimd adds it because the extension is populated.

kimaid and doveadmd

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	kimaid	doveadmd
reaches the product via	Kimai's REST API	doveadm HTTP API and `rename(2)`
resource types	`User`, `Group`	`User`
implements	list, get, create, replace, patch, delete	list, get, replace, patch
`DELETE` means	deactivate	`501`
runs	next to Kimai	on the mail backend

Takeaways

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- A product without SCIM is a deployment problem you can solve yourself, with one sidecar per product.
- The protocol work is the same every time. scimd does it once.
- The product-specific part is small. Most of the work is deciding what to refuse and making deprovisioning safe to repeat.

github.com/helsinki-systems/scimd, AGPL

```
export EXAMPLE_SERVICE_BEARER_TOKEN=secret
cargo run -p example -- --bind 127.0.0.1:5000   # mail users and the custom Device
curl -H "Authorization: Bearer secret" http://127.0.0.1:5000/v2/ResourceTypes
```

Questions?

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helsinki-systems.de

github.com/helsinki-systems/scimd