Captive Portal / Hotspot Design

Internal Architecture Spec: Hotspot Profile Deployment System

Objective

To provide clients with a backend tool that automates the configuration and deployment of secure, traceable captive portal environments. The system integrates with CoovaChilli, FreeRADIUS, and optionally Squid, based on client-defined Hotspot Profiles. Aruba Access Points serve as the external SSID broadcasters and are outside our management scope.

System Components

1. Aruba Access Point (External)

- Broadcasts Wi-Fi SSID (e.g., "Guest-WiFi")
- Places connected clients in a specified VLAN (e.g., 182)
- Handles DNS/DHCP unless otherwise specified

2. Hotspot Profile Manager (Core Backend)

- Allows definition of network-facing Hotspot Profiles
- Generates and applies configurations for:
  - CoovaChilli
  - FreeRADIUS
  - Squid (optional)
- Provides secure defaults and constraints to ensure valid setups

3. CoovaChilli

- Captive portal controller
- Manages client redirection, IP routing, session initiation
- Communicates with FreeRADIUS for authentication/authorization
- Optional integration with Squid for HTTP proxying

4. FreeRADIUS

- Authenticates users (voucher, username/password, MAC)
- Stores accounting logs for tracking session data and identity
- Enables full traceability of network access

5. Squid (Optional)

- HTTP/HTTPS proxy for traffic logging and access control
- Enforced via transparent iptables NAT rules from CoovaChilli
- Adds an additional layer of monitoring or filtering if required

Architecture Diagram

App is not responding. Wait or cancel?

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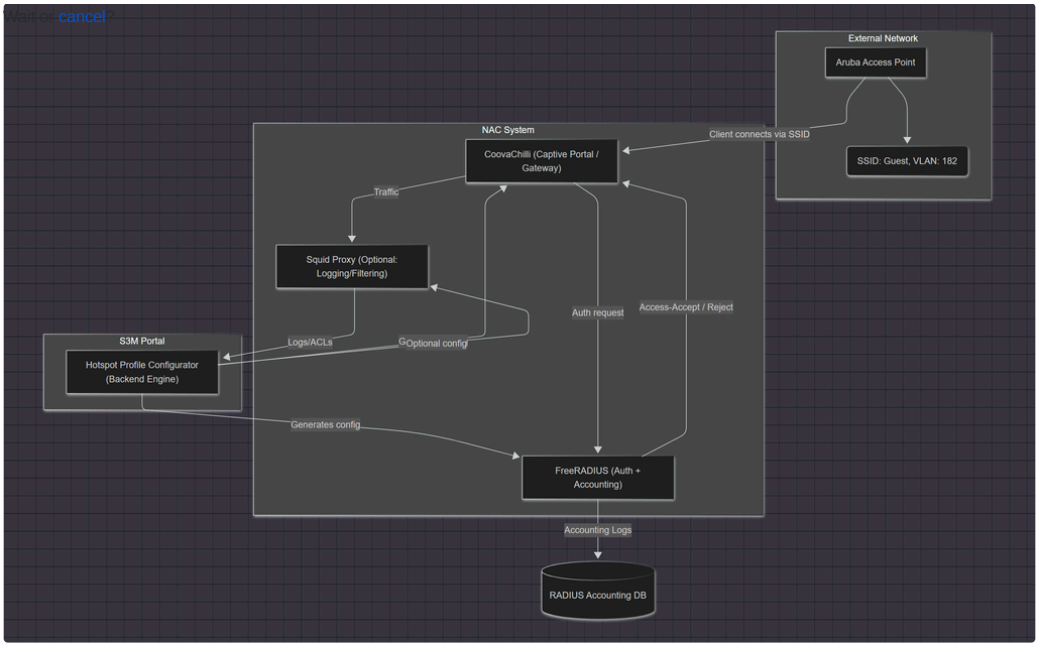

Data and Traffic Flow

1. **Client connects to Aruba AP**
   - Receives IP via DHCP (from Aruba or firewall)
   - Placed in Guest VLAN (e.g., 182)
2. **CoovaChilli Intercepts Traffic**
   - Redirects HTTP to captive portal (hosted locally or pre-generated)
   - Handles IP/MAC mapping and tracks session
3. **User Authenticates**
   - CoovaChilli sends RADIUS Access-Request
   - FreeRADIUS replies (Accept/Reject)
   - CoovaChilli enables forwarding based on response
4. **Optional: Squid Proxy**
   - HTTP/HTTPS traffic routed to Squid via NAT
   - Squid logs domain/IP and maps to client identity
5. **RADIUS Accounting**
   - Start/Stop packets track session time, data usage
   - Stored in backend DB for traceability and reporting

System Overview

Building a **backend system** that allows clients to define **Hotspot Profiles** through a database. Each profile describes how to configure a local instance of:

- **CoovaChilli**: the captive portal gateway
- **FreeRADIUS**: the authentication/accounting backend

- **Squid** (optional): HTTP/HTTPS logging proxy

This profile-driven design dynamically generates and deploys working configurations **locally on the same server**.

Component Responsibilities

Component	Source of Config	Deployment Target	Notes
CoovaChilli	DB → `generate_coova_config(profile)`	`/etc/chilli/defaults`	Handles portal redirect and DHCP-like behavior
FreeRADIUS	DB → `generate_radius_config(profile)`	`/etc/raddb/clients.conf`, `/etc/raddb/users`, or SQL ⚠️	Handles authentication and session accounting
Squid (optional)	DB → `generate_squid_config(profile)`	`/etc/squid/squid.conf`	Logs and filters post-auth HTTP/HTTPS

Hotspot Profile Database Design (Draft Schema)

```sql
CREATE TABLE hotspot_profiles (
    id SERIAL PRIMARY KEY,
    name TEXT UNIQUE,
    vlan_id INTEGER NOT NULL,
    interface TEXT NOT NULL,
    network_cidr TEXT NOT NULL,          -- e.g., '192.168.182.0/24'
    uam_server TEXT NOT NULL,            -- e.g., 'http://192.168.182.1:3990'
    uam_secret TEXT NOT NULL,
    uam_portal_type TEXT NOT NULL CHECK (uam_portal_type IN ('radius_login', 'voucher')),
    auth_method TEXT NOT NULL CHECK (auth_method IN ('radius', 'voucher')),
    radius_ip TEXT NOT NULL,
    radius_secret TEXT NOT NULL,
    proxy_enabled BOOLEAN DEFAULT FALSE,
    proxy_port INTEGER DEFAULT 3128,
    allowed_domains TEXT[],              -- JSON or array, e.g. ['example.com']
    created_at TIMESTAMP DEFAULT now()
);
```

Note: Secure fields like `radius_secret` and `uam_secret` should be **encrypted** or at least hashed-at-rest if planned to be shown in the frontend.

Field-by-Field Explanation

Field	Why It's Important	Where It's Used	Example Data
`profile_name`	Used to identify the profile	Naming configs, NAS-ID in RADIUS	cafe_latte_guest

`vlan_id`	Matches Aruba's Guest VLAN	Used for tagging/logging only (not needed in config)	182
`interface`	Physical NIC or VLAN interface that CoovaChilli will bind to	`HS_INTERFACE` in Coova	eth0
`network_cidr`	Guest IP pool for clients	`HS_NETWORK`, `HS_NETMASK` in Coova	192.168.182.0/24
`uam_server`	IP/URL of captive portal	Used in CoovaChilli's `HS_UAMSERVER`, redirect logic	http://192.168.182.1:3990
`uam_https`	If there is a valid certificate to be used	`HS_UAMHTTPS` for the captive portal in Coova	on | off
`uam_secret`	Shared secret for UAM portal integrity	`HS_UAMSECRET` in Coova, and used in captive page submission	abcd1234
`auth_method`	Whether FreeRADIUS handles user/pass or vouchers	Chooses logic for FreeRADIUS `users` file or SQL	radius | voucher
`radius_ip`	Where to send RADIUS requests (local, but still explicitly set)	`HS_RADIUS` in CoovaChilli config	10.34.10.5
`radius_secret`	Shared secret between Coova and RADIUS	Used in both CoovaChilli and FreeRADIUS `clients.conf` (Creating Access Device)	testing123
`proxy_enabled`	Whether to activate Squid proxying	Triggers Squid setup and iptables redirect	true | false
`proxy_port`	Port for Squid to listen on	`3128` by default, injected into Squid config	3128
`allowed_domains`	Domains allowed before authentication (e.g., CDN, Google login)	`HS_UAMALLOWED` in CoovaChilli	['api.example.com', 'static.examplecdn.com']

Goal:

When a new hotspot profile is added to the database, the system should:

1. Automatically create and deploy a new **CoovaChilli instance**
2. FreeRADIUS must respond to **Access-Request** and **Accounting-Request** messages from CoovaChilli.
3. **Enhances visibility and control** over user browsing after login with Squid if requested

Workflow Overview

```
1. Admin creates hotspot profile → stored in DB
2. Backend validates input
3. Each component generator reads the DB and generates its config:
     - CoovaChilli: /etc/chilli/defaults
     - FreeRADIUS: /etc/raddb/clients.conf, /etc/raddb/users or DB
     - Squid (optional): /etc/squid/squid.conf
4. System restarts services:
     - systemctl restart chilli
     - systemctl stop freeradius
     - systemctl start freeradius
     - systemctl restart squid (if enabled)
```

Big Picture Workflow (Step-by-Step)

1. A New Hotspot Profile is Created

- A user or admin adds a new hotspot profile via CLI, API, or directly in the DB.
- Example: a profile called `cafe_latte` with interface `eth0.100` (VLAN 100).

2. `ConfigController` Detects a New Profile

- A REST API handler
- The controller receives `profile_id` (or the full profile dict)

3. `ConfigController` Starts Deployment Pipeline

- It calls:
  - `deploy_profile(profile_id)`
- Which internally triggers:
  - `- deploy_coova_config(profile)`
  - `- deploy_radius_config(profile)`
  - `- deploy_squid_config(profile)`

4. CoovaChilli Configuration Phase

`deploy_coova_config(profile)` does the following:

Sub-Step	Description
Parse the profile	Reads info like interface name, UAM server URL, IP range, RADIUS IP
Generate a config file	Uses the profile to fill out a template like `cafe_latte.conf`

Link it for systemd	Symlink this config to `/etc/chilli/cafe_latte.conf`
Register it as a systemd instance	Coova will run as `chilli@cafe_latte.service`
Start the service	`systemctl start chilli@cafe_latte` creates a running captive portal gateway

⚠️ It is crucial that **CoovaChilli *can* run multiple instances simultaneously**, as long as each instance:

- Runs as a **separate process**
- Has its **own config file**
- Binds to a **unique physical or virtual interface**
- Uses a **different UAM listen IP and tun interface**
- Avoids port conflicts

This approach is **used in production environments**, especially for multi-tenant networks, public hotspots, and ISPs.

Verified Conditions for Multiple CoovaChilli Instances

Here's what you must ensure for this to actually work:

Config Element	Must Be
`HS_INTERFACE`	Unique per instance (e.g., `eth0.100`, `eth0.200`)
`HS_NETWORK` / `HS_NETMASK`	Non-overlapping IP pools per instance
`HS_UAMLISTEN`	Unique IP per instance (e.g., `192.168.182.1`, `192.168.183.1`)
`tunX` interface	Automatically created (e.g., `tun0`, `tun1`, etc.)
`iptables rules`	Written separately per instance (ideally per `tunX`)
`systemd`	Use template units: `chilli@profile_name.service`

File-Level Isolation

Each instance should have:

- Its own config: `/etc/chilli/cafe_latte.conf`, `/etc/chilli/techfair.conf`
- Its own log files (optional, if configured)
- Its own IP range, VLAN interface, and redirect portal

Things to Watch Out For

- **UAM ports** can conflict (default `3990`) → but only if using same IP/UAM listener
- You **must manage iptables/NAT rules separately** for each instance's `tunX` device
- Each interface (e.g., `eth0.100`) must be routable to your guests
- Ensure **routing/NAT/firewall rules** are written with interface awareness

5. Recognize CoovaChilli as a valid NAS

- Coova sends requests as a RADIUS client (NAS)
- FreeRADIUS must trust it as a NAS device, such as in the NAS table in the database

6. Handle Authentication Requests

Coova sends:

```
Access-Request
  User-Name = "guest123"
  User-Password = "secret"
  Calling-Station-Id = "MAC_ADDRESS"
  NAS-Identifier = "cafe_latte"
```

FreeRADIUS must proceed to guest services:

- Look up this user
- Validate credentials (username/password or voucher)
- Return an **Access-Accept** (or **Access-Reject**) with **optional attributes**

> Depending on your profile type:

- If it's **voucher-based**: FreeRADIUS should check that the voucher exists, is unused/valid, then mark it as used
- If it's **username/password**: validate against guest user table, LDAP, or flat file

7. Return Proper Reply Attributes

You can control the session using reply attributes:

Attribute	What It Does
`Session-Timeout`	Disconnect the user after X seconds
`Idle-Timeout`	Disconnect the user after X seconds of inactivity
`ChilliSpot-Max-Total-Octets`	Data cap in bytes
`WISPr-Bandwidth-Max-Down` / `Up`	Rate limits in bps

Example Access-Accept:

```
Access-Accept
  Session-Timeout = 1800
  ChilliSpot-Max-Total-Octets = 50000000
```

8. Handle Accounting Packets

Coova will send:

```
Accounting-Start
Accounting-Interim-Update
Accounting-Stop
```

FreeRADIUS must:

- Log these (in SQL or files)
- Track session start/stop time, IP, MAC, data used
- Tie this data back to the profile (e.g., via NAS-Identifier or Calling-Station-Id)

This is **how traffic is traced back to a guest** — these logs are mandatory!

> If you use a SQL-based accounting backend (e.g., `rlm_sql`), check that your schema includes:

- username
- framed_ip
- calling_station_id (MAC)
- acct_session_id
- acct_input_octets / output_octets

9. Configure Squid

In `/etc/squid/squid.conf`:

```
# Listen on default proxy port
http_port 3128 transparent

# Define ACLs
acl allowed_localnet src 192.168.182.0/24  # Change to match Coova subnet
http_access allow allowed_localnet

# Logging format (optional but recommended)
logformat custom_with_ip %ts.%03tu %>a %un %rm %ru %Hs %<st
access_log /var/log/squid/access.log custom_with_ip
```

- `http_port 3128 transparent` enables intercept mode
- `%>a` logs client IP, which is **critical for attribution**
- You can extend logging to include usernames if available

10. Enable NAT Redirection via iptables

After a user logs in and is allowed to surf:

```
iptables -t nat -A PREROUTING -i tun0 -p tcp --dport 80 -j REDIRECT --to-port 3128
```

This command captures all HTTP traffic from clients going through `tun0` (Coova's internal interface) and sends it to Squid.

You can add similar rules for port 443 (HTTPS), but **it requires SSL bumping** — advanced and potentially privacy-sensitive.

11. Access Logs

Squid will log traffic like:

```
1681328475.123    56 192.168.182.101 TCP_MISS/200 1652 GET http://example.com/ - DIRECT/93.184.216.34 text/html
```

You can parse logs to match:

- IP → `radacct.framedipaddress`

- MAC → via CoovaChilli session table
- Username → via RADIUS session or accounting

What Is a Voucher?

A **voucher** is simply a **username** (and optionally a password) that:

- Has a **limited lifetime** (time-based or expiration date)
- Is usually **pre-generated**
- Can be **single-use or multi-use**
- Is stored in a **database or flat file**
- Can return **custom RADIUS reply attributes** (like time or data caps)

Voucher System Architecture (Simplified)

```
[CoovaChilli Portal Page]
     → User enters voucher code
         ↓
[FreeRADIUS]
     → Checks voucher code against database or file
     → If valid:
         → Returns Access-Accept + Session-Timeout + bandwidth limits
         → Marks voucher as used (if one-time)
     → If invalid/expired:
         → Returns Access-Reject
```

Voucher Lifecycle Flow

1. **Create vouchers** (CLI or portal)
   - E.g., generate 100 codes, each valid for 1 hour, expires in 30 days
2. **Store them in a database** (SQL) or file
   - Fields: code, used, created_at, expires_at, session_time, octet_limit
3. **User enters code in captive portal**
   - Form submits username (voucher code) to CoovaChilli
   - CoovaChilli passes it as `User-Name` to RADIUS
4. **FreeRADIUS authenticates**
   - Finds the voucher
   - Verifies it is not used or expired
   - Replies with Access-Accept and session control
5. **FreeRADIUS marks it as used**
   - For one-time vouchers, `used = true` or deletes it
6. **RADIUS accounting tracks usage**
   - Username, IP, MAC, duration, bandwidth

SQL-Based Voucher System

1. **Create a SQL table**

```
CREATE TABLE vouchers (
    code VARCHAR(64) PRIMARY KEY,
    created_at TIMESTAMP DEFAULT now(),
    expires_at TIMESTAMP,
    session_time INTEGER DEFAULT 1800, -- in seconds
    octet_limit BIGINT DEFAULT NULL,  -- optional
    is_used BOOLEAN DEFAULT false
);
```

2. **Enable SQL module in FreeRADIUS**

- Use `rlm_sql` and define queries in `mods-config/sql/authorize-check.sql`

3. **Authorize with SQL**

- Add a policy in `sites-enabled/default → authorize`:

```
authorize {
    ...
    sql
    if (!ok) {
        reject
    }
}
```

4. **Control usage in `authorize`**

```
if ("%{sql:SELECT is_used FROM vouchers WHERE code='%{User-Name}'}" == "t") {
    reject
}
```

5. **Add reply attributes dynamically**

```
update reply {
    Session-Timeout := "%{sql:SELECT session_time FROM vouchers WHERE code='%{User-Name}'}"
}
```

6. **Mark voucher as used (Post-Auth or Accounting-Start)**

- Hook into `post-auth` or `sql` module's `post-auth-query`:

```
UPDATE vouchers SET is_used=true WHERE code='%{User-Name}';
```

Voucher Customization Examples

Field	Purpose
`session_time`	Auto-expire after X seconds
`expires_at`	Prevent login after a certain date
`is_used`	Single-use control
`octet_limit`	Cap on total data usage
`bandwidth_up/down`	Per-user bandwidth limits
`group`	Group vouchers by location or SSID/profile

Health Check

Purpose:

To detect **if a CoovaChilli instance (or system component)** is:

- Misconfigured
- Crashed
- Hung
- Not serving clients properly

Health Check (Per Instance):

Check	How	Why
CoovaChilli process running	`systemctl is-active chilli@profile`	Detects crash or failure to start
tunX interface exists	`ip link show tun0` (or tun1...)	Verifies tunnel is up
UAM server reachable	`curl -k https://portal.example.com`	Detects portal web server failure
Session check	`chilli_query list` has output	Confirms users are able to connect

Sample Concept

```
check_chilli_health() {
  profile=$1
  systemctl is-active chilli@$profile || echo "$profile is down"
  ip link show tun0 >/dev/null || echo "Tunnel not up"
  curl -k --max-time 3 https://portal.example.com/login || echo "Portal unreachable"
}
```

Sample Code Structure

```
hotspot_manager/
│
├── main.py                        # Entrypoint (CLI or REST)
│
├── config_generators/             # Handles config generation for each tool
│   ├── __init__.py
│   ├── coova.py                   # CoovaChilli generator, deploy, delete
│   ├── radius.py                  # FreeRADIUS generator, deploy, delete
│   ├── squid.py                   # Squid generator, deploy, delete
│
├── controllers/                   # Central orchestration logic
│   ├── __init__.py
│   └── config_controller.py       # deploy_profile(), update_profile(), delete_profile()
│
├── templates/                     # Jinja2 templates for config generation
```

```
16 │   ├── coova_defaults.j2
17 │   ├── radius_clients.j2
18 │   ├── squid_conf.j2
19 │
20 ├── utils/                          # Utilities
21 │   ├── __init__.py
22 │   ├── db.py                       # DB functions: get_profile_by_id(), get_all_profiles()
23 │   ├── netutils.py                 # parse_cidr(), validate_ip(), calculate_netmask()
24 │   ├── templates.py                # Jinja2 wrapper: render_template(template_name, context)
25 │
26 ├── migrations/                     # SQL scripts for creating and upgrading the DB schema
27 │   └── create_hotspot_profiles.sql
28 │
29 └── logs/                           # Config deployment logs
30     └── deploy.log
```

Key Modules

`config_generators/coova.py`

- `generate_coova_config(profile)`
- `deploy_coova_config(profile)`
- `delete_coova_config(profile_name)`

`controllers/config_controller.py`

- `deploy_profile(profile_id)`
- `update_profile(profile_id)`
- `delete_profile(profile_id)`

`utils/db.py`

- `get_profile_by_id(profile_id)`
- `insert_profile(data)`
- `update_profile(profile_id, data)`
- `delete_profile(profile_id)`

`utils/netutils.py`

- `parse_cidr('192.168.182.0/24') → ('192.168.182.0', '255.255.255.0')`

Lifecycle Handlers

Action	Trigger	Operation
Add Profile	`POST /profiles` or `create_profile()`	Validate + generate config + deploy
Edit Profile	`PUT /profiles/:id` or `update_profile()`	Regenerate config + restart affected service(s)
Delete Profile	`DELETE /profiles/:id` or `delete_profile()`	Remove config file + restart/clean affected services