SNMPeek Technical Reference

Complete Process Flow & Architecture

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1. Overview

SNMPeek is a Python CLI tool that queries an AKiPS network monitoring server to search for and report on network devices. It auto-detects the type of search the user intends based on the input string and routes the query through the appropriate pipeline.

Supported query types (auto-detected):

Input Example	Detected Type	Pipeline Used
`10.1.0.0/24`	CIDR Subnet	Host Query (api-db)
`192.168.1.1`	Single IP	Host Query (api-db)
`switch-core`	Hostname	Host Query (api-db)
`*router*`	Hostname wildcard	Host Query (api-db)
`aa:bb:cc:dd:ee:ff`	Full MAC address	SPM Query (api-spm)
`00:50:56`	Partial MAC address	SPM Query (api-spm)
`aabb.ccdd`	Partial MAC (Cisco)	SPM Query (api-spm)

Multiple queries of mixed types can be passed in a single invocation. Each is classified independently and routed to the correct pipeline.

1.1 Technology Stack

- **Language:** Python 3.13
- **AKiPS Client:** `akips` Python library (v0.5.1) — wraps the AKiPS HTTP Web API
- **Terminal UI:** `rich` library — formatted tables, panels, spinners
- **Config:** `python-dotenv` — reads `.env` for server credentials

1.2 External Dependencies

The tool depends on a running **AKiPS Network Monitoring** server with the following Web API sections enabled:

API Section	Purpose	Required?
`api-db`	Device list, ping/SNMP states, LLDP, groups, events	Yes
`api-spm`	Switch Port Mapper (MAC lookups)	Only for MAC queries
`api-script`	Site script functions	No (not currently used)
`api-msg`	Syslog and trap messages	No (not currently used)

2. Complete Process Flow

2.1 High-Level Execution Flow

```
main()
  |
  +-- parse_args()                    Parse CLI flags and positional queries
  |
  +-- classify_query()  [per query]   Auto-detect: MAC / subnet / hostname
  |     |
  |     +-- MAC_PATTERN.match()       Full MAC? (12 hex chars, any format)
  |     +-- is_partial_mac()          Partial MAC? (delimited hex fragment)
  |     +-- ipaddress.ip_network()    Valid CIDR / IP?
  |     +-- fallback: hostname        Wrap bare strings in wildcards
  |
  +-- connect_akips()                 Build AKIPS API client from .env
  |
  +-- [IF mac_addresses]              === MAC Pipeline ===
  |     +-- fetch_mac_data()
  |     |     +-- query_spm()         GET /api-spm?mac=...
  |     |     +-- parse_spm_response() Parse delimited SPM text
  |     |     +-- get_attributes()    Enrich: port status/speed/descr
  |     |     +-- get_events()        Enrich: 7-day port event history
  |     +-- display_mac_results()     Rich table + event history table
  |     +-- [IF --csv] write_mac_csv() CSV export (opt-in)
  |
  +-- [IF networks or hostnames]      === Host Pipeline ===
        +-- fetch_data()
        |     +-- get_devices()       All devices + base SNMP attrs
        |     +-- get_attributes()    PING.icmpState for every device
        |     +-- [optional]          Groups, SNMP state, LLDP neighbors
        +-- filter_and_merge()        Match devices against query filters
        +-- display_results()         Rich table with color-coded status
        +-- [IF --csv] write_csv()    CSV export (opt-in)
```

2.2 Phase 1 — Argument Parsing

Function: `parse_args()`

The argument parser accepts one or more positional `query` strings plus optional flags that control which data columns are displayed.

Positional arguments:

- `query` (one or more) — CIDR subnet, MAC address, or hostname pattern

Optional field flags:

Flag	Long Form	Effect
`-g`	`--groups`	Include AKiPS group memberships
`-d`	`--descr`	Include SNMPv2-MIB.sysDescr (OS/model)
	`--location`	Include SNMPv2-MIB.sysLocation
`-l`	`--lldp`	Include LLDP neighbor information
	`--snmp`	Include SNMP reachability state
`-a`	`--all-fields`	Enable all of the above

Output flags:

Flag	Long Form	Effect
	`--csv`	Export results to a CSV file
`-o`	`--output`	Write CSV to a specific file (implies `--csv`)

CSV output is **off by default**; it must be explicitly requested with `--csv` or `-o`. When `-o` is provided, `--csv` is automatically set.

When `--all-fields` is set, the code flips all individual field booleans to `True` so downstream functions only check the individual flags.

2.3 Phase 2 — Query Classification

Function: `classify_query(query_str)`
Returns: `(type_string, normalized_value)`

This is the core routing logic. Each user-supplied query string is tested against a series of patterns in priority order:

Step 1: Full MAC Address Check

The compiled regex `MAC_PATTERN` tests for a complete 48-bit MAC address in any of five common notations (case-insensitive):

Format	Example
Colon-separated octets	`aa:bb:cc:dd:ee:ff`
Dash-separated octets	`aa-bb-cc-dd-ee-ff`

Format	Example
Cisco dot notation (3 groups of 4)	`aabb.ccdd.eeff`
Dash groups of 4	`aabb-ccdd-eeff`
Plain hex (no delimiters)	`aabbccddeeff`

If matched, `normalize_mac()` strips all non-hex characters, lowercases, and re-joins as colon-separated pairs: `aa:bb:cc:dd:ee:ff`.

Return: `("mac", "aa:bb:cc:dd:ee:ff")`

Step 2: Partial MAC Address Check

Function: `is_partial_mac(s)`

If the full MAC regex did not match, the string is tested for partial MAC patterns. A **delimiter is required** to avoid misidentifying short hex hostnames. The following patterns are recognized:

Pattern	Example	Description
`XX:XX ... XX:XX:XX:XX:XX`	`00:50:56`	2–5 colon-separated octets
`XX-XX ... XX-XX-XX-XX-XX`	`00-50-56`	2–5 dash-separated octets
`XXXX.X ... XXXX.XXXX`	`0050.56`	Cisco partial (1 quad + fragment)
`XXXX-X ... XXXX-XXXX`	`0050-56`	Dash quad partial

If matched, `normalize_mac()` processes the fragment the same way (strip delimiters, lowercase, re-pair with colons). A 3-octet OUI like `00:50:56` stays `00:50:56`.

Return: `("mac", "00:50:56")`

Step 3: CIDR / IP Address Check

Python's `ipaddress.ip_network(query_str, strict=False)` is called. The `strict=False` flag allows host bits to be set (e.g. `10.1.0.5/24` is accepted and normalized to `10.1.0.0/24`). A bare IP like `192.168.1.1` becomes a `/32` network.

Return: `("subnet", IPv4Network("10.1.0.0/24"))`

Step 4: Hostname Fallback

Everything that fails the above checks is treated as a hostname pattern. If the string contains no glob wildcards (`*` or `?`), it is automatically wrapped: `"switch"` becomes `"*switch*"` for substring matching. Explicit wildcards are preserved as-is.

Return: `("hostname", "*switch*")`

2.4 Phase 3 — API Connection

Function: `connect_akips()`

Reads credentials from the `.env` file via `python-dotenv`:

Variable	Purpose	Default
`AKIPS_SERVER`	Hostname or IP of AKiPS server	*(required)*
`AKIPS_USERNAME`	API username	`api-ro`
`AKIPS_PASSWORD`	API password	*(required)*
`AKIPS_VERIFY_SSL`	Verify TLS certificates	`true`
`AKIPS_TIMEZONE`	Server timezone for timestamps	`America/New_York`

Returns an initialized `AKIPS` client object that holds an authenticated `requests.Session` for all subsequent API calls.

2.5 Phase 4A — MAC Address Pipeline

This pipeline executes when one or more queries were classified as `"mac"`.

2.5.1 SPM Query

Function: `query_spm(api, mac=None, ip=None)`

Calls the AKiPS Switch Port Mapper endpoint:

```
GET https://<server>/api-spm?username=...&password=...&mac=<normalized_mac>
```

The `api._get(section="api-spm", params={"mac": mac})` method is used directly. This is a separate API section from the main `api-db` database and must be independently enabled on the AKiPS server.

Returns: Raw text response from the server, or `None` on error.

2.5.2 Response Parsing

Function: `parse_spm_response(text)`

The SPM API returns delimited text data. The parser auto-detects the format:

1. **Delimiter detection:** Checks the first line for tab characters, then semicolons, then falls back to comma.
2. **Header detection:** If 2 or more fields in the first line contain keywords like "mac", "vendor", "switch", "interface", "vlan", or "ip", the line is treated as a header row and used to map columns by name.
3. **Data parsing:** Each subsequent line is split by the detected delimiter and mapped to a dictionary.

Without a header, the assumed field order is:

Position	Field	Description
0	`mac`	MAC address
1	`vendor`	OUI vendor / manufacturer
2	`switch`	Switch device name in AKiPS
3	`interface`	Physical port name
4	`vlan`	VLAN name or ID
5	`ip`	Associated IP address (may be empty)

2.5.3 Port Enrichment

For each SPM result that includes a switch and interface name, the tool fetches additional port-level attributes from the AKiPS database via `api-db`:

```
mget * <switch> <interface> /IF-MIB.ifOperStatus|IF-MIB.ifAlias|
                            IF-MIB.ifHighSpeed|IF-MIB.ifAdminStatus/
```

Attribute	Type	Data Extracted
`IF-MIB.ifOperStatus`	Enum	Operational status (up/down) + last-change timestamp
`IF-MIB.ifAdminStatus`	Enum	Administrative status (up/down)
`IF-MIB.ifAlias`	Text	Interface description (often room/jack/cable ID)
`IF-MIB.ifHighSpeed`	Gauge	Port speed in Mbps

Enum values are parsed by `parse_enum_state()` which extracts the text value and the `modified` epoch timestamp from the AKiPS enum format: `number,value,created_epoch,modified_epoch,description`.

2.5.4 Event History

For each switch/interface pair, recent events are fetched:

```
mget event all time last7d <switch> <interface> *
```

This returns up to 20 events covering the last 7 days. Each event includes:

Field	Description
`epoch`	Unix timestamp
`parent`	Switch device name
`child`	Interface name
`attribute`	Attribute that triggered the event
`type`	Event classification (critical, enum, threshold, uptime)
`flags`	Event flags
`details`	Human-readable event description

2.5.5 MAC Results Display

Function: `display_mac_results(mac_data_list)`

For each queried MAC address, the output consists of:

1. Summary Panel (magenta border):

```
+-- MAC Address Lookup -------------------------+
| MAC: aa:bb:cc:dd:ee:ff  |  Results: 1         |
+-----------------------------------------------+
```

2. Results Table (magenta theme):

Column	Source	Description
MAC Address	SPM	Full MAC from SPM response
Vendor	SPM	OUI manufacturer name
IP Address	SPM	Associated IP or em-dash
Switch	SPM	AKiPS device name of the switch

Column	Source	Description
Port	SPM	Physical interface name
VLAN	SPM	VLAN name/ID
Port Status	Enrichment	Operational status (color-coded)
Speed	Enrichment	Link speed (e.g. 1G, 10G)
Description	Enrichment	IF-MIB.ifAlias value

Port status is color-coded:

- Green: `up`
- Red: `down`
- Yellow: `admin down` (administratively disabled)

3. Event History Table (green theme, only shown if events exist):

Columns: Time, Switch, Port, Type, Details.

2.5.6 MAC CSV Export (opt-in)

Function: `write_mac_csv(mac_data_list, filename)`

Only runs when `--csv` or `-o` is specified. Writes all MAC results to CSV with columns: Query MAC, MAC Address, Vendor, IP Address, Switch, Port, VLAN, Port Status, Admin Status, Speed (Mbps), Port Description, Port Last Change.

Default filename (when `--csv` is used without `-o`): `akips_mac_<hex>.csv` where `<hex>` is the query MAC with colons removed.

2.6 Phase 4B — Host Pipeline (Subnet / Hostname)

This pipeline executes when one or more queries were classified as `"subnet"` or `"hostname"`.

2.6.1 Data Fetching

Function: `fetch_data(api, args)`

Issues parallel-ish requests to the AKiPS `api-db` section:

Step	Command	Data Returned
1 (always)	`mget text * sys /<attrs>/`	All devices with sysName, sysDescr, sysLocation, ip4addr
2 (always)	`mget * * * PING.icmpState`	Ping status and timestamps for all devices
3 (if `-g`)	Group membership API	Device-to-group mappings
4 (if `--snmp`)	`mget * * * SNMP.snmpState`	SNMP reachability enum per device
5 (if `-l`)	`mget * * * /LLDP-MIB.lldpRemSysName|lldpRemPortId/`	LLDP neighbor discovery

Each fetch displays a `rich` spinner status message while the HTTP request is in flight.

2.6.2 Filtering and Merging

Function: `filter_and_merge(networks, hostname_patterns, devices, ping_states, extras, args)`

Iterates over every device returned by AKiPS and checks whether it matches **any** of the user's query filters (OR logic across all queries):

Subnet matching:

```
ip = ipaddress.ip_address(device_ip)
if ip in network:    # network is an IPv4Network object
    matched = True
```

Hostname matching:

```
fnmatch.fnmatch(hostname.lower(), pattern.lower())
# Also checks device_name (AKiPS primary key) as fallback
```

For each matched device, a result row is built:

Default fields (always included):

Field	Source	Logic
`hostname`	`SNMPv2-MIB.sysName` or device key	Display name
`ip`	`ip4addr` attribute	Device IP address

Field	Source	Logic
`status`	`PING.icmpState` enum	"Active" if value=up, "Inactive" if down, else "Unknown"
`uptime`	`PING.icmpState` modified timestamp	`now - modified` when status is Active
`last_seen`	`PING.icmpState` modified timestamp	`now` if Active, else `modified` time

Optional fields (flag-dependent):

Field	Flag	Source
`descr`	`-d`	`SNMPv2-MIB.sysDescr`
`location`	`--location`	`SNMPv2-MIB.sysLocation`
`groups`	`-g`	AKiPS group membership list
`snmp_state`	`--snmp`	`SNMP.snmpState` enum value
`lldp`	`-l`	LLDP neighbor names and port IDs

Results are sorted by IP address (ascending) for consistent output.

2.6.3 Host Results Display

Function: `display_results(results, networks, hostname_patterns, args)`

1. Summary Panel (blue border):

```
+-- AKIPS Host Query ------------------------------------------+
| Subnet: 10.1.0.0/24  |  Found: 45  |  Active: 42  |         |
| Inactive: 3                                                  |
+--------------------------------------------------------------+
```

2. Results Table (blue theme):

Status is color-coded with bullet indicators:

- Green: `Active`
- Red: `Inactive`
- Yellow: `Unknown`

Uptime is formatted as human-readable durations: `138d 3h 1m`.

2.6.4 Host CSV Export (opt-in)

Function: `write_csv(results, filename, args)`

Only runs when `--csv` or `-o` is specified. Default filename pattern (when `--csv` is used without `-o`): `akips_hosts_<label>.csv` where label is built from query parameters (CIDR slashes become underscores, wildcards become X/Q).

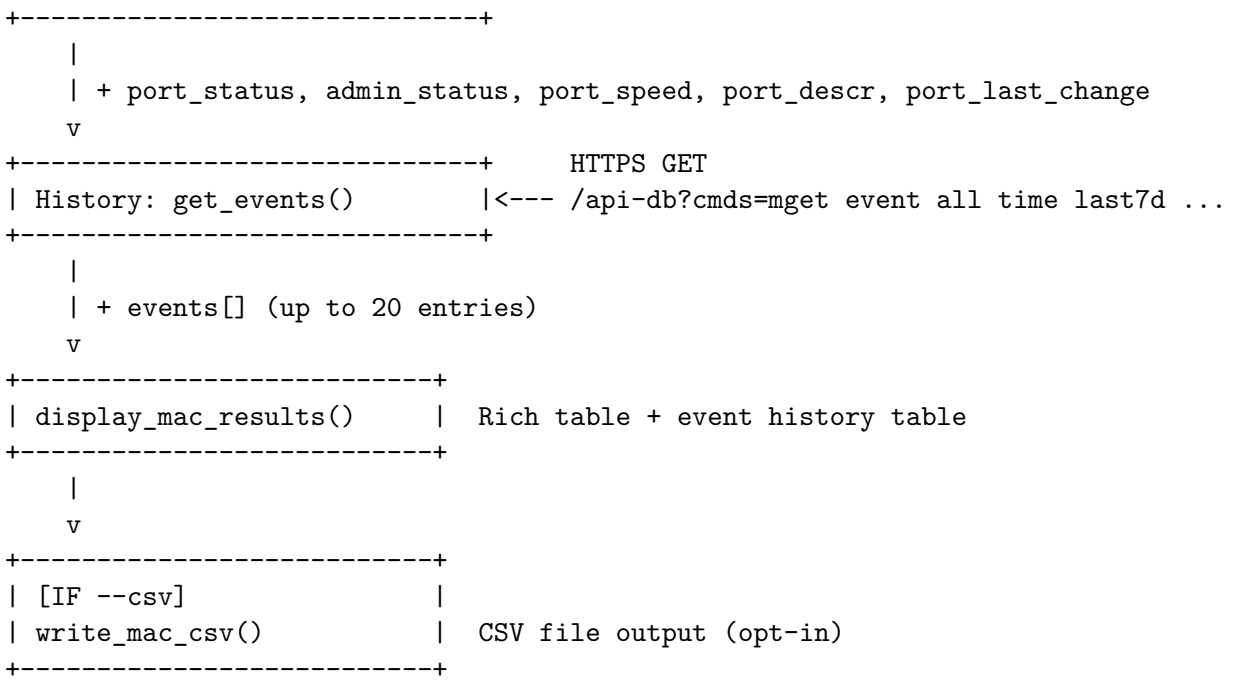
3. Data Flow Diagrams

3.1 Query Classification Flow

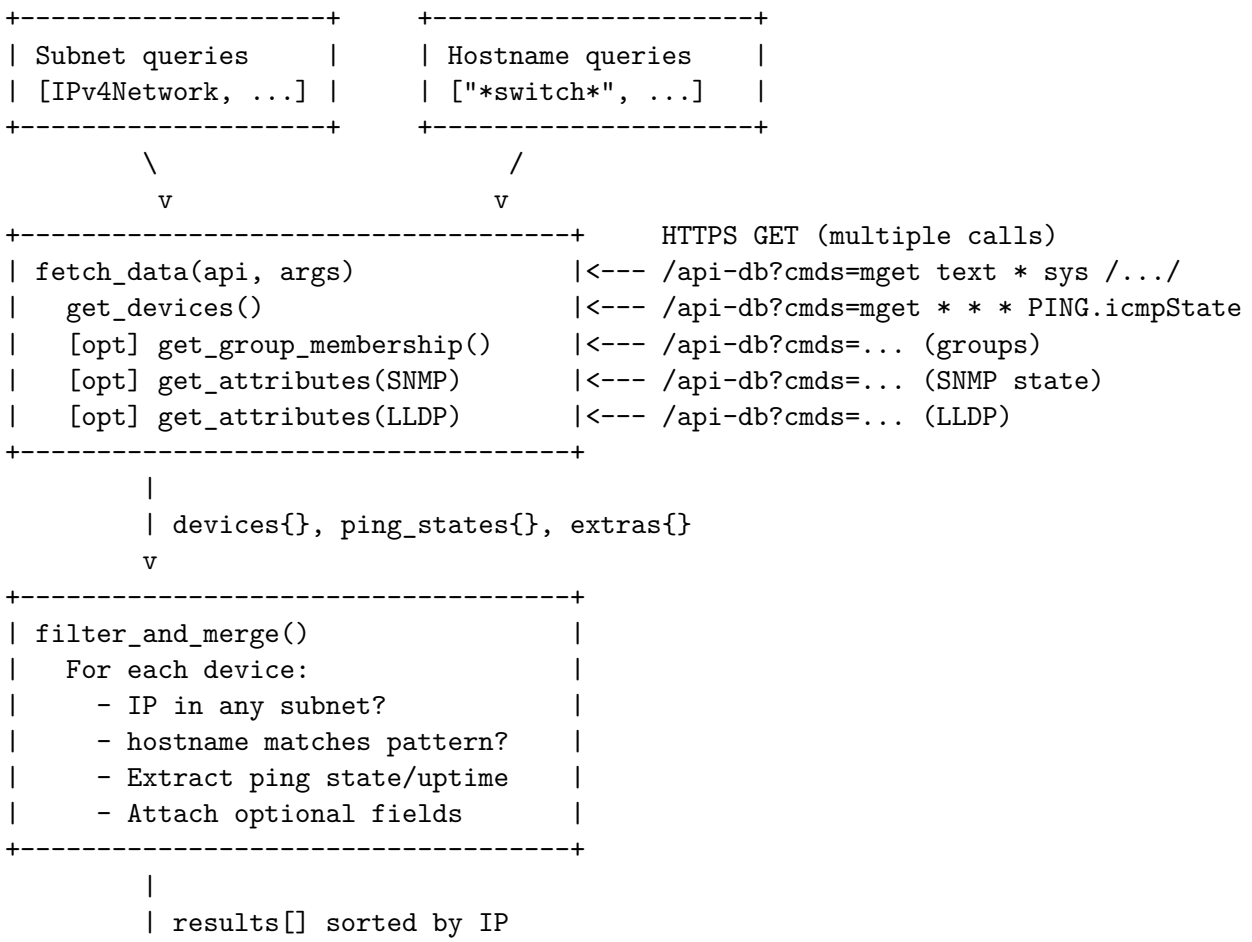
```
User Input
    |
    v
+-----------------------+
| MAC_PATTERN.match()?  |---Yes---> ("mac", normalized_full_mac)
+-----------------------+
    | No
    v
+-----------------------+
| is_partial_mac()?     |---Yes---> ("mac", normalized_partial_mac)
+-----------------------+
    | No
    v
+-----------------------+
| ip_network() valid?   |---Yes---> ("subnet", IPv4Network)
+-----------------------+
    | No (ValueError)
    v
+-----------------------+
| Has wildcards (* ?)?  |---Yes---> ("hostname", pattern_as_is)
+-----------------------+
    | No
    v
("hostname", "*<input>*")          <-- auto-wrapped for substring match
```

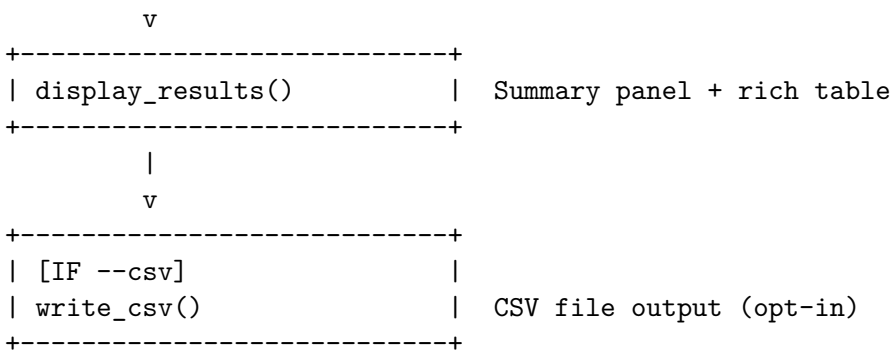
3.2 MAC Lookup Data Flow

```
normalize_mac(input)
    |
    v
+----------------------+     HTTPS GET
| AKiPS api-spm       |<---------------- /api-spm?mac=aa:bb:cc:dd:ee:ff
| Switch Port Mapper   |
+----------------------+
    |
    | Delimited text (MAC, Vendor, Switch, Interface, VLAN, IP)
    v
+-------------------------+
| parse_spm_response()    |  Auto-detect delimiter + header
+-------------------------+
    |
    | List of dicts [{mac, vendor, switch, interface, vlan, ip}, ...]
    v
+-----------------------------+     HTTPS GET
| Enrichment: get_attributes() |<--- /api-db?cmds=mget * <switch> <iface> /IF-MIB.../
```



3.3 Host Lookup Data Flow




v
display_results()
Summary panel + rich table
[IF --csv]
write_csv()
CSV file output (opt-in)

4. AKiPS Enum Format

Many AKiPS attributes (ping state, SNMP state, interface status) are stored as **enum** types with a five-field comma-separated format:

`<number>,<value>,<created_epoch>,<modified_epoch>,<description>`

Field	Type	Example	Description
number	int	`0`	Numeric enum index from the MIB
value	string	`up`	Human-readable enum value
created	epoch	`1706000000`	Unix timestamp when first recorded
modified	epoch	`1738972475`	Unix timestamp of last state change
description	string	`ping check`	Child object description

`parse_enum_state()` extracts the `value` and converts `modified` to a Python `datetime`. This is used to derive:

- **Status:** `up` = Active, anything else = Inactive
- **Uptime:** `now - modified` (time since last state change to "up")
- **Last Seen:** `now` if Active, else the `modified` timestamp

5. MAC Address Normalization

All MAC addresses — regardless of input format — are normalized to **colon-separated lowercase** before being sent to the API or displayed.

Input	Normalized
`AA:BB:CC:DD:EE:FF`	`aa:bb:cc:dd:ee:ff`
`AA-BB-CC-DD-EE-FF`	`aa:bb:cc:dd:ee:ff`
`AABB.CCDD.EEFF`	`aa:bb:cc:dd:ee:ff`
`AABB-CCDD-EEFF`	`aa:bb:cc:dd:ee:ff`
`AABBCCDDEEFF`	`aa:bb:cc:dd:ee:ff`
`00:50:56` (partial)	`00:50:56`
`0050.56AB` (partial)	`00:50:56:ab`

The algorithm: strip all non-hex characters, lowercase, then join every 2 characters with a colon.

6. Error Handling

Scenario	Behavior
Missing `.env` credentials	Prints error, exits with code 1
AKiPS API HTTP error	Exception raised, caught in `main()`, printed, exit 1
AKiPS returns `ERROR:` text	`AkipsError` raised by library
SPM section not enabled	`query_spm()` catches exception, prints warning, returns `None`
Port enrichment fails	Silently caught; MAC results still shown without enrichment
No results found	Yellow "no hosts found" / "no results found" message
Mixed query with MAC failure	MAC error printed but host pipeline still runs

7. Output Files

CSV output is **disabled by default**. Pass `--csv` to enable it, or `-o FILE` to write to a specific path (which implies `--csv`).

When `--csv` is used without `-o`, filenames are auto-generated:

Query Type	Default Filename Pattern	Example
Subnet	`akips_hosts_<cidr>.csv`	`akips_hosts_10_1_0_0_24.csv`
Hostname	`akips_hosts_<pattern>.csv`	`akips_hosts_XswitchX.csv`
MAC	`akips_mac_<hex>.csv`	`akips_mac_aabbccddeeff.csv`
Mixed	Separate files per type	Both files generated

The `-o` flag overrides the filename for the primary query type. If both MAC and host queries are present, `-o` applies to whichever is the sole type; otherwise auto-generated names are used for both to avoid collisions.