A Generic C/C++ API for Wireless Interfaces in GNU/Linux Systems

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Motivation

- A generic C/C++ API for network interfaces.
  - Almost full coverage of wireless network configurations.
    - `iwconfig`
    - `iwlist`
    - `wlanconfig`
  - Generic network interface operations.
    - `ifconfig`
    - `route`
- A library, not a command line tool.
- A core component of the Connectivity Brokerage.

Literature

- A majority of the previous works were basically parsing command (e.g. `iwlist`) outputs.
- Accessing command line tools within a program execution flow is dangerous and not convenient.
  - Command outputs are unreliable.
    - High possibility of unknown outputs (bugs).
    - Hard to be in sync. with every release.
    - Requires a significant amount of work to parse and extract certain tokens.

Literature (Cont'd)

- Other libraries with similar goals:
  - `libiw` of Wireless Tools for Linux,
  - `libnm` of NetworkManager.
- Cons:
  - not designed for embedded environments (library dependencies),
  - function calls are blocking,
  - lacks ifup/ifdown and routing table functionalities,
  - no fine-grained access to the configurations,
  - doesn't provide an easy to use unified API.

Contribution

- a **unified C/C++ library** with on par features compared to `iwconfig`, `iwlist`, `wlanconfig`, `ifconfig`, `route` tools.
- not yet another command wrapper, but a written from scratch library accessing network drivers through `ioctl()` **calls to the kernel** and **nl80211** netlink.
- **fine-grained access**, that is, just get/set a single property at a time.
- **non-blocking function calls**.
- code base is not bloated with 10 year old backward compatibility issues.
- fully **documented, clean code**; suitable for research & education purposes.

Where Are We?

- **Finished!** (Yeah we did!)
  - Website & Docs.: `http://vy.github.com/wapi/`
  - Source Code: `http://www.github.com/vy/wapi/`
- Tested on various hardware. (Atheros, Broadcom, etc.)
- Fully documented code base. (Thanks Doxygen.)
- Now available as an **official OpenWrt package**!

Roadmap

- Get rid off `libiw` dependency.
  - Because of a race-condition bug in `nl80211`, delayed for a while.

Getters: Source Code

```
int ret;
double freq;
wapi_freq_flag_t freq_flag;
char essid[WAPI_ESSID_MAX_SIZE + 1];
wapi_essid_flag_t essid_flag;

...

/* freq */
ret = wapi_get_freq(sock, ifname, &freq, &freq_flag);
printf("freq: %g\n", freq);
printf("freq_flags: %s\n", wapi_freq_flags[freq_flag]);

/* essid */
ret = wapi_get_essid(sock, ifname, essid, &essid_flag);
printf("essid: %s\n", essid);
printf("essid_flag: %s\n", wapi_essid_flags[essid_flag]);

...
```

Getters: Output

```
ip: 192.168.1.111
netmask: 255.255.255.0
freq: 2.412e+09
freq_flag: WAPI_FREQ_AUTO
chan: 1
freq: 2.412e+09
essid: ozu
essid_flag: WAPI_ESSID_ON
mode: WAPI_MODE_MANAGED
ap: 00:14:C1:34:CE:83
wireless.c:451:wapi_get_bitrate(): Bitrate is disabled.
wireless.c:546:wapi_get_txpower():ioctl(SIOCGIWTXPOW): Invalid argument
```

Scanning: Source Code

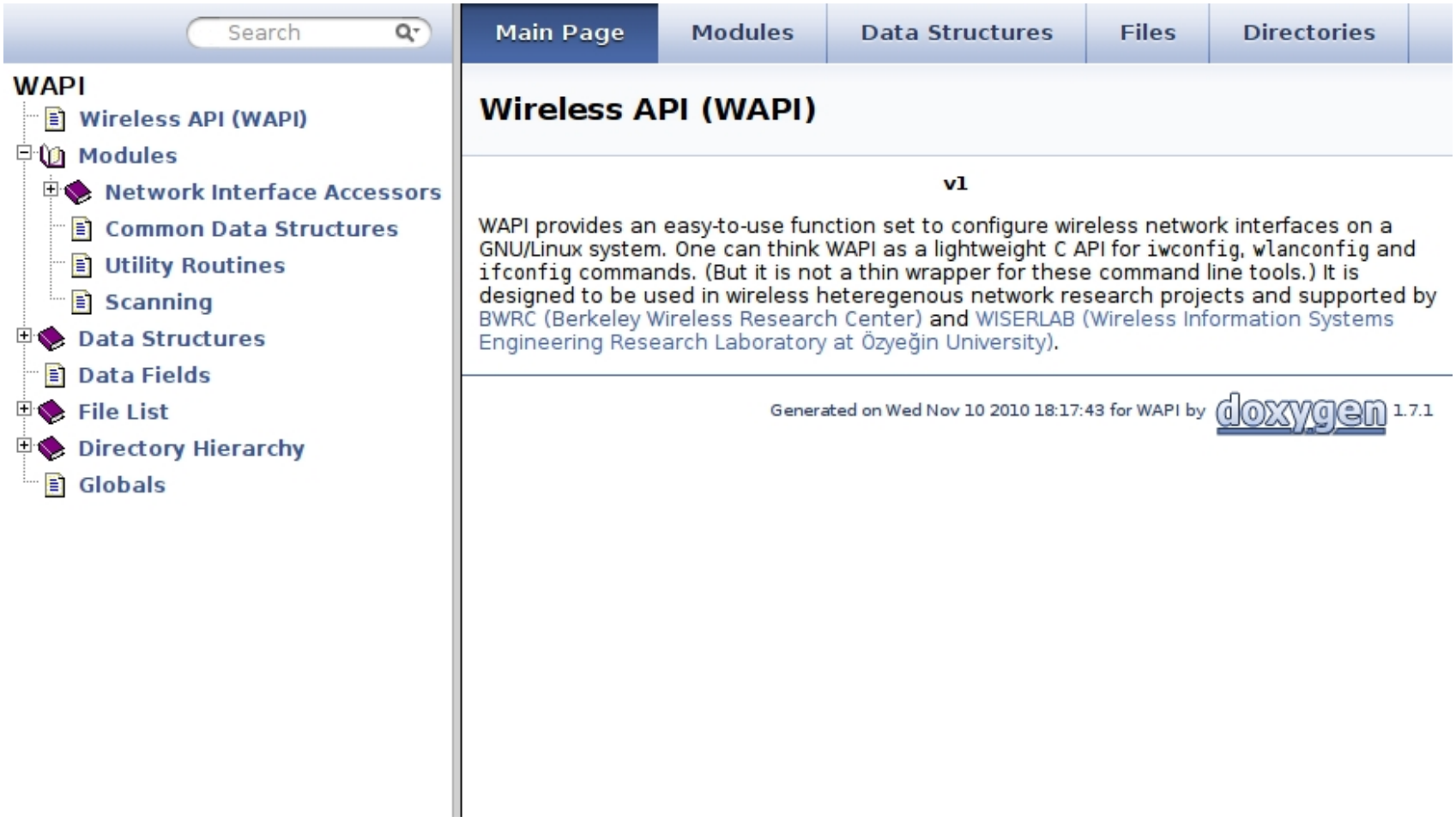
```
int sleepdur = 1;
int sleeptries = 5;
wapi_list_t list;
wapi_scan_info_t *info;
int ret;

/* start scan */
ret = wapi_scan_init(sock, ifname);
printf("wapi_scan_init(): ret: %d\n", ret);

/* wait for completion */
do {
    sleep(sleepdur);
    ret = wapi_scan_stat(sock, ifname);
    printf("wapi_scan_stat(): ret: %d, sleeptries: %d\n", ret, sleeptries);
} while (--sleeptries > 0 && ret > 0);
if (ret < 0) return;

/* collect results */
bzero(&list, sizeof(wapi_list_t));
ret = wapi_scan_coll(sock, ifname, &list);
printf("wapi_scan_coll(): ret: %d\n", ret);

/* print found aps */
for (info = list.head.scan; info; info = info->next)
    printf(">> @%xl %s\n", (size_t) info, (info->has_essid ? info->essid : ""));
```

Scanning: Output

```
wapi_scan_init(): ret: 0
wapi_scan_stat(): ret: 1, sleeptries: 5
wapi_scan_stat(): ret: 0, sleeptries: 4
wapi_scan_coll(): ret: 0
>> @8214ce8l OzuNet.Visitors
>> @8214c90l Wozunacad
>> @8214c38l OzuNet.Visitors
>> @8214be0l canbazoglu
>> @8214b88l NWii
>> @8214b30l wozunguest
>> @8214ad8l Wozunacad
>> @8214a80l ZQNET29
>> @8214a28l wozunvisitor
>> ...
```

Doxygen

- All available public API (functions, variables, constants, structs, enums, etc.) is fully documented.
- Driver specific turnarounds are documented.
- All documentation is integrated within the source code itself as comment lines.
- Using Doxygen to produce HTML, LaTeX, RTF, etc. output from these comment lines.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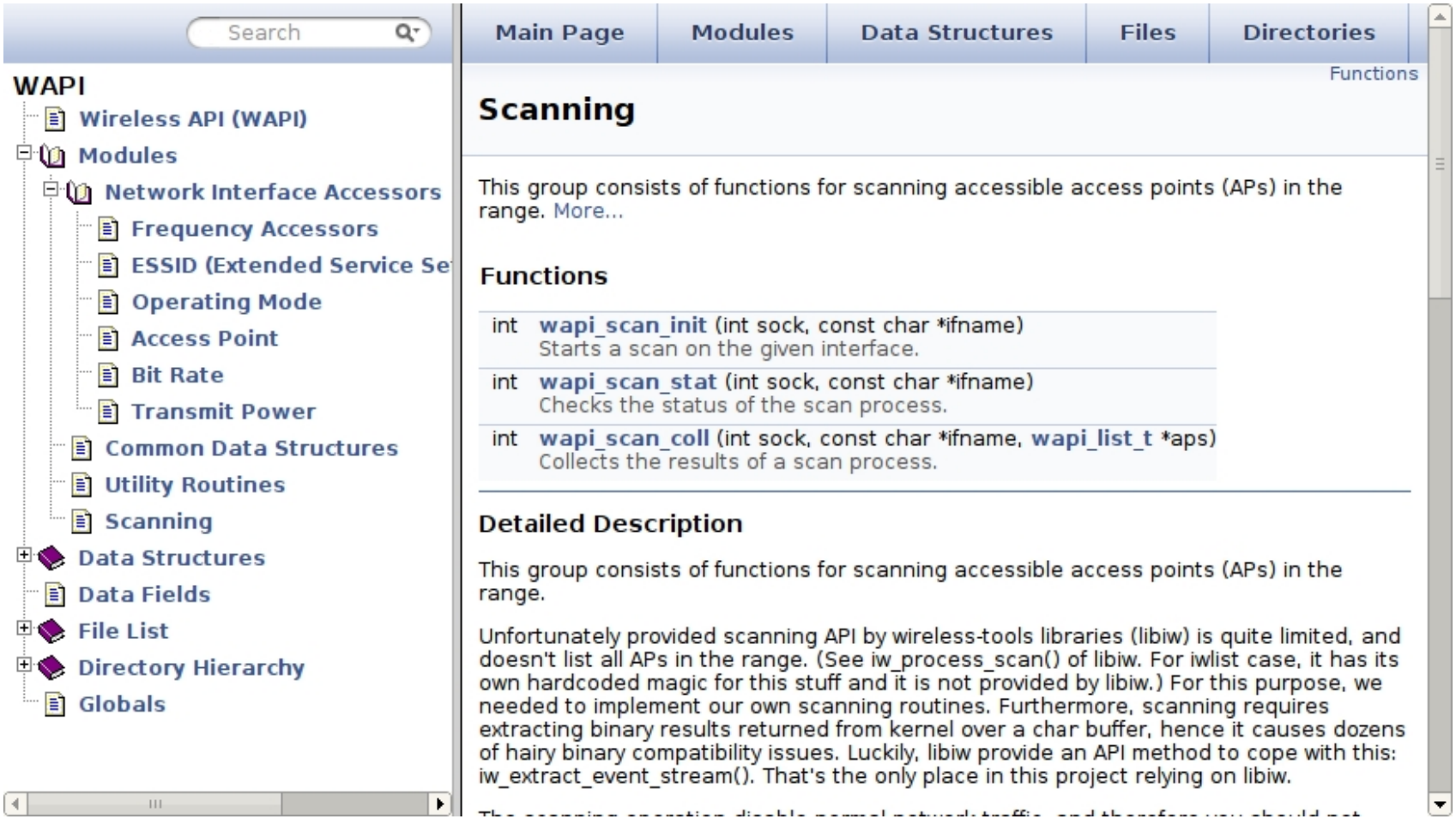
Wireless API (WAPI)
v1
WAPI provides an easy-to-use function set to configure wireless network interfaces on a GNU/Linux system. One can think WAPI as a lightweight C API for iwconfig, wlanconfig and ifconfig commands. (But it is not a thin wrapper for these command line tools.) It is designed to be used in wireless heteregenous network research projects and supported by BWRC (Berkeley Wireless Research Center) and WISERLAB (Wireless Information Systems Engineering Research Laboratory at Özyeğin University).
Generated on Wed Nov 10 2010 18:17:43 for WAPI by doxygen 1.7.1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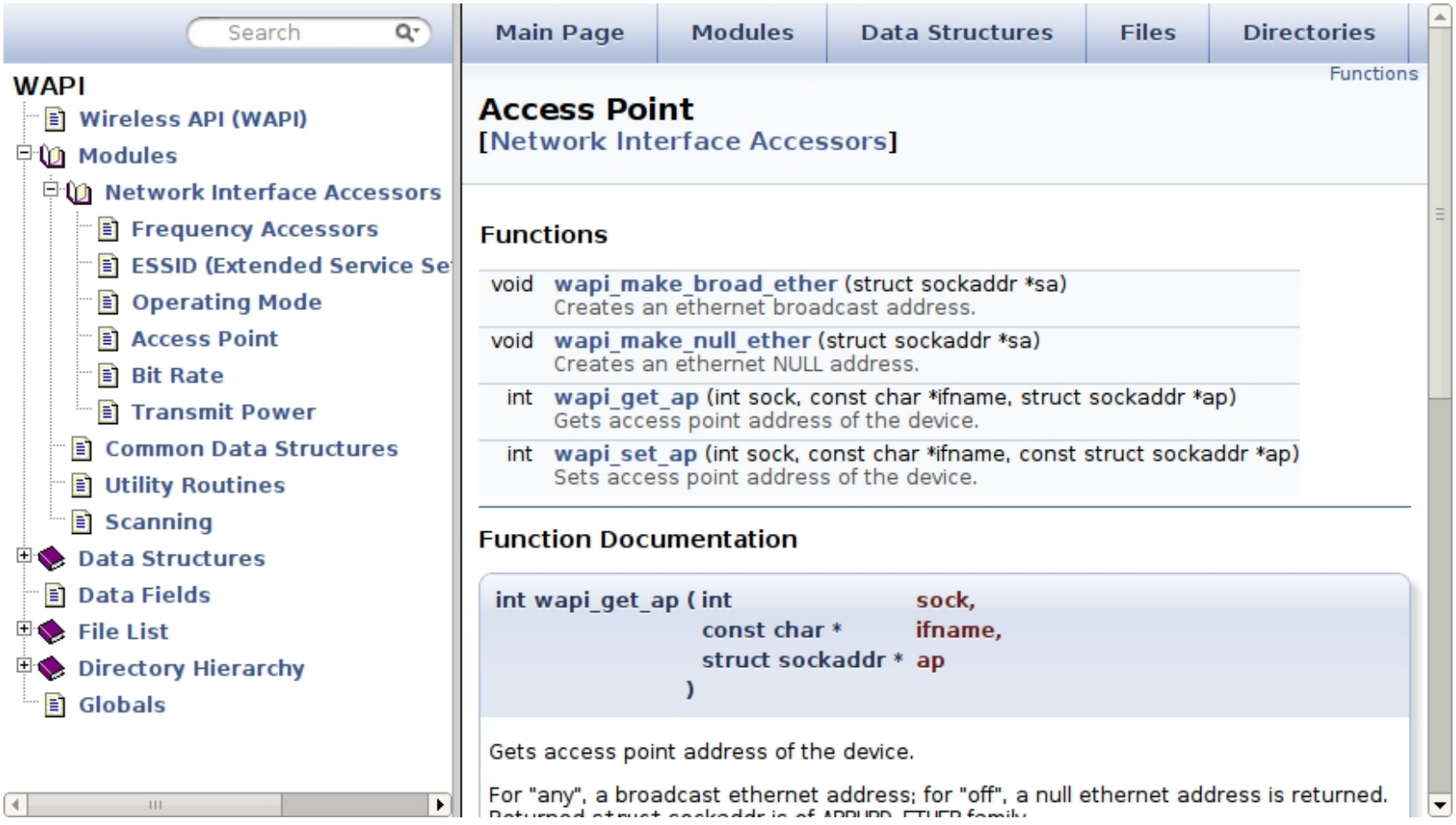
Functions
Scanning
This group consists of functions for scanning accessible access points (APs) in the range. More...
Functions
int wapi_scan_init (int sock, const char *ifname)
Starts a scan on the given interface.
int wapi_scan_stat (int sock, const char *ifname)
Checks the status of the scan process.
int wapi_scan_coll (int sock, const char *ifname, wapi_list_t *aps)
Collects the results of a scan process.
Detailed Description
This group consists of functions for scanning accessible access points (APs) in the range.
Unfortunately provided scanning API by wireless-tools libraries (libiw) is quite limited, and doesn't list all APs in the range. (See iw_process_scan() of libiw. For iwlist case, it has its own hardcoded magic for this stuff and it is not provided by libiw.) For this purpose, we needed to implement our own scanning routines. Furthermore, scanning requires extracting binary results returned from kernel over a char buffer, hence it causes dozens of hairy binary compatibility issues. Luckily, libiw provide an API method to cope with this: iw_extract_event_stream(). That's the only place in this project relying on libiw.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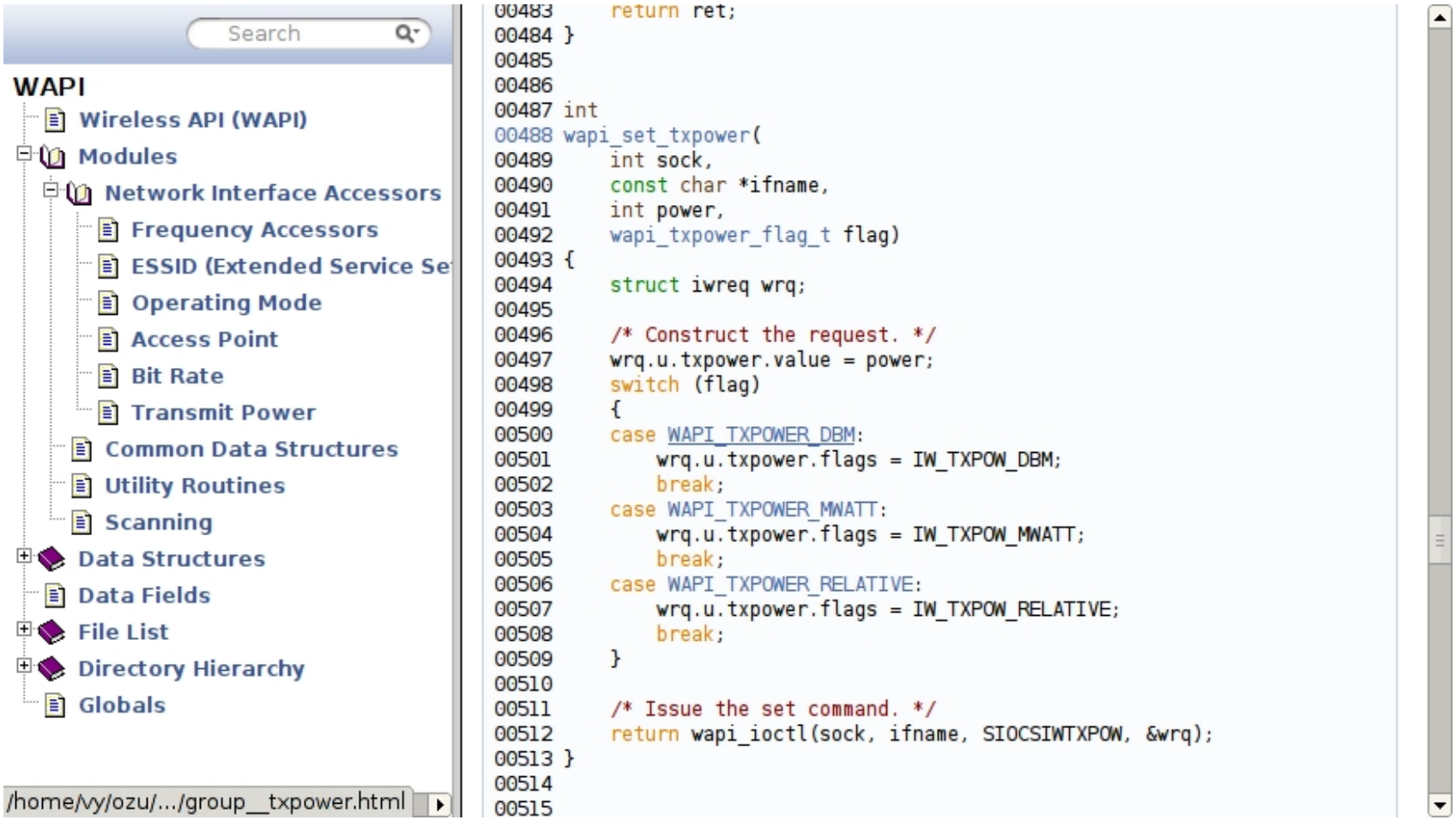
Access Point
[Network Interface Accessors]
Functions
void wapi_make_broad_ether (struct sockaddr *sa)
Creates an ethernet broadcast address.
void wapi_make_null_ether (struct sockaddr *sa)
Creates an ethernet NULL address.
int wapi_get_ap (int sock, const char *ifname, struct sockaddr *ap)
Gets access point address of the device.
int wapi_set_ap (int sock, const char *ifname, const struct sockaddr *ap)
Sets access point address of the device.
Function Documentation
int wapi_get_ap (int sock,
const char * ifname,
struct sockaddr * ap
)
Gets access point address of the device.
For "any", a broadcast ethernet address; for "off", a null ethernet address is returned.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Globals
/home/vy/ozu/.../group__txpower.html
00483 return ret;
00484 }
00485
00486
00487 int
00488 wapi_set_txpower(
00489 int sock,
00490 const char *ifname,
00491 int power,
00492 wapi_txpower_flag_t flag)
00493 {
00494 struct iwreq wrq;
00495
00496 /* Construct the request. */
00497 wrq.u.txpower.value = power;
00498 switch (flag)
00499 {
00500 case WAPI_TXPOWER_DBM:
00501 wrq.u.txpower.flags = IW_TXPOW_DBM;
00502 break;
00503 case WAPI_TXPOWER_MWATT:
00504 wrq.u.txpower.flags = IW_TXPOW_MWATT;
00505 break;
00506 case WAPI_TXPOWER_RELATIVE:
00507 wrq.u.txpower.flags = IW_TXPOW_RELATIVE;
00508 break;
00509 }
00510
00511 /* Issue the set command. */
00512 return wapi_ioctl(sock, ifname, SIOCSIWTXPOW, &wrq);
00513 }
00514
00515

Questions?

answers of questions

I'm Feeling Lucky