

# SPCTOR UAV SDRadar Command Protocol

This is a work in progress file describing the SPCTOR UAV-SDRadar Command Protocol. The commands listed below are intended to be used as examples and a foundation for designing the final protocol.

A 'request' is a TCP/IP packet containing a numeric request code and a request string. The request code will determine how the request string is interpreted. In the case shown for req\_code = 200, the request string is treated as a list of commands.

## Table of Request Codes

req_code	Description	req_str
001	get daytime string	n/a
002	get system status	n/a
003	power off system	n/a
004	power on system	n/a
200	send command to uavsd radar	command string

## Table of Commands (req\_code = 200)

Command	Description	Arg	Example
help	help message	n/a	--help
status	get status	n/a	--status
date	get date/time	n/a	--date
flightplan	Upload a flight plan	string	--flightplan [lat1,lon1,el1;lat2,lon2,el2;...]
executeflight	Execute flight plan at specified date/time	string	--executeflight YYYYMMDDThhmmss
file	Base name of data output file (must have .dat extension)	string	--file flight1/out.dat
freqs	Vector of RF Center frequencies. Format; f1,f2,... or f1:df:fend	string	--freqs 1e9:5e7:2e9
sweeps	number of frequency sweeps (Default: 1)	int	--sweeps 1000
sri	Frequency Sweep Repetition Interval in sec	double	--sri .7
getdata	Get full dataset for a give flight id	string	--getdata fABC001

## Example Command (req\_code = 200)

In the case where req\_code=200 is specified, the request string is treated as a list of commands i.e.

```
--flightplan [lat0,lon0,el0;lat1,lon1,el1] --executeflight 20200918T123000 --freqs 1e9:5e7:2e9 --sweeps 1000 --sri .7 --file flight1/out.dat
```

This would tell the UAV to:

- fly the specified coordinates starting at 12:30:00 with the radar operating in stepped frequency mode from 1-2 GHz in 50 MHz steps.
- operate the radar would for 1000 sweep pulses at sweep repetition interval of .7 sec/sweep.
- save data with base filename `flight1/out.dat` such that actual filenames would look something like `flight1/sweep-0/out-1000mhz-20200918T123000s100000`.

In response to this command, the uavsdrradar would send a unique flightid which could be used later by the RPi to request data

## Example C++ Server Code Snippet

This is example C++ code that will interface with the uavsdrradar and respond to requests over TCP/IP

```
void tcp_connection::handle_read_request(const boost::system::error_code& error)
{
    std::string m_message;
    if (error == boost::asio::error::eof){
        std::cout<<"\nEnd Response"<<std::endl;
        //break; // Connection closed cleanly by peer.
    }
    else if (error){
        std::cout << "Error: " << error << "\n";
        throw boost::system::system_error(error); // Some other error.
    }
    else{
        // Check that response is OK.
        std::istream response_stream(&request_);
        std::string udar_version;
        response_stream >> udar_version;

        unsigned int req_code;
        response_stream >> req_code;
        std::string req_str;
        std::getline(response_stream, req_str);
        std::cout<<"Request:"<<udar_version<<" "<<req_code<<" "<<req_str<<std::endl;
        if (!response_stream || udar_version.substr(0, 5) != "UDAR/")
        {
            std::cout << "Invalid response\n";
            return;
        }
        if (req_code == 001)
        {
            m_message = make_daytime_string();
        }
        else if (req_code == 002)
        {
            m_message = _uavsdrradar->get_system_status();
        }
        else if (req_code == 003)
        {
            m_message = _uavsdrradar->poweroff();
        }
        else if (req_code == 004)
        {
            m_message = _uavsdrradar->poweron();
        }
        else if (req_code == 200)
        {
            std::string flightplanstr, flighttimestr, freqplanstr, rxfname, flightid;
            int numsweeps;
            double sri;
        }
    }
}
```

```

std::vector<std::string> tokenvec = tokenize(req_str);
//setup the program options
po::options_description desc("Allowed options");
desc.add_options()
    ("help |"help message")
    ("status |"get status")
    ("date |"get date/time")
    ("flightplan |po::value<std::string>(&flightplanstr), "Upload a flight plan")
    ("executeflight |po::value<std::string>(&flighttimestr), "Execute flight plan at specified date/t
    ("file |po::value<std::string>(&rxfname), "Base name of data output file (must have .dat extensio
    ("freqs |po::value<std::string>(&freqplanstr), "Vector of RF Center frequencies. Format; f1,f2,..
    ("sweeps |po::value<int>(&numsweeps)->default_value(1), "number of frequency sweeps (Default: 1)"
    ("sri |po::value<double>(&sri),"Frequency Sweep Repitition Interval in sec")
    ("getdata |po::value<std::string>(&flightid),"Get full dataset for a give flight id")
;
po::variables_map vm;
try{
    po::store(po::command_line_parser(tokenvec).options(desc).run(), vm);

    if (vm.count("help")){
        std::stringstream ss;
        ss << boost::format("UAV SDRadar supported commands: %s.") % desc;
        m_message = ss.str();
        boost::asio::async_write(socket_, boost::asio::buffer(m_message),
            boost::bind(&tcp_connection::handle_write, shared_from_this(),
                boost::asio::placeholders::error,
                boost::asio::placeholders::bytes_transferred));
        return;
    }
    po::notify(vm);
}
catch(po::error& e) {
    std::cerr << "ERROR: " << e.what() << std::endl << std::endl;
    std::cerr << desc << std::endl;
    std::stringstream ss;
    ss << "ERROR: " << e.what() << "\n";
    ss << boost::format("UAV SDRadar supported commands: %s.") % desc;
    m_message = ss.str();
    boost::asio::async_write(socket_, boost::asio::buffer(m_message),
        boost::bind(&tcp_connection::handle_write, shared_from_this(),
            boost::asio::placeholders::error,
            boost::asio::placeholders::bytes_transferred));
    return;
}
if(vm.count("status")>0){
    m_message = get_status_string();
    boost::asio::async_write(socket_, boost::asio::buffer(m_message),
        boost::bind(&tcp_connection::handle_write, shared_from_this(),
            boost::asio::placeholders::error,
            boost::asio::placeholders::bytes_transferred));
    return;
}
if(vm.count("date")>0){
    m_message = make_daytime_string();
    boost::asio::async_write(socket_, boost::asio::buffer(m_message),
        boost::bind(&tcp_connection::handle_write, shared_from_this(),
            boost::asio::placeholders::error,
            boost::asio::placeholders::bytes_transferred));
    return;
}

if (!_usrp->isActive())
    _uavsdradar->refresh();

std::vector<double> freqvec;
std::string freqvecstr;
if(vm.count("freqs") > 0){
    boost::filesystem::path freqplanp = _config_path / boost::filesystem::path(freqplanstr);
    if (boost::filesystem::exists(freqplanp)){
        freqvecstr = get_text_file_string(freqplanp.string());
    }
    else{
        freqvecstr = freqplanstr;
    }
}

```

```

    }
    if(parse_freqplan(freqvec,freqvecstr)){
        m_message = "[--freqs] Error: Unable to parse frequency plan: " + freqplanstr;
        boost::asio::async_write(socket_, boost::asio::buffer(m_message),
            boost::bind(&tcp_connection::handle_write, shared_from_this(),
                boost::asio::placeholders::error,
                boost::asio::placeholders::bytes_transferred));
        return;
    }
    _uavsdrradar->set_freqvec(freqvec);
}
if(vm.count("sri") > 0)
    _uavsdrradar->set_sri(sri);

if(vm.count("flightplan") > 0)
    _uavsdrradar->upload_flight_plan(flightplanstr);

std::string curr_flightid;
if(vm.count("executeflight") > 0){
    curr_flightid = _uavsdrradar->execute_flight_at_time(flighttimestr,numsweeps,rxfname);
    m_message.append("--flightid " + curr_flightid + "\n");
    boost::asio::async_write(socket_, boost::asio::buffer(m_message),
        boost::bind(&tcp_connection::handle_write, shared_from_this(),
            boost::asio::placeholders::error,
            boost::asio::placeholders::bytes_transferred));
    return;
}

if(vm.count("getdata") > 0){
    if (flightid.empty()) // return data from current flight
        flightid = _uavsdrradar->get_last_flight_id();

    std::vector<std::string> outfiles;
    _uavsdrradar->get_fnames_from_flightid(flightid,outfiles);

    for (size_t i=0; i<outfiles.size();i++){
        boost::filesystem::path p(outfiles[i].c_str());
        if(p.extension().string()==" .txt"){
            m_message.append("--outfile " + p.string()+"\n");
            m_message.append(_uavsdrradar->get_text_file_string(outfiles[i]));
        }
        else {
            std::string binary_str;
            int nbytes = _uavsdrradar->get_binary_file_bytestr(binary_str);
            m_message.append("--binaryoutfile " + p.string()+ " --nB " + std::to_string(nbytes) + "\n");
            m_message.append(binary_str);
            m_message.append("\n--eof\n");

            // Implementation of binary file data stream code:

            // std::stringstream data_ss;
            // std::ifstream ifile;
            // ifile.open(outfiles[i].c_str(), std::ios::binary);
            // int nbytes = 0;
            // if (ifile.is_open()){
            //     ifile.seekg(0,ifile.end);
            //     nbytes = ifile.tellg();
            //     ifile.seekg(0,ifile.beg);
            //     data_ss << ifile.rdbuf();
            // }
            // m_message.append("--binaryoutfile " + p.string()+ " --nB " + std::to_string(nbytes) + "\n");
            // m_message.append(data_ss.str());
            // m_message.append("\n--eof\n");
        }
        m_message.append("\n");
    }
}
else {
    m_message = make_req_code_help_string();
}

boost::asio::async_write(socket_, boost::asio::buffer(m_message /*+"\r\n--eof\r"*/),
    boost::bind(&tcp_connection::handle_write, shared_from_this(),

```

```
boost::asio::placeholders::error,  
boost::asio::placeholders::bytes_transferred));
```

## Example Python Client Code

Example python script that can send formatted commands to uavsd radar server

```
import socket  
import ssl  
import getpass  
import getopt,sys  
  
# client  
def main(argv):  
    HOST = '11.10.10.1'  
    PORT = 9912  
    logfilename = "client_test.log"  
  
    try:  
        opts,args = getopt.getopt(argv,"hi:f:",["help", "ip=", "file="])  
    except getopt.GetoptError:  
        print("Usage : client_test.py -i <server ip> -f <logfile> or client_test.py --ip <server ip> --file <logfile>")  
        sys.exit(2)  
    for opt, arg in opts:  
        if opt in ("-h", "--help"):  
            print("Usage : client_test.py -i <server ip> -f <logfile> or client_test.py --ip <server ip> --file <logfile>")  
            sys.exit()  
        elif opt in ("-i", "--ip"):  
            HOST = str(arg)  
        elif opt in ("-f", "--file"):  
            logfilename = str(arg)  
  
    print("Using Server IP:")  
    print(HOST)  
    print("Using output logfile:")  
    print(logfilename)  
  
    logfile = open(logfilename,"w")  
  
    server_cert = '~/x300_Client/config/server.crt'  
    client_cert = '~/x300_Client/config/client.crt'  
    client_key = '~/x300_Client/config/client.key'  
  
    # pword = input("Enter Password:")  
    pword = getpass.getpass()  
  
    # sock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)  
    # sock.setblocking(1);  
    # sock.connect((HOST, PORT))  
  
    context = ssl.SSLContext(ssl.PROTOCOL_TLSv1_2)  
    context.verify_mode = ssl.CERT_REQUIRED  
  
    context.load_verify_locations(server_cert)  
    context.load_cert_chain(certfile=client_cert, keyfile=client_key, password=pword)  
    context.load_dh_params('~/x300_Client/config/dh1024.pem')  
  
    print("Enter Command (try --help)")  
  
    while True:  
        request_str = input(">>>")  
        if (request_str=="quit" or request_str=="q"):  
            break;  
  
        sock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)  
        sock.setblocking(1);  
        sock.connect((HOST, PORT))
```

```

if ssl.HAS_SNI:
    secure_sock = context.wrap_socket(sock, server_side=False, server_hostname=HOST)
else:
    secure_sock = context.wrap_socket(sock, server_side=False)

# secure_sock.connect((HOST, PORT))

cert = secure_sock.getpeercert()
# print("getpeercert():")
# print(cert)

# verify server
# if not cert or ('commonName', 'test') not in cert['subject'][3]: raise Exception("ERROR")
# secure_sock.send(b"UDAR/1.0 200 --status")

request = "UDAR/1.0 200 " + request_str + "\n\r\n"
request_b = request.encode('ASCII')

print("request:")
print(request_b)

secure_sock.send(request_b)
# secure_sock.send(b"UDAR/1.0 200 --status\n\r\n")

while True:
    try:
        rx_data = secure_sock.recv(4096)
        if len(rx_data) == 0:
            break
        print(str(rx_data, 'ASCII'))
        logfile.write(str(rx_data, 'ASCII'))
    except ssl.SSLError as e:
        print(e)
        break

secure_sock.unwrap()
# secure_sock.shutdown(socket.SHUT_RDWR)
secure_sock.close()
sock.close()

logfile.close()
print("Done!")

if __name__ == '__main__':
    main(sys.argv[1:])

```