Protocol Definitions

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1. SPI Protocol (AVR ↔ ESP8266)

1.1 Overview

The SPI protocol connects the AVR microcontroller (master) with the ESP8266 (slave). It is used for transferring floppy disk commands and data. Communication is packet-based, uses fixed lengths, and a simple checksum for error detection.

1.2 Packet Structure

SPI Data Packet (Master → Slave)

- **Maximum length:** 32 bytes
- **Actual length:** Varies depending on the command (see table below)

General Structure (varies by command):

Byte Range	Meaning
0	Command (`cmd`)
1..n	Parameters/Data
...	...
Last Byte	Checksum

Overview of SPI Commands and Packet Lengths

The commands are defined as `enum vdCommands`:

Command	Code	Typical Packet Length	Fields in Packet (Order)	Description
VD_CMD_NONE	0x00	1	cmd, checksum	No command
VD_CMD_STATUS	0x01	2	cmd, status, checksum	Query status
VD_CMD_SEL_FILE	0x02	15	cmd, filename[13], checksum	Select file
VD_CMD_RD_FILE	0x03	4	cmd, offset, length, checksum	Read file
VD_CMD_RD_NEXT	0x04	3	cmd, length, checksum	Read next data
VD_CMD_WR_FILE	0x05	20	cmd, offset, length, data[16], checksum	Write file
VD_CMD_WR_NEXT	0x06	3	cmd, length, checksum	Write more data
VD_CMD_SEEK_FILE	0x07	6	cmd, offset[4], checksum	Set file position
VD_CMD_SEL_TR_SEC	0x08	0	not used	Select track/sector
VD_CMD_RD_SECTOR	0x09	0	not used	Read sector
VD_CMD_WR_SECTOR	0x0A	0	not used	Write sector

The SPI packet is always padded to 32 bytes by the slave (ESP8266) if less is transmitted. Unused bytes are filled with 0x00.

SPI Response Packets (Slave → Master)

The SPI slave (ESP8266) responds to many commands not only with a status packet but—depending on the command—also with data packets.

- **Maximum length:** 32 bytes
- **Actual length:** Varies depending on the command (see table below)

The type of response depends on the command:

- **Status query:** Response is a 4-byte status packet.
- **Read commands (e.g., VD_CMD_RD_FILE):** The master polls the status of the slave until it is ready. Then it reads the data packet with payload (e.g., read sector data).
- **Write commands:** Confirmation via status packet.

Response Data Packet (Slave → Master)

- **Length:** Variable, depending on command and data amount (e.g., 16 or 512 bytes payload, possibly split across multiple packets)

- **Structure:**

Byte Range	Meaning
0	Command (`cmd`)
1..n	Data (payload)
...	...
Last Byte	Checksum

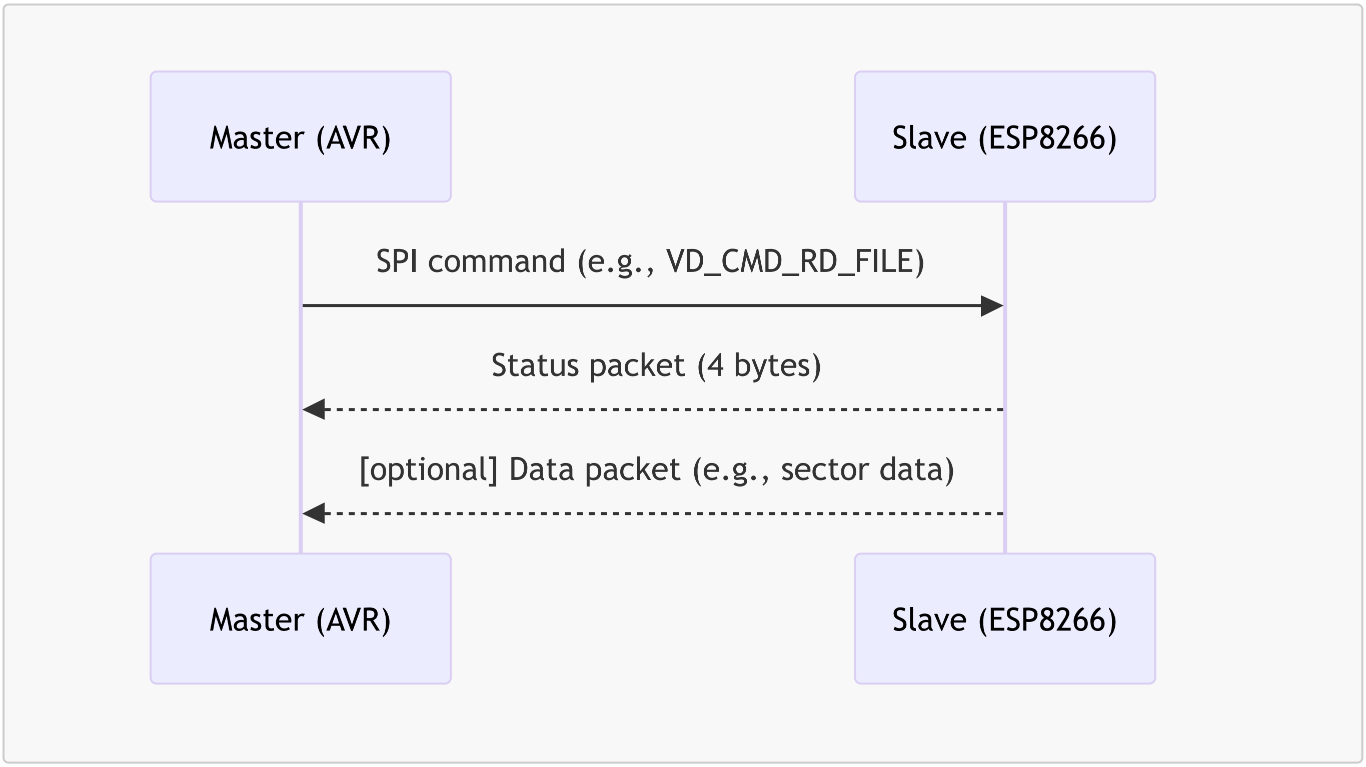
Status Packet (Slave → Master)

- **Length:** 4 bytes (always fixed)
- **Structure:**

Byte	Meaning
0	SPI Status (Ready/Busy/Error)
1	Status of last command
2	Data of last command
3	Free (0x00)

- **Byte 0:** SPI Status
  - 0x00: Ready (SPISLAVE_READY)
  - 0x01: Busy (SPISLAVE_BUSY)
  - 0x02: Checksum Error (SPISLAVE_CHKSUM_ERR)
- **Byte 1:** Status of last command (e.g., VD_STATUS_OK, VD_STATUS_ERROR, VD_STATUS_FILE_NOT_FOUND)
- **Byte 2:** Data/function-specific
- **Byte 3:** Free (0x00)

Packet Diagram



1.3 Checksum

The checksum is the simple sum of all bytes (including command and data). The transmission is valid if the sum of all bytes (including the checksum) is 0 (`checksum == 0`).

1.4 ESP8266-specific SPI Prefix Bytes

Overview

For every SPI communication with the ESP8266 as slave, special prefix bytes must be sent before the actual protocol command. These serve to distinguish whether it is a data, status, or control command and are specified by the implementation of the ESP8266 SPI slave library (e.g., `hspi_slave.c`/`SPISlave.h`).

Prefix Bytes

Before each actual protocol packet, **two bytes** are sent:

Byte	Meaning	Value (Example)
0	SPI command type	e.g., 0x02 = Write Data
1	Dummy/Zero	0x00

Only after this does the actual protocol packet follow (e.g., the floppy command and payload).

Typical SPI Command Types (Prefix Byte 0):

Value	Meaning
0x02	Write Data
0x03	Read Data
0x04	Read Status
0x01	Write Status

These values are defined in the file `virtDisk.h` as `SPI_WR_DATA`, `SPI_RD_DATA`, `SPI_RD_STATUS`, `SPI_WR_STATUS` and are always sent as the first byte in communication.

Where do these bytes come from?

The prefix bytes are specified by the architecture of the ESP8266 SPI slave implementation. The library expects these commands to distinguish between data and status transfers. See the official documentation and source code of the ESP8266 Arduino Core SPI slave library (ESP8266 Arduino SPI Slave).

Example: When sending a floppy command, the transmission looks like this:

1. `0x02` (Write Data)
2. `0x00` (Dummy)
3. ...Protocol packet (e.g., `VD_CMD_RD_FILE`, parameters, checksum)

Only if these prefix bytes are set correctly will the ESP8266 process the packet correctly!

1.5 Sequence and Example

1. Master sets chip select and sends a 32-byte packet.
2. Slave checks checksum, processes the command, and sets status.
3. Master polls the status (4 bytes) until the slave reports "Ready".
4. Master checks command and data status.

Example: Read File

1. Master sends `VD_CMD_RD_FILE` with filename, offset, and desired data length.
2. Slave checks checksum, processes the command, and prepares response data.
3. Status packet indicates how many bytes were read and whether an error occurred.

1.6 Notes

- All packets are packed with `#pragma pack(1)`, no padding bytes.
- Filenames are in 8.3 format (max. 13 bytes including null terminator).
- SPI communication is blocking: The slave remains "Busy" until the command is processed.

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2. TCP Protocol (ESP8266 ↔ PC Server)

2.1 Overview

The TCP protocol connects the ESP8266 client with the PC server. It transfers the floppy commands and data 1:1. The packets are identical to the SPI protocol, but larger data amounts (e.g., 512 byte sectors) can be transferred.

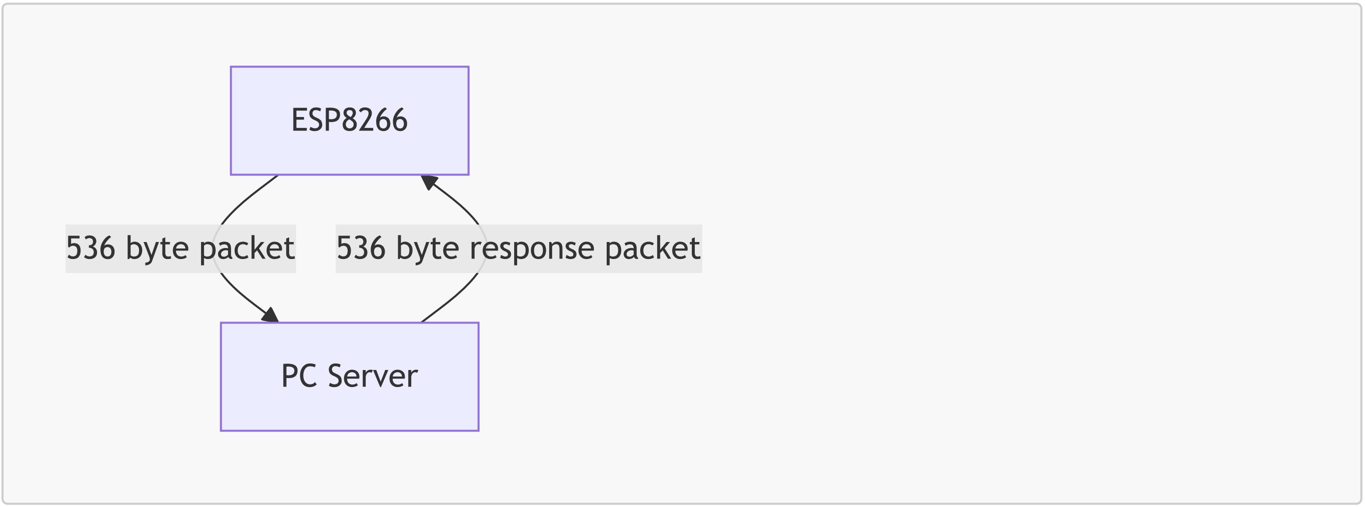
2.2 Packet Structure

- **Structure:**

Field	Type	Description
cmd	uint8_t	Command
status	int8_t	Status
filename	char[13]	Filename (8.3)
fileOffset	uint32_t	Offset for SEEK
track	uint16_t	Track
sector	uint8_t	Sector
data	uint8_t[512]	Data buffer
dataLen	uint16_t	Length of valid data

- **Total length:** 536 bytes per packet

Packet Diagram



2.3 Commands

The commands correspond to the SPI protocol (`enum vdCommands`):

Value	Name	Description
0x00	NONE	No command
0x01	STATUS	Query status
0x02	SEL_FILE	Select file
0x03	RD_FILE	Read file
0x04	RD_NEXT	Read next data
0x05	WR_FILE	Write file
0x06	WR_NEXT	Write more data
0x07	SEEK_FILE	Set file position
0x08	SEL_TR_SEC	Select track/sector
0x09	RD_SECTOR	Read sector
0x0A	WR_SECTOR	Write sector

2.4 Status and Error Codes

- **Status (int8_t status):**
  - 0: OK
  - 1: ERROR
  - 2: FILE_NOT_FOUND
  - 3: FILE_RD_ERROR
  - 4: DISK_NOT_FOUND
  - 5: TR_SEC_ERROR
  - 6: SEC_RD_ERROR
  - 7: SEC_WR_ERROR

2.5 Sequence and Example

1. Client establishes TCP connection to server.
2. Client sends a 536-byte packet with floppy command.
3. Server processes the command and sends a response packet back.
4. Client evaluates status and data.

Example: Read Sector

1. Client sends `VD_CMD_RD_SECTOR` with track, sector, and desired length.
2. Server reads sector and sends data back.
3. Client checks status and processes data.

2.6 Notes

- The packets are packed with `#pragma pack(1)`, no padding bytes.
- The TCP connection remains open for multiple commands.

- Error codes are returned in the status field.

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