TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Computer Engineering, Chair of VLSI Design, Diagnostics & Architecture

THE PS/2 PROTOCOL

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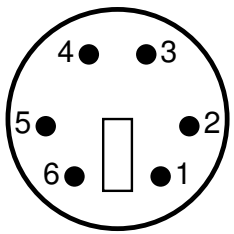
Goals of this Lecture

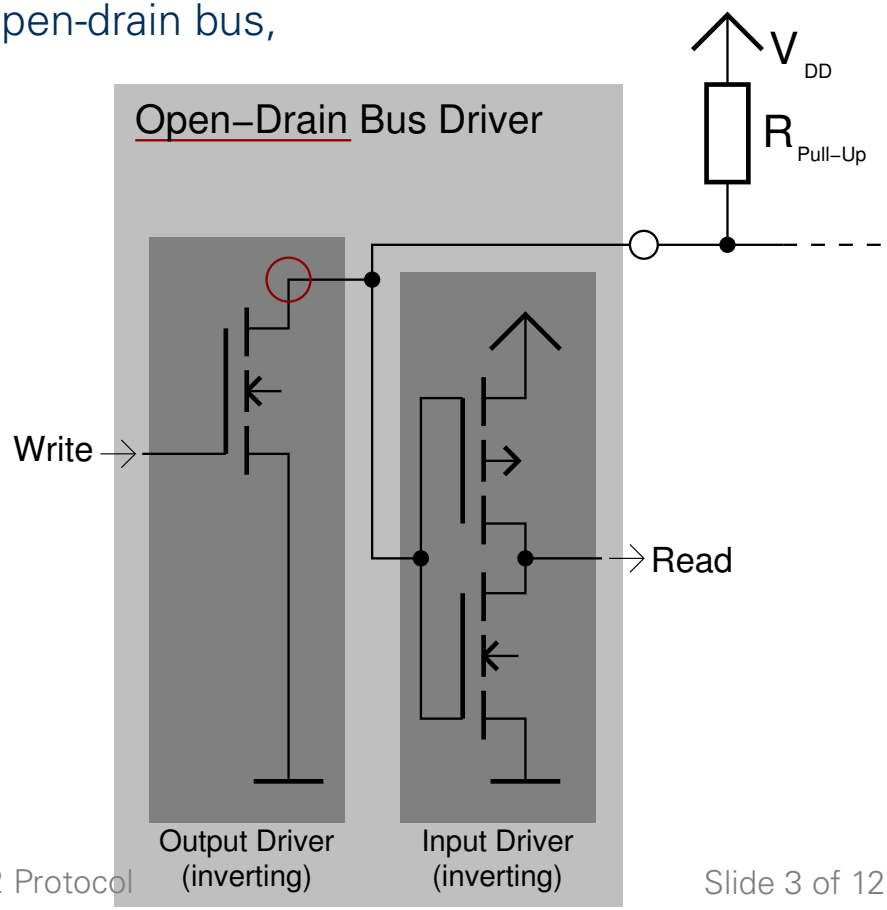
- Describe the communication across a PS/2 bus.
- Enable the design of a PS/2 controller.

Bit-Level Protocol

- synchronous serial protocol on open-drain bus,
- PS/2 plug (mini DIN)



1. Clock (Open Drain)
2. Ground
3. Data (Open Drain)
4. %
5. Vcc (5V)
6. %

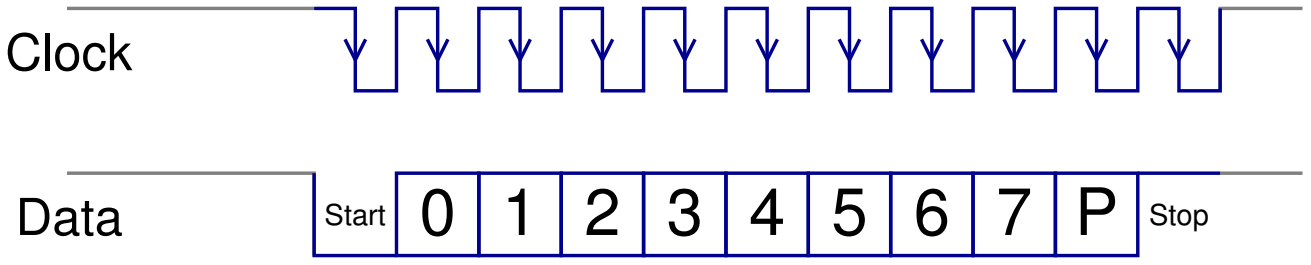


Characteristics

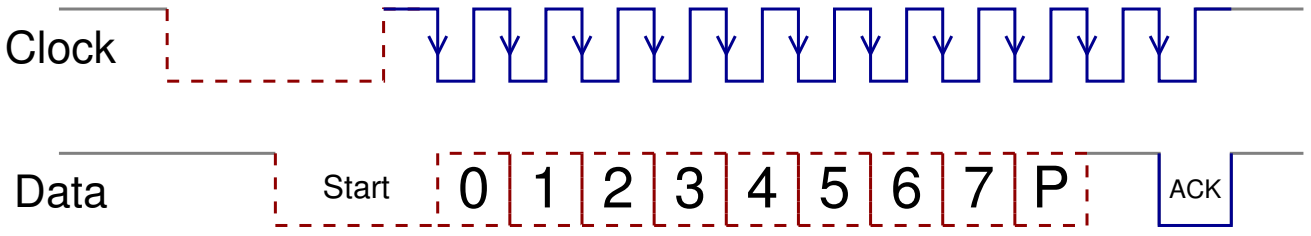
- bit-serial transmission of bytes, LSB first,
- odd parity for ensuring data integrity,
- framing by start, stop and ack bits,
- clock always defined by the device ($f \sim 10 \ldots 17\,\mathrm{kHz}$),
- direction of communication defined by the host, and
- host reads or writes data bits at falling clock edge.

Timing

Device → Host:



Host → Device:



Initiation by host on clock line (about 1.5 bit widths).

blue Device
red Host

00 AT Keyboard: Overview

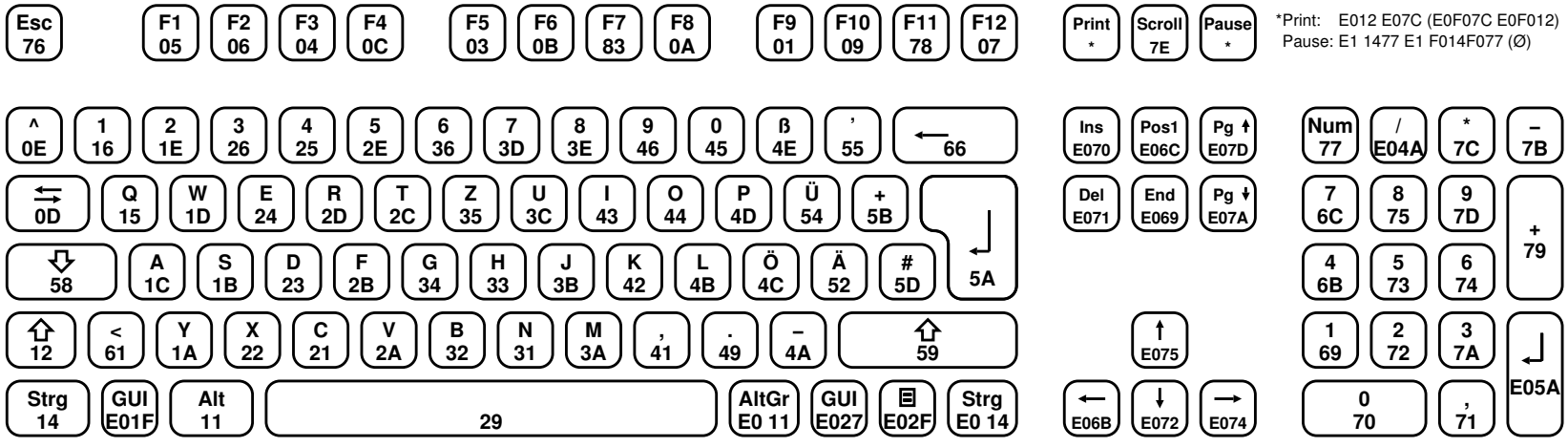
Duties of the Keyboard:

- Transmission of scan and release codes,
- debouncing of keys,
- repetition of scan codes as long as a key is held, and
- display of status LEDs.

Duties of the Host:

- Interpretation of the scan codes,
- management of the *lock* key states, and
- control of the status LEDs.

Scancodes



. . . may comprise several bytes, e.g.

`Pause/Break: E1 14 77 E1 F0 14 F0 77`

Release Codes

- are flagged by the prefixes `F0` and `E0 F0`, respectively:
  `76` → `F0 76`; `E0 75` → `E0 F0 75`
- Exceptions: *"Print"* und *"Pause"*

Commands

Host → Keyboard:

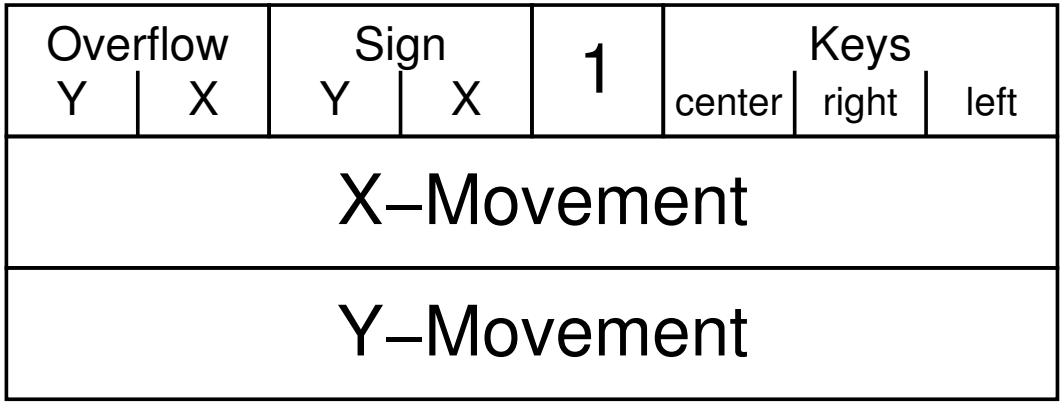
`ED`	Setting the Status LEDs
	followed by byte containing a bitmask
`EE`	Echo Request
`F4`	Keyboard Enable
`F5`	Keyboard Disable
`FE`	Resend:
	repeat most recent byte
`FF`	Keyboard Reset

Keyboard → Host:

`EE`	Echo Reply
`FA`	Acknowledge
`FE`	Resend:
	repeat most recent byte
`FF`	Error

Basic PS/2 Mouse

- 2× 9-bit, 2's-complement counter with overflow flag (x- and y-movements)
- 3× button states (left, right, center)
  - transmitted in 3-byte packets:



counters are reset by transmission

Operation Modes

- **Reset Mode**:
  1. executes BAT (Basic Assurance Test) transmitting result to host,
  2. sets default values: Sampling Rate: 100 Hz
     Resolution : 4 mm^{-1}
- **Stream Mode**:
  Unsolicited state updates are sent to the host,
  at most with the configured sampling rate (10, 20, 40, 60, 80, 100, 200 Hz).
- **Remote Mode**:
  State updates must be requested (`0xEB`) individually by the host.
- **Wrap Mode**:
  Mouse echoes all data sent to it.
  Only `0xEC` "Reset Wrap Mode" und `0xFF` "Reset" are interpreted with their command semantics.

Mouse Commands

`E8`	Set Resolution
`E9`	Query Status
`EA`	Activate Stream Mode
`EB`	Request a State Update
`EC`	Leave Wrap Mode
`EE`	Enter Wrap Mode
`F0`	Enter Remote Mode
`F2`	Query Device ID
`F3`	Set Sampling Rate
`F4`	Activate Data Transmissions
`F5`	Deactivate Data Transmissions
`F6`	Set Default Values
`FE`	Resend
`FF`	Reset

Microsoft IntelliMouse Extensions

The command sequence

1. Set Sample Rate to 200 Hz
2. Set Sample Rate to 100 Hz
3. Set Sample Rate to 80 Hz

activates the extra functions of scroll mice.

→ The status packet is extended by one byte containing the incremental movement of the scroll wheel. (range: −8 . . . 7)

The command sequence

1. Set Sample Rate to 200 Hz
2. Set Sample Rate to 200 Hz
3. Set Sample Rate to 80 Hz

activates two more buttons (if available).

Additional data byte: