

# B-sensor Module + Readout Developments

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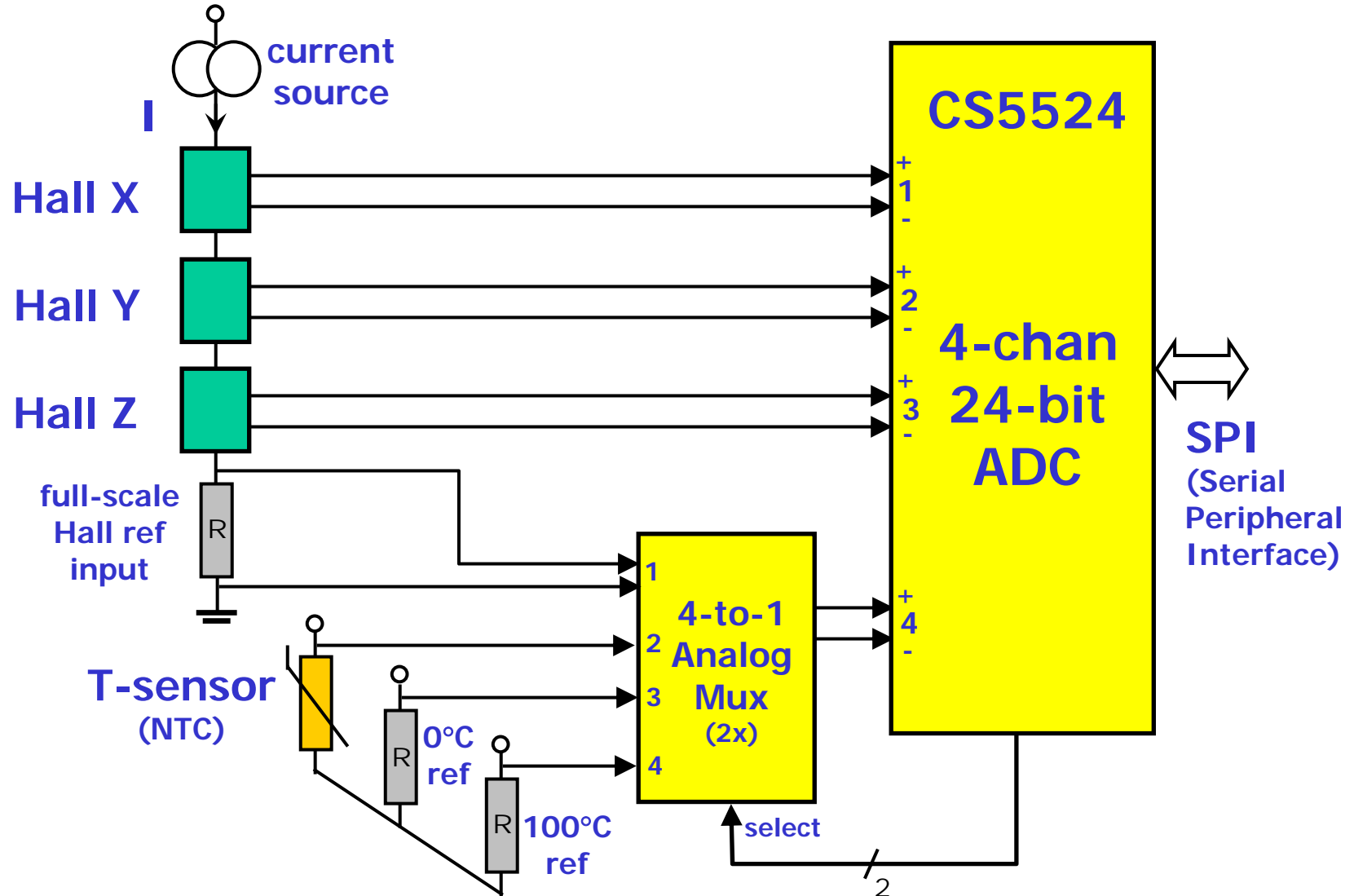
*Henk Boterenbrood*  
*Henk Groenstege*  
*Jaap Kuijt*



# Contents

- **B-sensor module read-out**
  - existing solutions
    - basic SPI version (used in *ATLAS* detector)
    - 'addressable' SPI version (used in the magnet mappers)
  - new solution
    - basic SPI version with add-on CAN microcontroller board

# B-sensor Module basics



# B-sensor Module versions

## Two Types/Implementations/Versions:

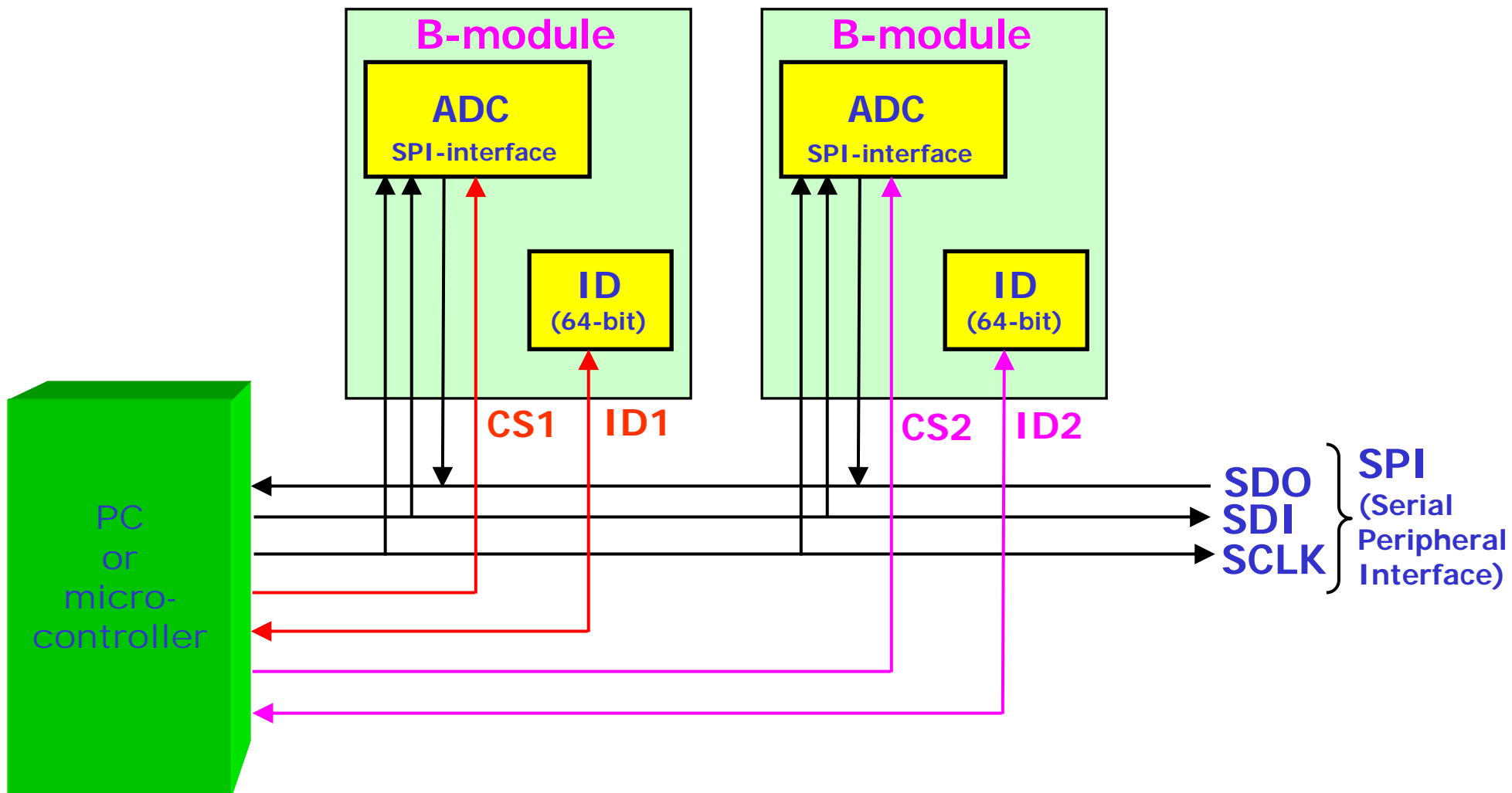
### ■ 'Basic' type

- selection by **Chip-Select** signal per module
- module identification by *1-Wire 64-bit ID-chip*
- readout/control by **SPI** (*Serial Peripheral Interface*)
- used in ATLAS detector

### ■ 'Addressable' type

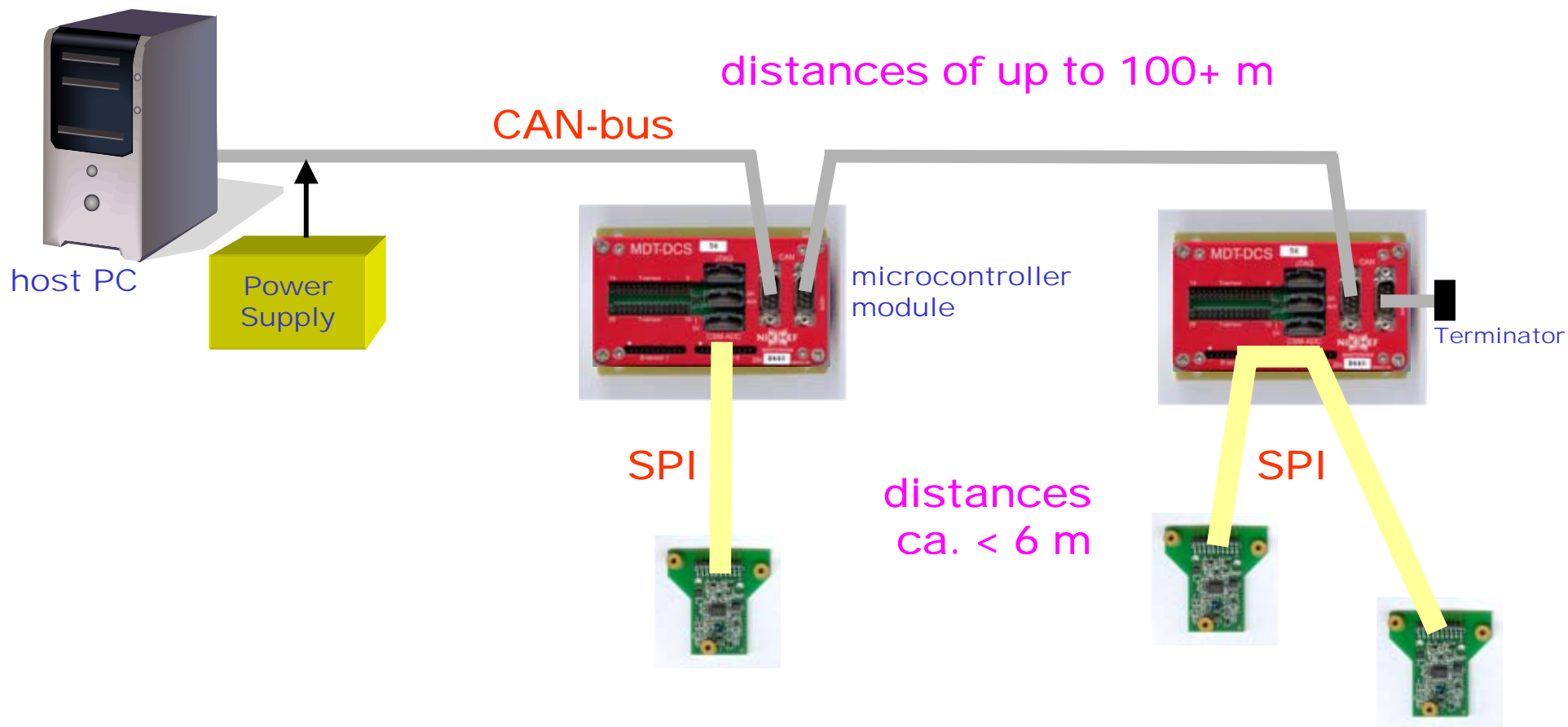
- selection by **1-byte 'address'** (= module identification), using an extra protocol layer (software/firmware)
- readout/control by **SPI** (*Serial Peripheral Interface*)
- used in magnet mapper machines

# B-sensor basic type: usage (1)

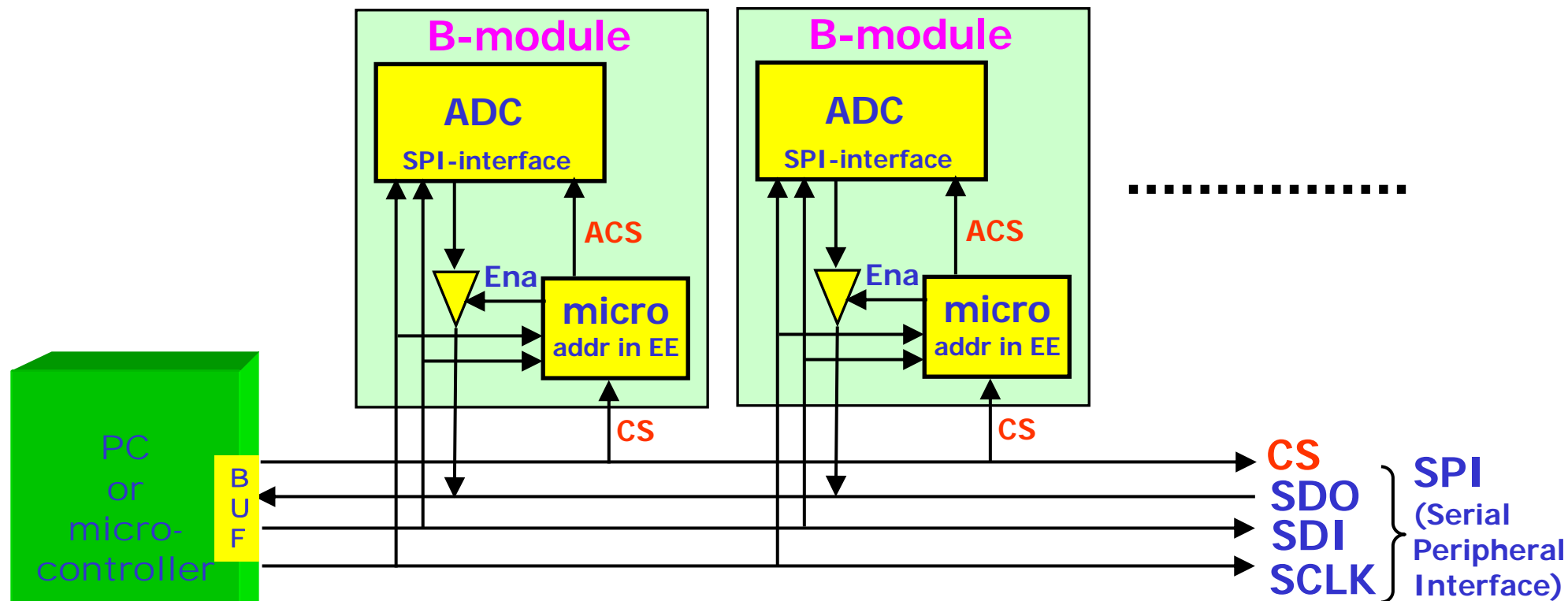


# B-sensor basic type: usage (2)

- In the ATLAS detector:



# B-sensor addressable type: usage (1)



## Advantages:

- only 4 signal wires for N modules (tested: 16 modules on 15 meter cable, using signal buffering)
- broadcast conversion command possible

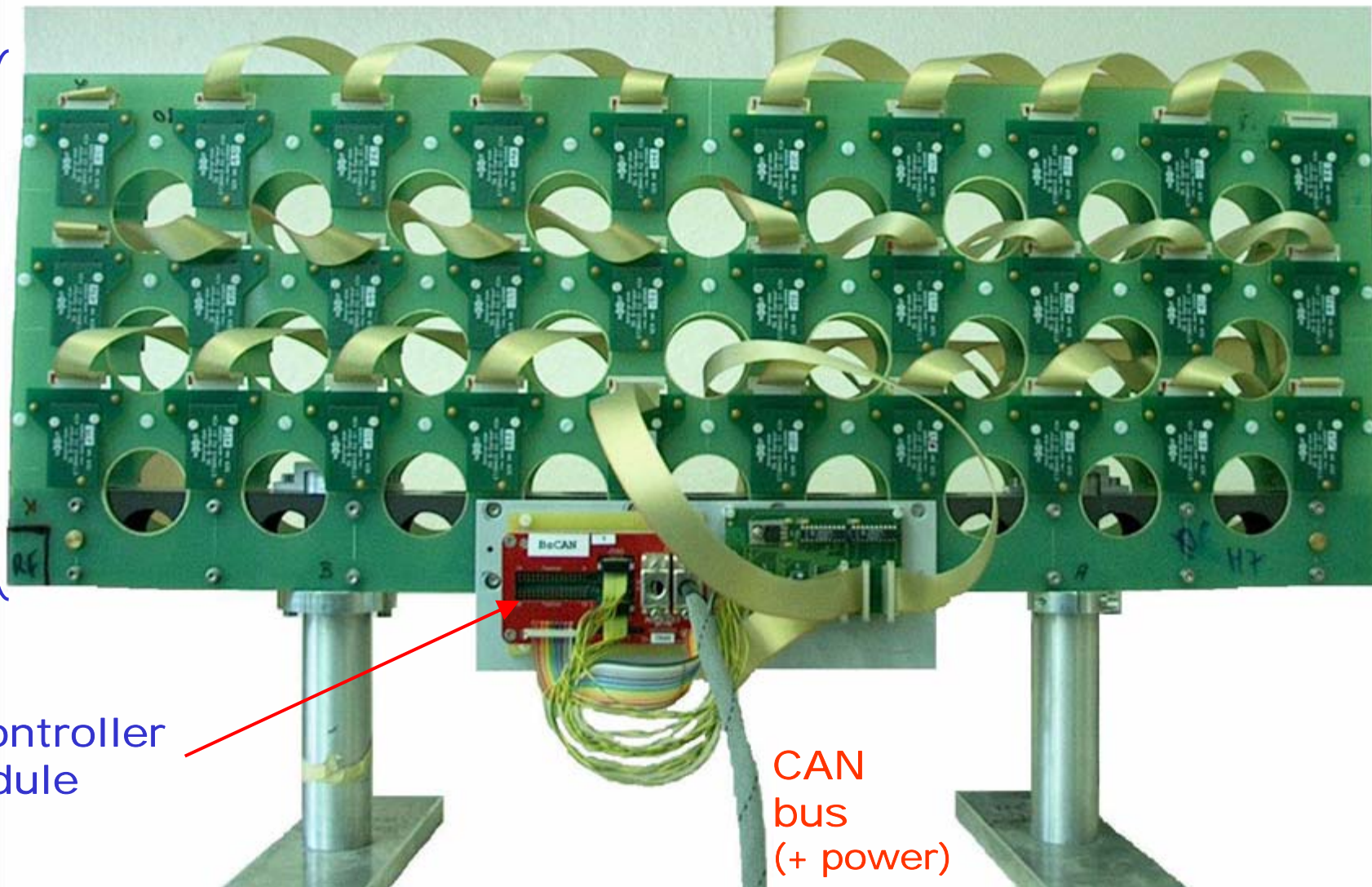
## Disadvantages:

- comm protocol more complex
- production more labor-intensive (micro must be programmed)

# B-sensor: addressable type: usage (2)

LHCb  
Magnet  
Mapper

Frame with  
2 x 30  
*addressable*  
B-sensor  
modules  
in  
4 *strings*  
of 15



microcontroller  
module

CAN  
bus  
(+ power)

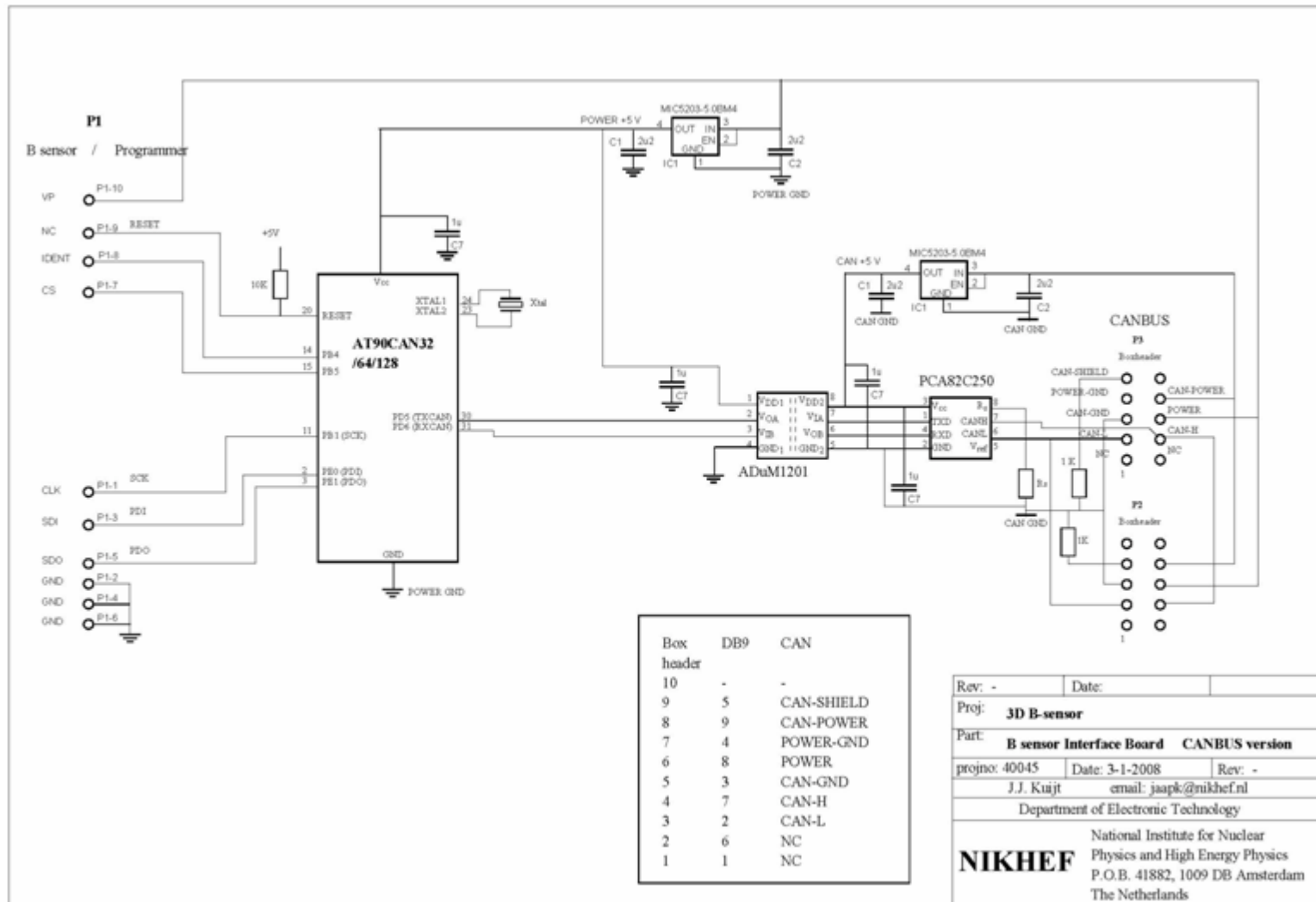
# Problems...

- **Connectors**
- **Cables**
- **Incompatibility between the 2 module types**
  - software: read-out, tester, calibrator
  - missing unique ID on 'addressable' type

# Proposed solution

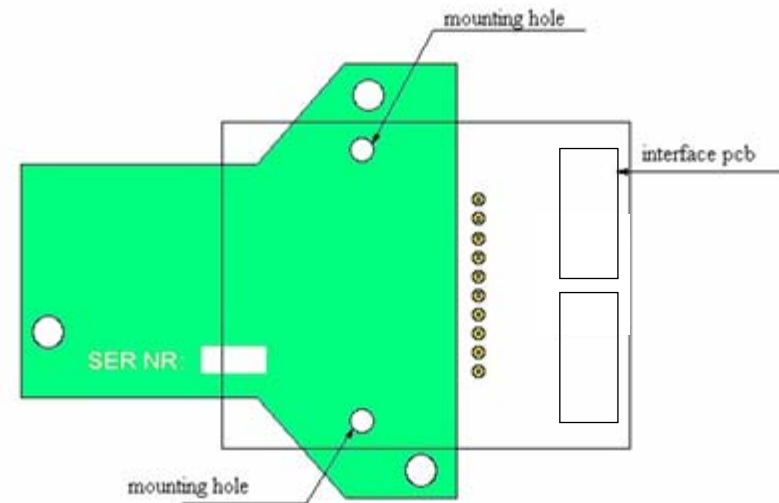
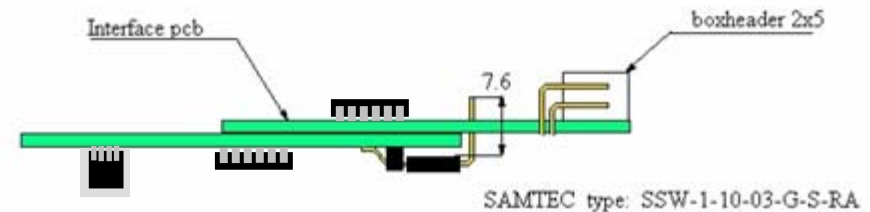
- **Keep the basic type B-sensor module, including ID-chip**
  - compatible with Felix's calibrator (mech. + software)
  - compatible with ATLAS (mech. + software)
  - some improvements with respect to noise (ask Henk Groenstege)
  - added feature: optional Chip-Select signal via ID-chip 'addressing' (enabling setups similar to 'addressable' B-sensor module version)
- **Develop add-on board with microcontroller + CAN interface**
  - by using an 8-bit micro from the same family as the ELMB's we can reuse a big part of existing micro *and* PC software
  - read-out compatible with ATLAS
  - relatively easy to port e.g. existing mapper application software, since already CAN-based (B-sensor byte 'address' replaced by CAN 'address'; additional read-out of ID)

# Proposed solution: schematic of add-on

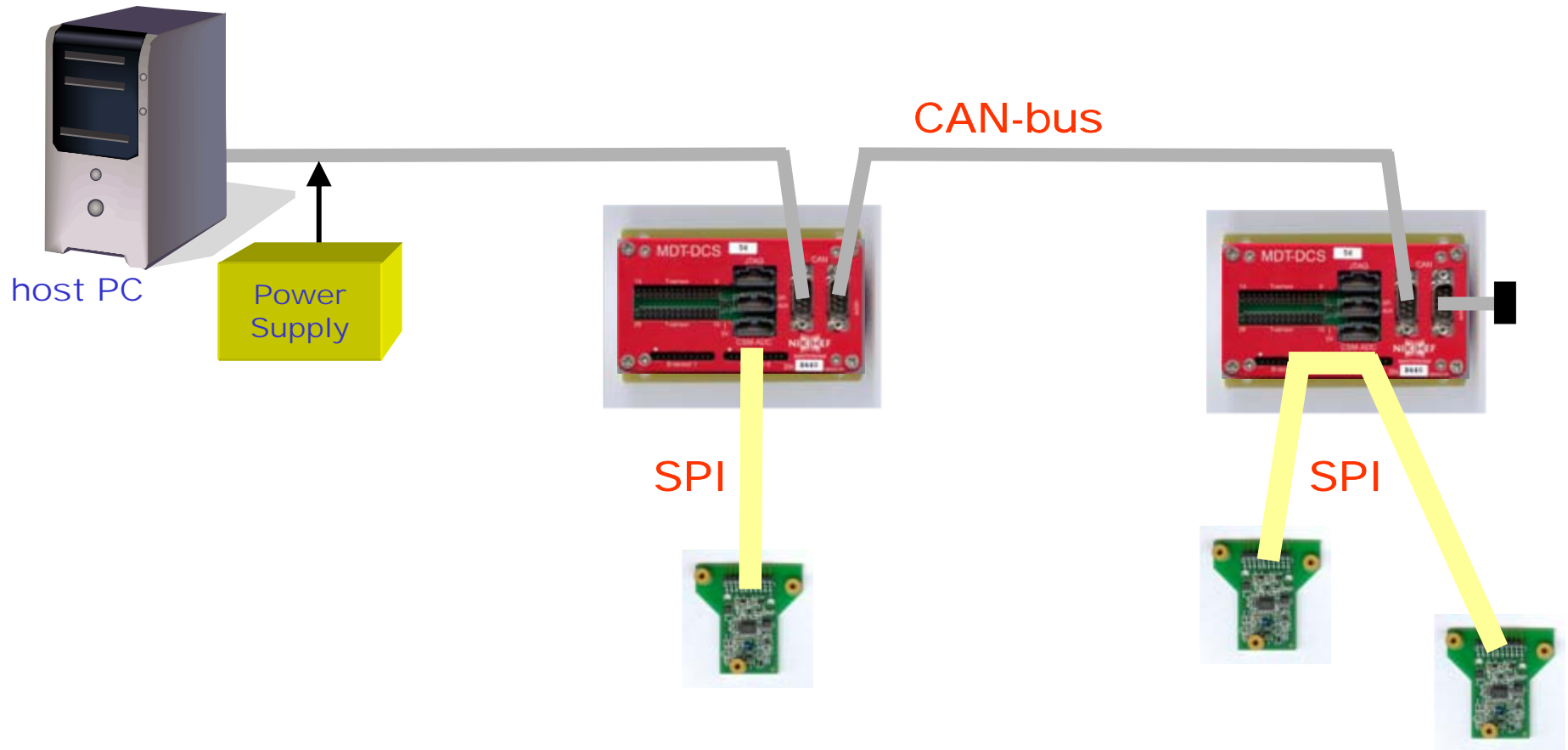


# Proposed solution: mechanics

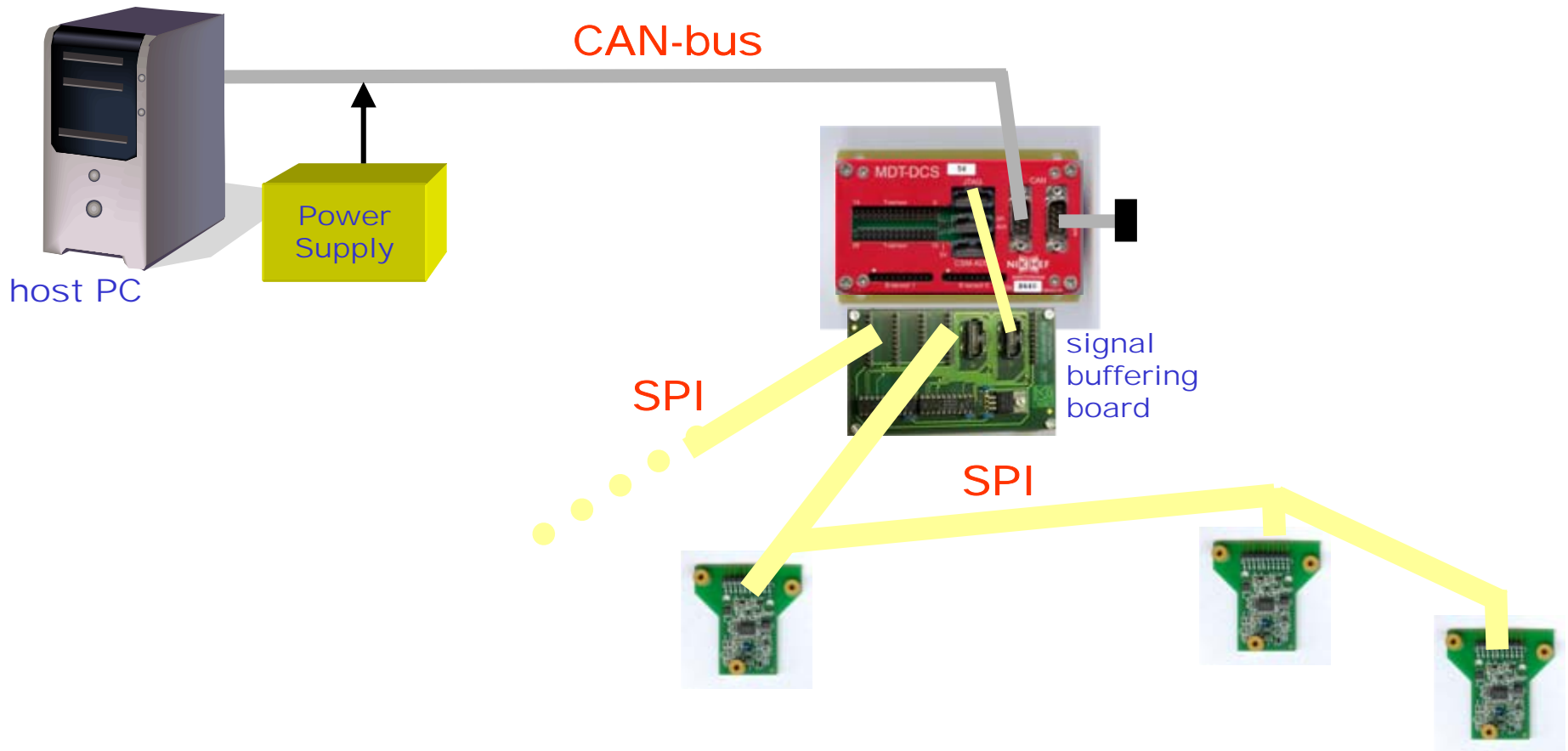
- double CAN-connector for easy daisy-chaining
- 10-pin 'box header' with CANopen layout (1-to-1 flatcable connections to DB9 connector)
- B-sensor connector is also the microcontroller's programmer connector (but after 1<sup>st</sup> time programming, updates will be possible via CAN-bus, thanks to *Bootloader* firmware)



# System Layout: old (B-module basic type)

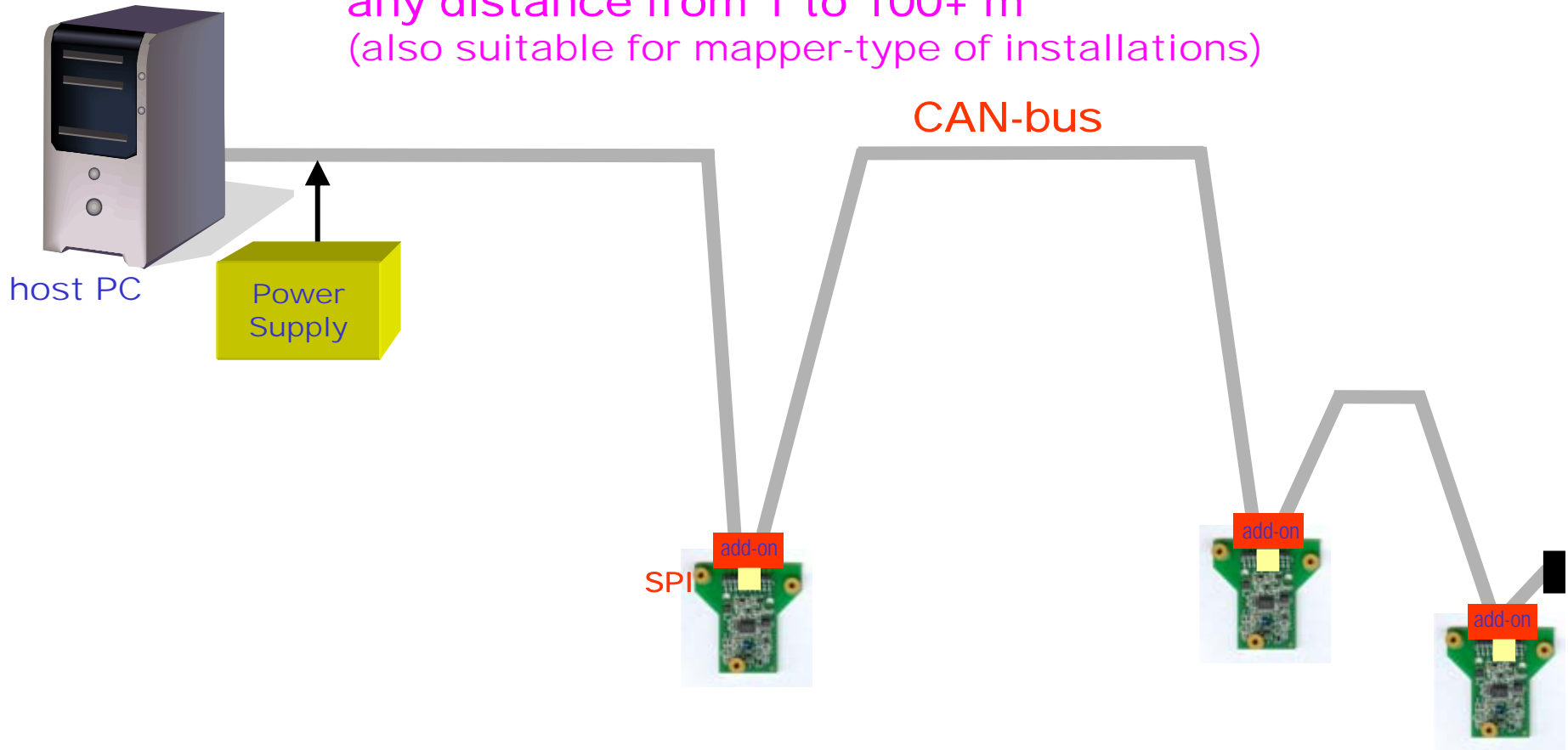


# System Layout: old (B-module addressable type)



# System Layout: new

any distance from 1 to 100+ m  
(also suitable for mapper-type of installations)



# Firmware for add-on board: TODO

- **Port CAN-controller code (on the ELMB: external Siemens chip) to on-chip CAN-controller of the *AT90CANxxx* microcontroller**  
(is the main job... 1-2 weeks)
- **Strip existing ATLAS (MDT) ELMB firmware of code not needed** (i.e. everything except B-sensor readout and CANopen stuff; 1-2 days)
- **Adapt *Bootloader* firmware to new micro** (1 day?)
- **Some (minor?) changes in certain code parts and *Bootloader* due to change in size of the Flash memory, and slightly different hardware configuration** (0.5 day?)

# B-sensor Module schematic

