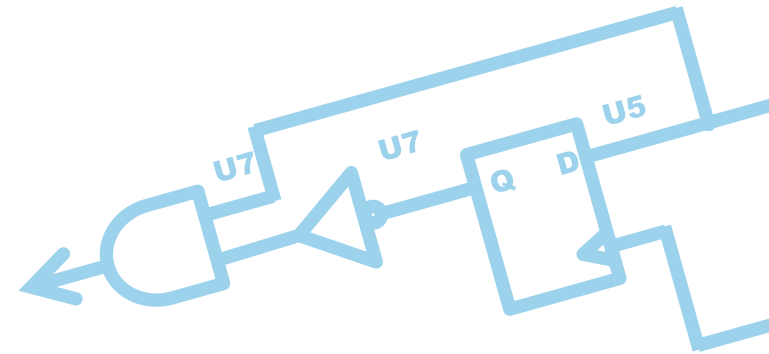




ifm electronic

# IO-Link Protocol Stack for a Configurable Microprocessor



# Sensors in Modern Industrial Automation

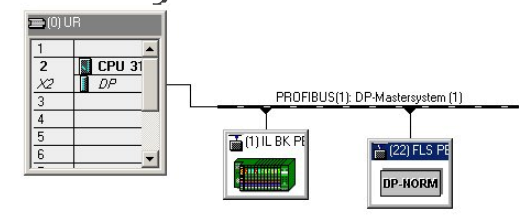
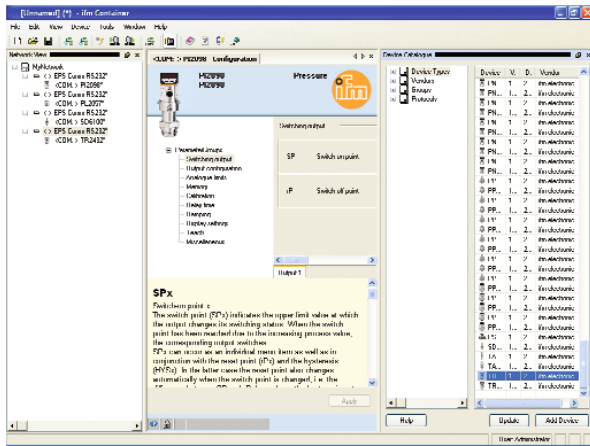
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- Sensor are widely used for process monitoring and control with ever rising requirements on sensing distance, stability and EMC
- Customers expect reliable machines that quickly deliver a return-on-invest
- Necessity for fast and easy sensor adaption
- Flexible solutions needed
- Possibility for application specific settings and reconfiguration methods



# New perspectives of sensors and actuators

- Universal connection of sensors and actuators
- Standardised set-up and documentation of the system configuration
- Standardised checking, setting and storage of device parameters
- Easy integration of the system diagnosis up to the sensor / actuator
- Cost reduction in the entire life cycle of the system



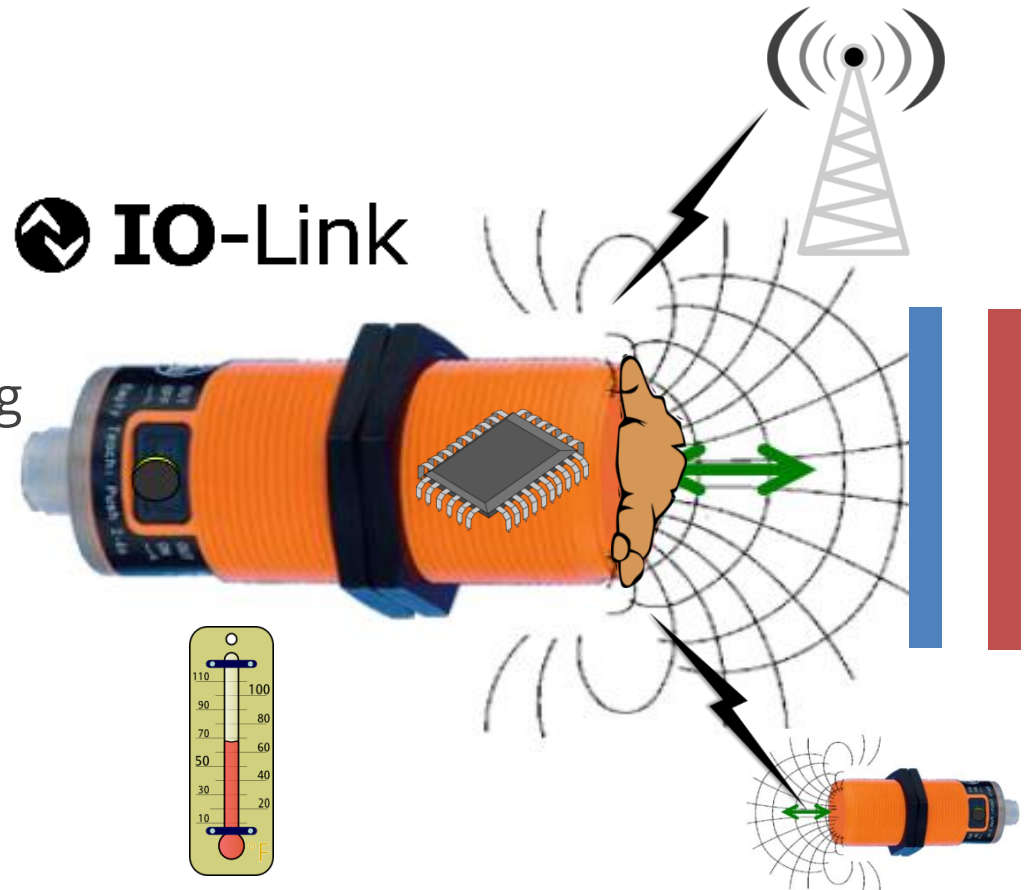
# Smart Sensors

## Challenges

- Environmental influence (EMC, temperature)
- Sensor interference
- Changed application requirements
- Significant local processing

## Solution: Smart Products

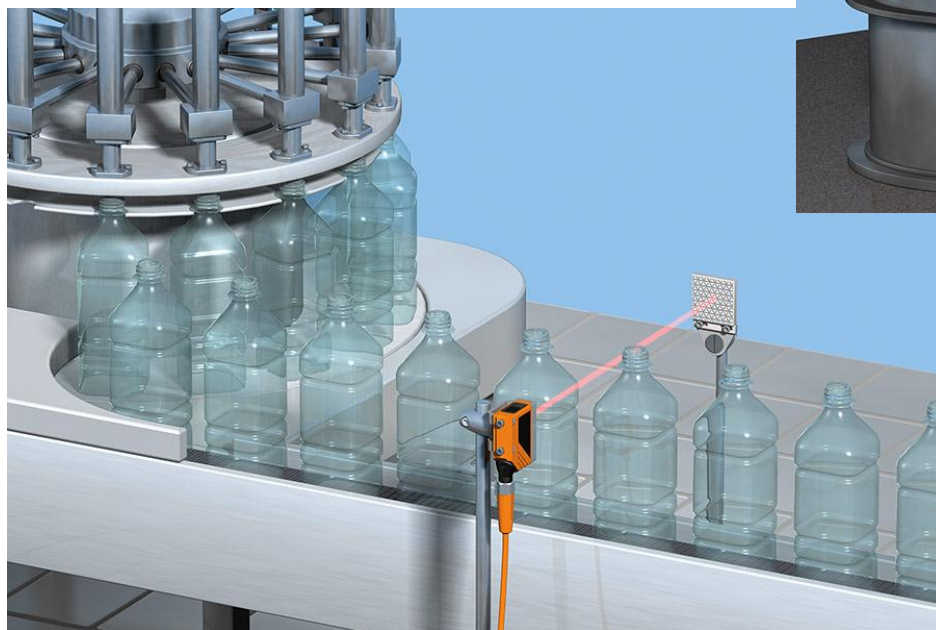
- Programmable architecture
- Digital signal processing
- Adaptive algorithms
- Communication interface



# Application of Smart Sensors

## Additional Information

- Internal measurement values
- Reliability information

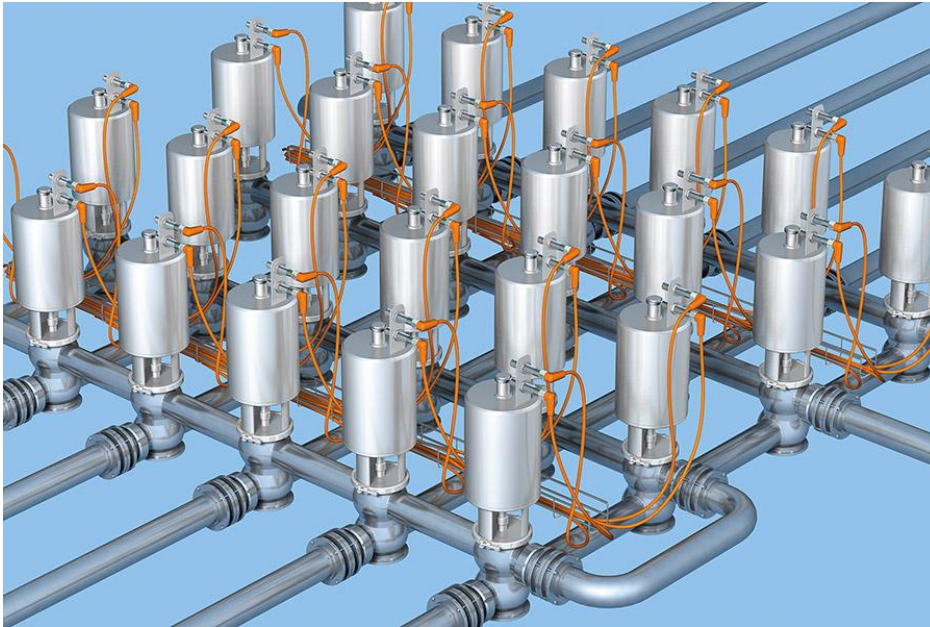


## Application Evaluation

- Signal setting
- Application specific configuration adjustment



# Application of Smart Sensors



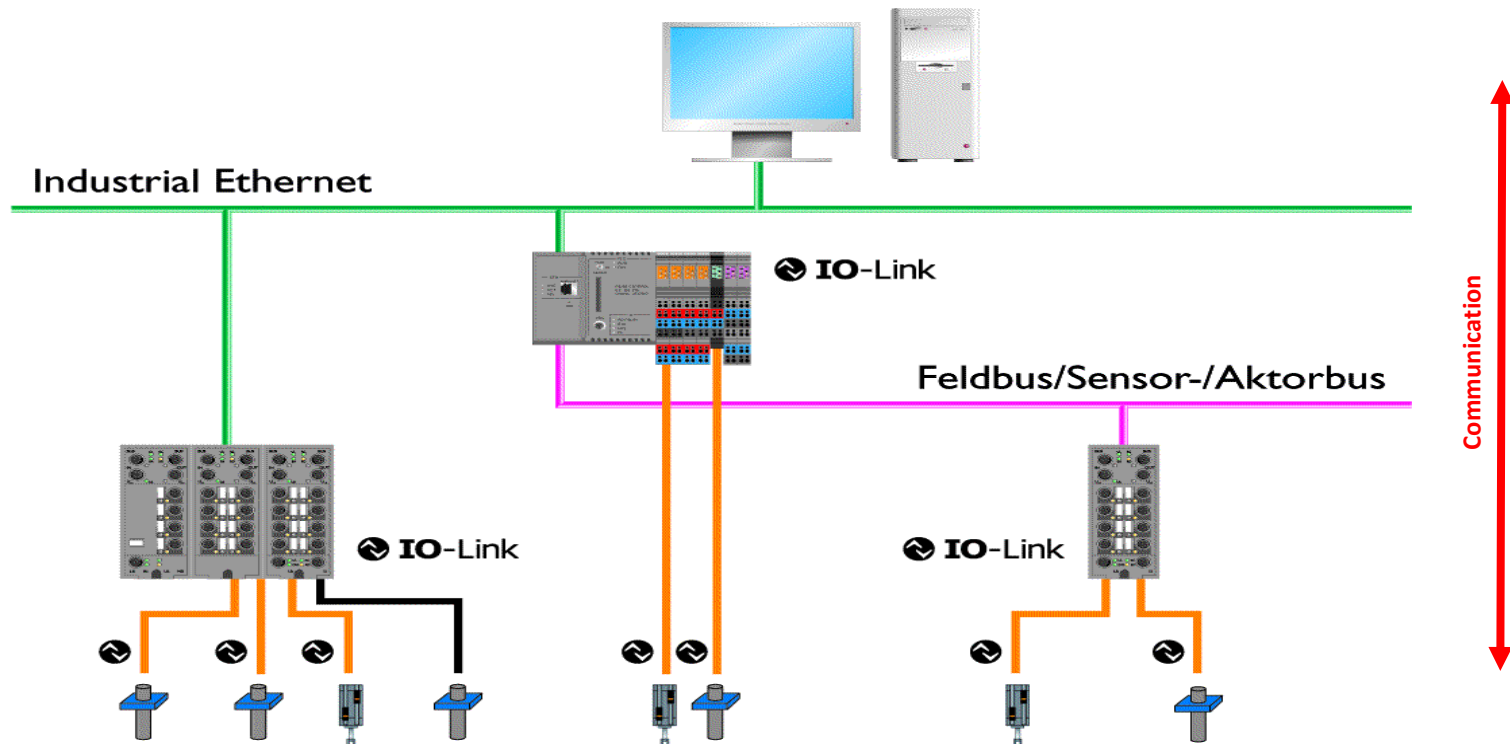
- Device parameter and configuration transfer
- Simple replacement

- Re-Configurability
- Central data processing possibility
- Sensor networks



# IO-Link

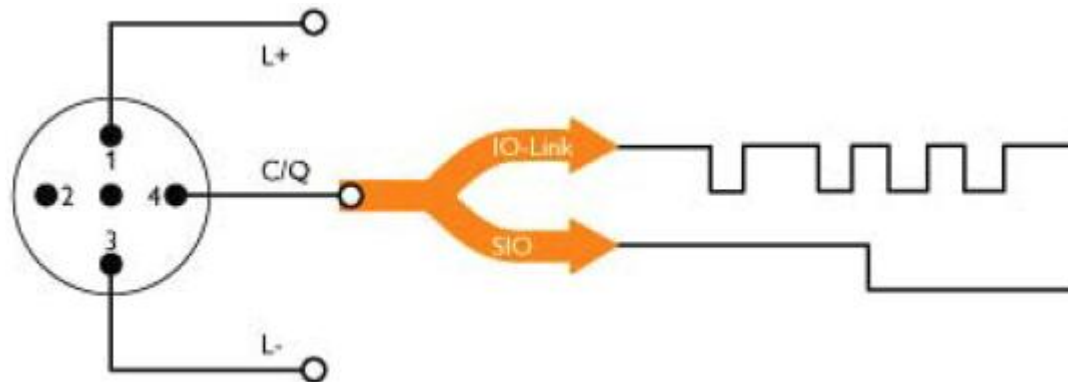
- Allows to access functionalities according to Smart Sensor Profile
- Extension to conventional field bus systems



# IO-Link Communication Interface

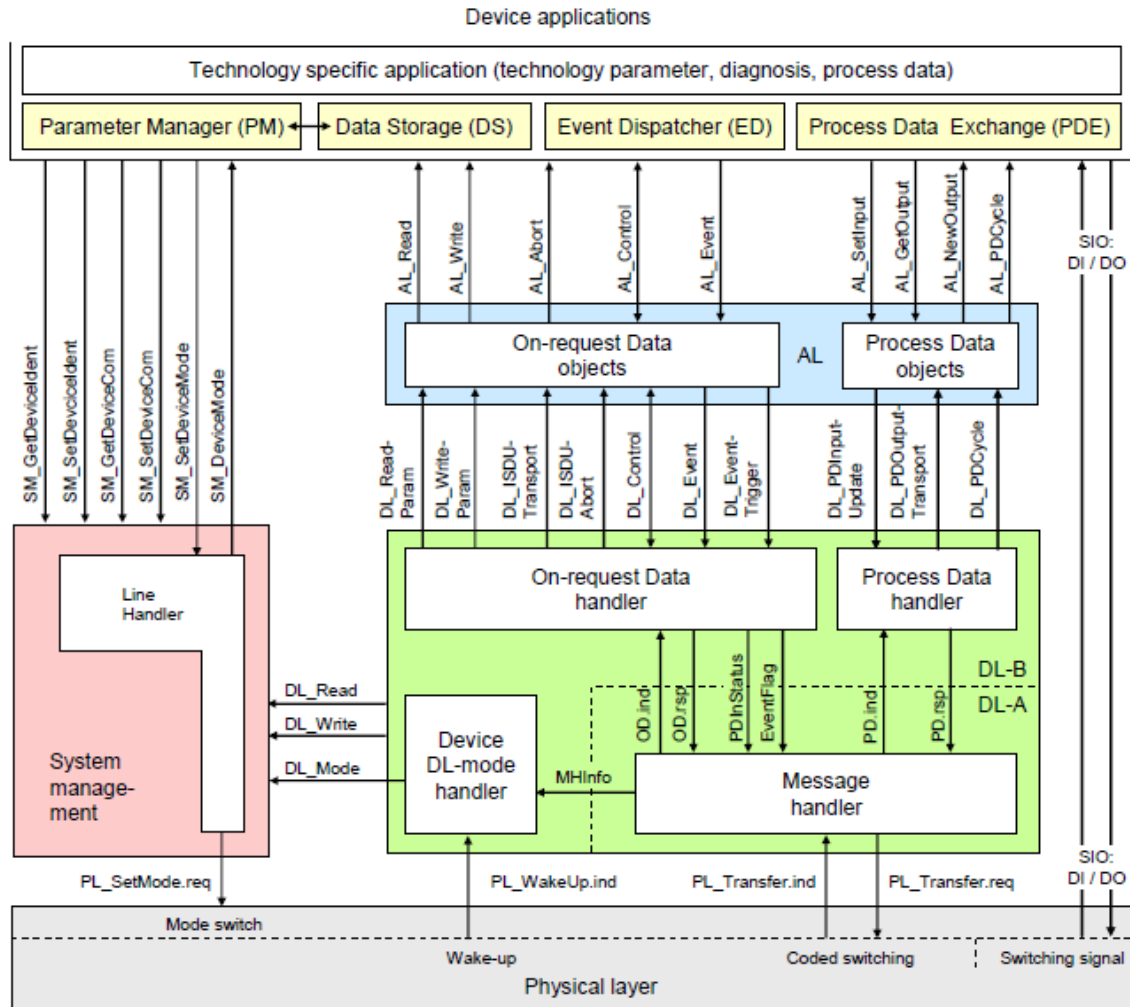
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- Same 24V industrial switching physics
- IO-Link as a new communication mode
- Speed rates: 4.8 to 230.4 kbaud





# IO-Link Device Stack



# IO-Link Implementation for Smart Products

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## New perspective: Configurable microprocessors

- Hybrids of modern 28nm FPGA plus microprocessor
- Benefits:
  - Crucial system layers become configurable
    - Design flexibility for a broad spectrum of sensors
    - Reduce products variants
  - Put the processing burden where it belongs
  - Significant local signal processing capabilities
  - Rich user interface, OS ecosystem
  - Competitive pricing options

# IO-Link Implementation for Configurable Microprocessors

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- Mantra:
  - Put the processing burden where it belongs
- Approach:
  - Move time-critical IO-Link layers to programmable logic
- Perspective:
  - Less clock cycles per IO-Link message
  - $\mu$ C is released

# IO-Link Implementation Footprints

Microcontroller architecture	Compiler (optimization)	IO-Link stack footprint (kB)	
		Code size (kB)	Data size (kB)
Atmel ATmega328	IAR v6.50.2 (speed)	15.9	1.0
	IAR v6.50.2 (size)	14.4	1.0
	AVRGCC v4.6.2 (speed)	20.9	0.9
	AVRGCC v4.6.2 (size)	17.1	0.9
ARM Cortex-M3	IAR v6.50.2 (speed)	16.4	1.8
	IAR v6.50.2 (size)	13.6	1.8
	ARMGCC v4.6.1 (speed)	18.8	2.9
	ARMGCC v4.6.1 (size)	15.9	2.9
Altera Nios-II	Nios-II 10.1 (speed)	28	
	Nios-II 10.1 (size)	27	
Xilinx Microblaze	Xilinx SDK 14.3 (speed)	40.9	
	Xilinx SDK 14.3 (size)	34.7	

## Results

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- ifm electronic gmbh and Missing Link Electronics have implemented an IO-Link device stack for a commercial proximity sensor.
  - Portable
  - Configurable
  - Maintainable
  - ANSI/ISO C++
  - Competitive footprint
  
- Perspective: Equip new smart products with IO-Link & Smart Sensor functionalities