Smart Transducers Interface

Thomas Losert

TECHNISCHE UNIVERSITÄT WIEN

Overview

- Introduction and Motivation
- Smart Transducers
- Observations
  - State vs. Event Values
  - Global Notion of Time
  - Interface File System (IFS)
- TTP/A
- Case Study
- Conclusion & Outlook

Smart Transducer (ST)

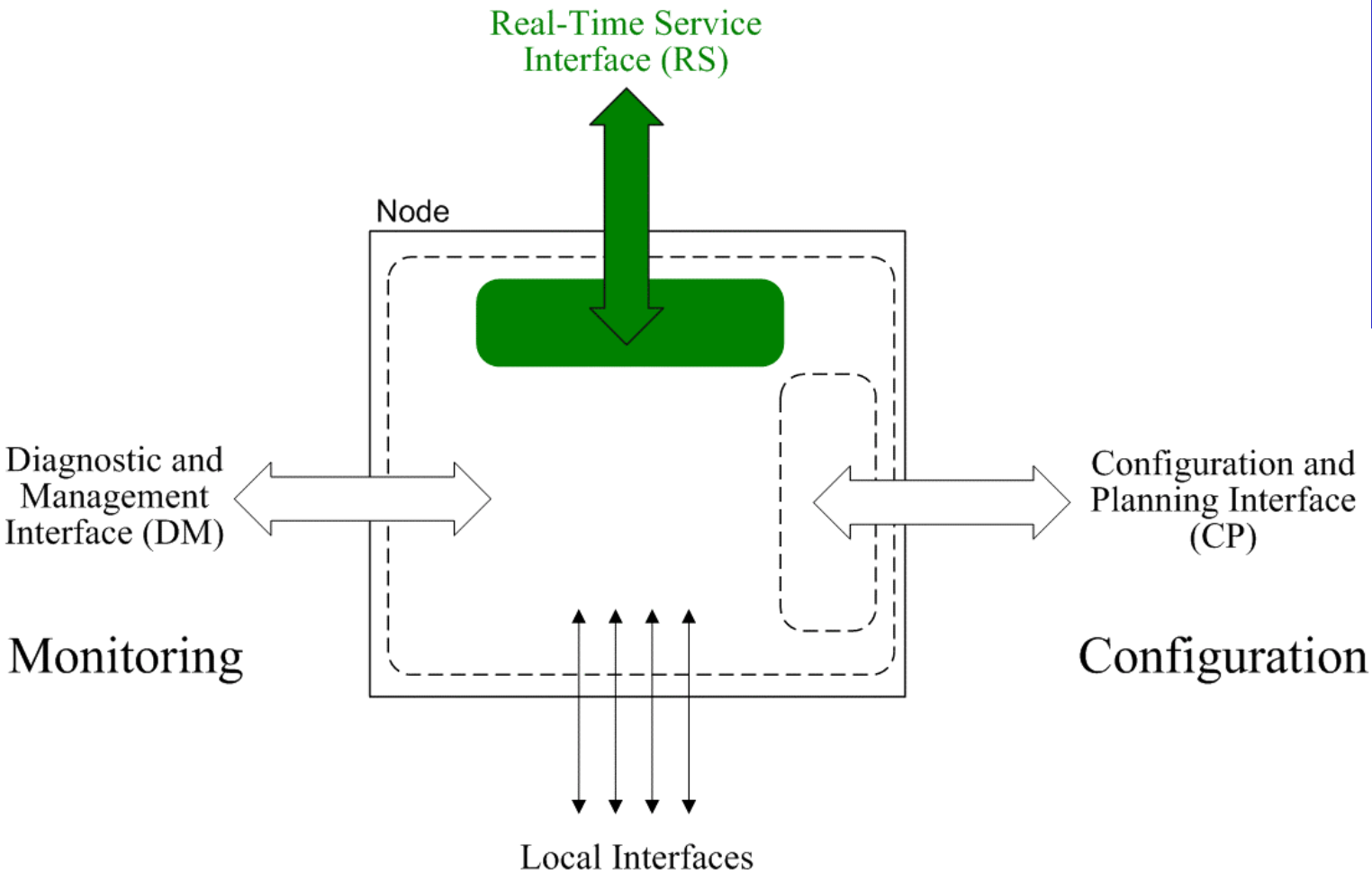
Comprises the Integration of one or more Sensor/Actuator Elements with a Micro-controller and a Communication Network Interface that provides the following Services across standard Interfaces:

- Diagnostic and Management
- Real-Time Communication
- Calibration of Sensor
- Signal Conditioning and Conversion to standard Units

Advantages

- No noise pickup from long external signal transmission lines.
- Better Diagnostics – Simple external sensor failure modes (e.g., fail-silent)
- "Plug-and-play" capability if the sensor contains its own documentation on silicon or in an external database.
- Reduction of the complexity at the system hardware and software and the internal sensor failure modes can be hidden from the user by a well-designed fully specified smart sensor interface.
- Cost reduction in installation and maintenance.

Three Interfaces of a Node



Observations

An observation consists of an atomic triple

< *observed value*, *instant*, *RT-entity Name* >

For Communication of Observations across an RS interface a common set of concepts is necessary:

- Common representation of values in a Shared code-space
- Common notion of time and its representation
- Common meaning of the names of RT entities
- Access protocol to the information.

State vs. Event Values

Characteristic	State Observation	Event Observation
Value	Full Value	Value Difference
Frequency	Periodic	Sporadic
Loss of Observ.	Period lost	Loss of synchr.
Semantics	At-least-once	Exactly-once
Error Detection	At receiver	At sender only

Observations

An observation consists of an atomic triple

< observed value, instant, RT-entity Name >

For Communication of Observations across an RS interface a common set of concepts is necessary:

- Common representation of values in a Shared code-space
- Common notion of time and its representation
- Common meaning of the names of RT entities
- Access protocol to the information.

Global Notion of Time

64-Bit binary number with 40 Bit for number of seconds since GPS-epoch (6. Jan. 1980, 00:00:00) and 24 Bits for fractions of a second

- Continuous representation of Time (no leapseconds)
- Easy Access to the full second
- No overflow during the livetime of the product
- High availability with low jitter
- Easy manipulation of timestamps by using native commands

Observations

An observation consists of an atomic triple

< *observed value*, *instant*, *RT-entity Name* >

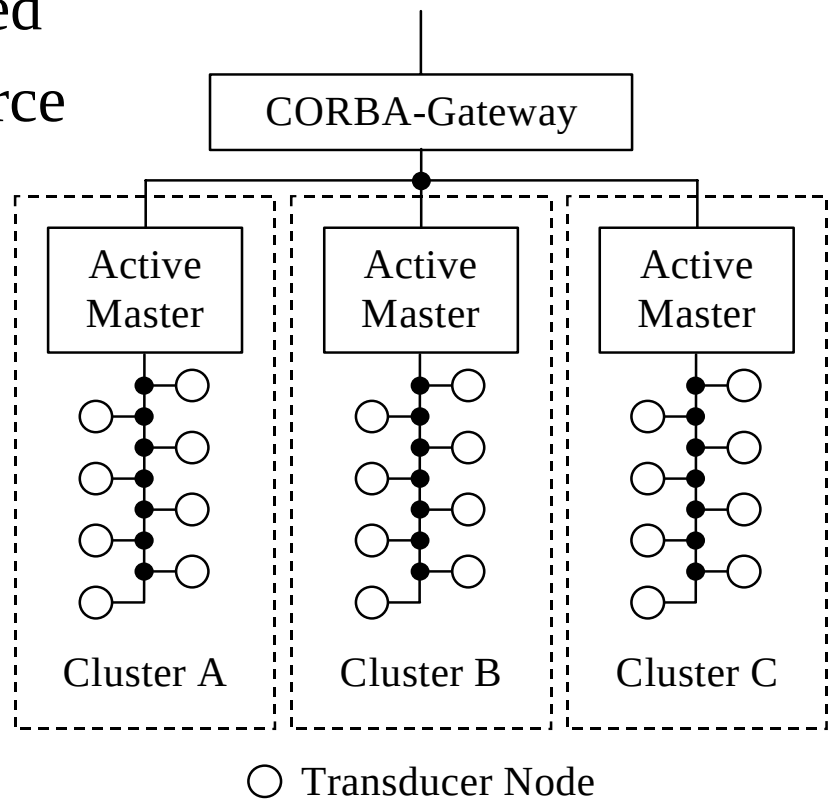
For Communication of Observations across an RS interface a common set of concepts is necessary:

- Common representation of values in a Shared code-space
- Common notion of time and its representation
- Common meaning of the names of RT entities
- Access protocol to the information.

Interface File System (IFS)

Hierarchical, distributed File-System is the source and sink of the communication

- Up to 250 Clusters
- Up tp 250 Nodes
- Up to 64 Files
- Up to 256 Records

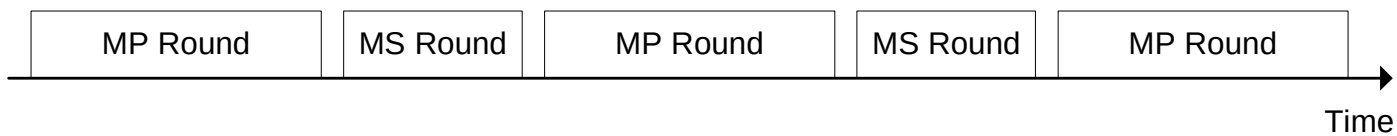


TTP/A

- Time-Triggered Protocol for Fieldbus Applications
- TDMA Bus Access Scheme
- Communication Organized into Rounds
- Supports Various Physical Layers

Each round is initiated by the master by sending the Fireworks-Byte

- Multipartner (RS)
- Master/Slave (DM, CP)



Case-Study

We have implemented the TTP/A protocol on several Microcontrollers (Atmel, Microchip, Motorola)

We have implemented a CORBA-gateway according to the Standard Proposal

Conclusion & Outlook

- We have proven the concept
- We work on further physical layers for the connection from the CORBA-Gateway to the Clusters like Wireless or Ethernet