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# ISDM – A New Approach by a Large Number of Automotive Suppliers

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# Agenda

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- IEEE TEDS - A Valuable Concept
- The IEEE1451.4 TEDS Format
- Limitations of Current TEDS
- New Challenge for TEDS
- ISDM TEDS Extension
- Need for Physical and Virtual TEDS
- ISDM Next Steps
- Conclusions

# IEEE TEDS – A Valuable Concept

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## The Problem

Imagine

- you are operating a test stand
- equipped with dozens of different sensors

You expect

- all sensors well selected
- in best operating condition



Measuring quantity - Measuring range - Calibration status

## The Vision

An auto verification of all sensors and an auto configuration of the automation system measuring channels were a cracking good story!

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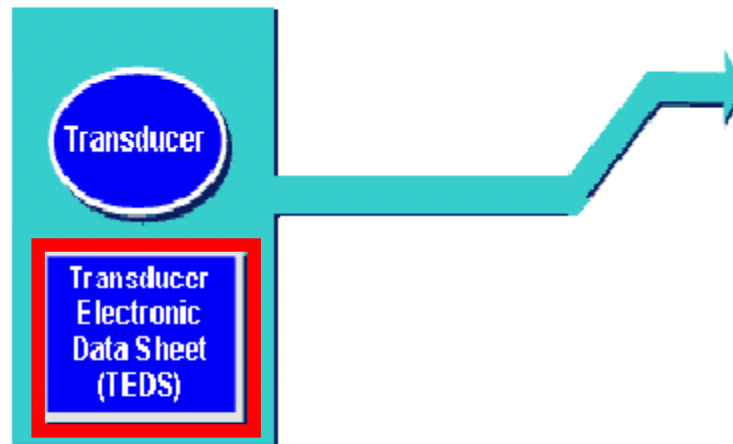
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## Transducer Electronic Data Sheet (TEDS)

Standardized by IEEE 1451.4

a mechanism for adding self-describing data to sensors  
with an analogue signal interface.

Transducer  
&  
Memory chip



Analog Signal



# IEEE TEDS – A Valuable Concept

## Transducer Electronic Data Sheet (TEDS)

Standardized by IEEE 1451.4

a mechanism for adding self-describing data to sensors  
with an analogue signal interface.

Transducer  
&  
Memory chip



Mixed-Mode  
Interface  
(analog and  
digital)

Analog Signal



Digital (TEDS)

```
000101011111
010101010010
100100101001
```

- Sensor Manufacturer
- Model Number
- Serial Number
- Measuring Range
- Calibration Data
- User Info
- .....and more

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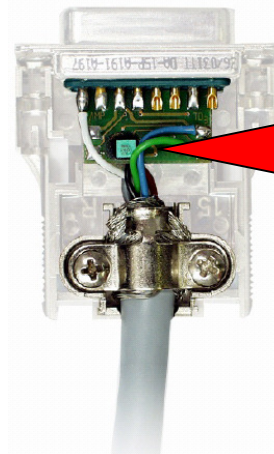
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# IEEE TEDS – A Valuable Concept

TEDS integrated in sensor



TEDS integrated in the connector



TEDS Properties	Values
Manufacturer ID	30
Model Number	4
Version Number	2
Version Letter	B
Serial Number	246
Sensitivity @ reference condition	5.000000E-7 V/N
High pass cut-off frequency (F hp)	5.000000E-3 Hz
Stiffness of transducer	1.000000E+6 N/m
Mass below gage	1.000000E-1 g
Sensitivity direction (x, y, z)	x
Transducer weight	1.000000E-1 g
Transducer Electrical Signal Type	Voltage Sensor
Mapping Method	Linear
AC or DC Coupling	AC
Polarity (Sign)	Positive
Reference frequency (F ref)	3.500000E-1 Hz
Reference temperature (T ref)	1.500000E+1 °C
Calibration Date	1/1/2004
Calibration Initials	SAA
Calibration Period (Days)	0 days
Measurement location ID	0
User Data	This is

Manufacturer  
Model Number  
Serial Number  
Measuring Range  
Calibration Data  
User Info  
.....and more

TEDS integrated in the cable



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Sensor plug-and-play capability, similar to the plug-and-play capability of a computer USB device

The measuring device  
reads out the sensor data  
configures itself  
starts measuring

Smart TEDS  
(IEEE 1451.4)  
Sensor

TEDS Capable Data  
Acquisition System



Common sensor data line  
- analogue sensor signal  
- digital sensor data

# The IEEE1451.4 TEDS Format



## Basic TEDS

Manufacturer ID  
Sensor Model  
Version Letter  
Version Number  
Serial Number

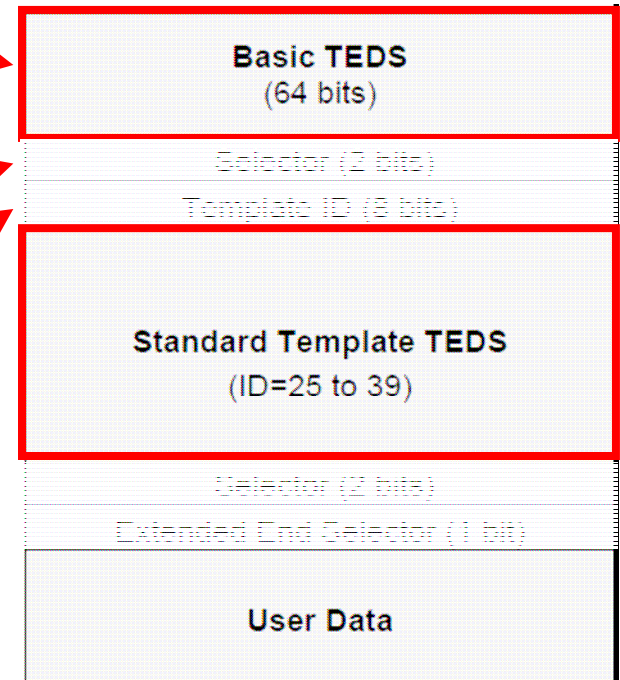
## Descriptor Selector

DS = 0 IEEE defined template  
DS = 1 manufacturer defined template  
DS = 2 template from diff. manufacturer  
DS = 3 extended

## Template ID

ID of used template

## Template Data





# The IEEE1451.4 TEDS Format

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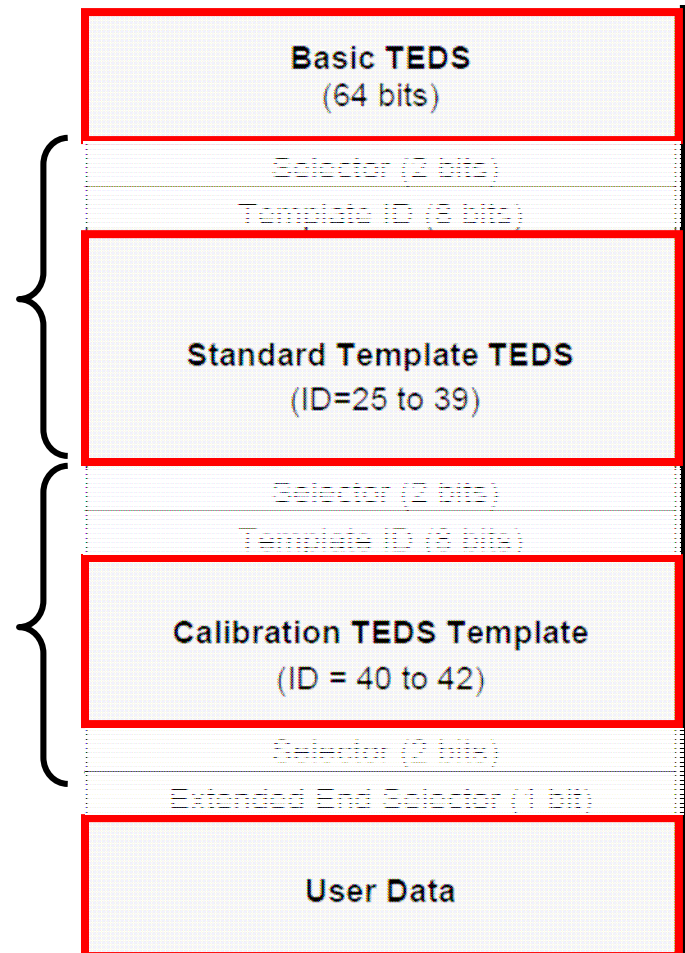
## Templates

Identify the data block & structure, e.g.

- Accelerometer
- Strain gage
- Microphone
- Calibration data
- ...

## Supports

- Concatenation of templates
- Appending non-IEEE templates  
(User Data)



# Limitations of Current TEDS

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IEEE 1451.4 intentionally defined

- the TEDS content

- as „pure“ sensor description data

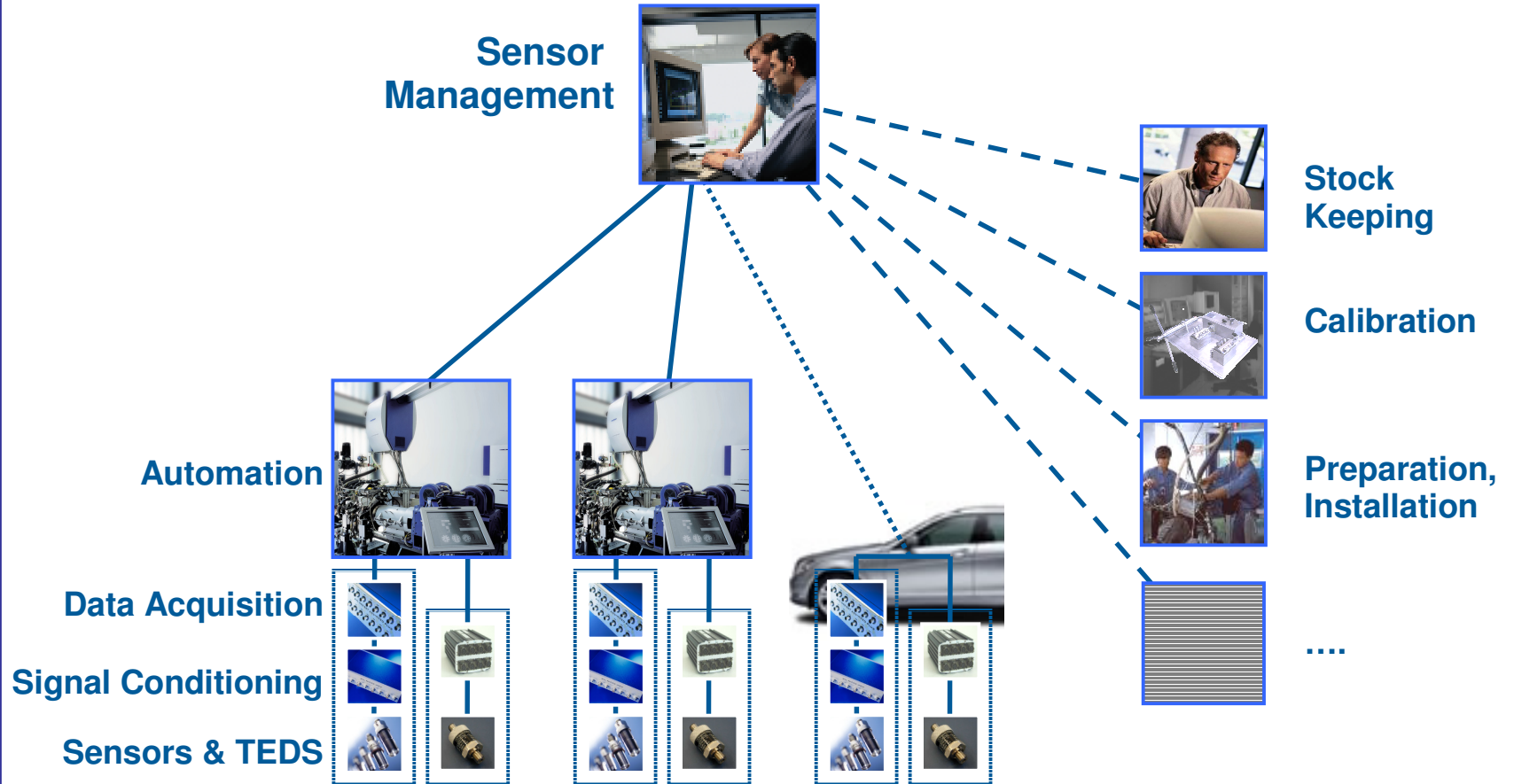
- the usage

- for stand-alone measuring devices

- to enable an auto configuration of measuring devices

# New Challenge for TEDS

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# ISDM TEDS Extension

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## The Goal

Extend TEDS usage to all processes in the test field

Tracking the sensor data across the full sensor life cycle like:

Ordering  
Stock Keeping  
Test Order  
Installation & Preparation  
Measurement / Test  
Failure Recognition  
History Log  
Maintenance  
Calibration  
Removing from Stock

IEEE1451.4 Scope

# ISDM TEDS Extension

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## Requirements

Compatibility with the existing IEEE1451.4 standard

Initial

Basic TEDS

general sensor description (IEEE template)

Appendable

ISDM templates

# ISDM TEDS Extension

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## The ISDM Templates

- A dedicated set of attributes for all sensor processes  
each attribute as triple with  
attribute name – value – unit
- Written as
  - a xml section
  - according to a common xsd schema definition
  - a compressed xml text string to save memory

# ISDM TEDS Extension

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An example

Attribute set for process „Sensor Stock Keeping“

## Process: Stock keeping / input quality test

VisualCheck	VC	visual check (ok/not ok)
NominalValCheck	NC	check of specification ok/nok
MaintReq	M1	maintenance required (Yes/No)
CalReq	C1	Request for exceptional calibration (yes/no)
StorageTemp_Min	S1	Storage temperature min
StorageTemp_Max	S2	Storage temperature max
StorageHumidity_Max	S3	Storage of relative humidity max
StorageShockMove_Max	S4	Storage shock acceleration max
StorageLocation	S5	Stock location of sensor
StoragePress_Min	S6	Storage barom. pressure min
StoragePress_Max	S7	Storage barom. pressure max
AccuracyClass	AC	Class of measurement accuracy
Reusage	RU	Can the sensor be used again? [yes, reduced, no]
ApplicationReduced	AR	free descriptive text

Attribute Name	xml Tag Name	Explanation
----------------	--------------	-------------

# Need for Physical and Virtual TEDS

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## Drawbacks

- Restricted memory size
  - Only a subset of sensor data archivable in the sensor memory
- Slow readout times
  - TEDS applied at test stands with hundreds of sensors

## Needed

- Fast access to test bed sensor data

## Solution

- Use the „Basic TEDS“ in the sensor memory (Physical TEDS)
- Read the unique „Sensor ID“ from the Physical TEDS
- Use a database as „Virtual TEDS repository“
- Retrieve the Virtual TEDS via the unique „Sensor ID“



# Physical and Virtual TEDS

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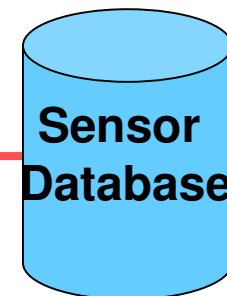
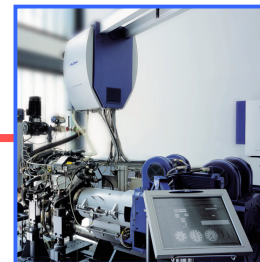
## An indoor test stand application

The workflow of the automation system

- scans via the measuring boxes the Physical TEDS
- reads-out the sensor IDs
- retrieves extended sensor data from the sensor data base (Virtual TEDS)
- configures the measuring channels
- verifies the sensor measuring ranges to be compliant with the test requirements
- verifies the sensor calibration status
- logs significant sensor events



Physical TEDS



Virtual TEDS

# Physical and Virtual TEDS

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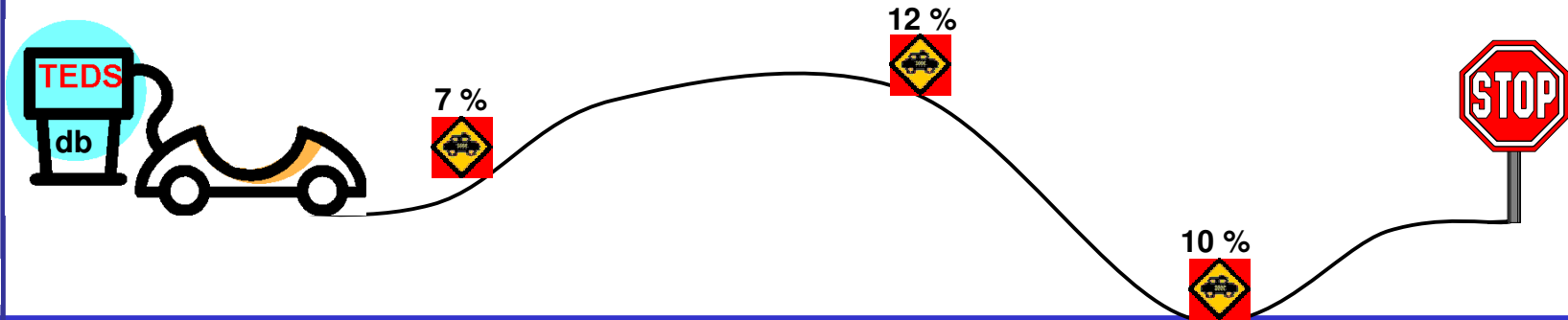
## An outdoor test application

### Preparation of the physical sensor TEDS

- download the required sensor data from the virtual TEDS db into the physical TEDS

### The workflow of the mobile automation system

- reads-out the physical TEDS
- configures the measuring channels
- verifies the compliance of the measuring ranges with the test requirements
- checks the sensor calibration status
- starts logging measuring data



# ISDM Next Steps

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Cooperation with IEEE1451.4

Communication is opened to make ISDM extensions part of  
IEEE1451.4 standard

# Conclusions

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## Transducer Electronic Data Sheets

- are a valuable concept
- intentionally defined by IEEE1451.4 for usage with measuring devices

## Initiative for Sensor Data Management (ISDM)

- definitions are fully compatible with IEEE1451.4
- definitions will be promoted by IEEE1451.4 for a revised standard

## The ISDM TEDS concept

- extends the TEDS scope to the full sensor life cycle
- supports full integration in test stand & test field environments

## ISDM TEDS enlarge the plug&play capability of sensors

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