

The Integration of Add-on Sensors into the Manufacturing Tool Environment – Recent Models and Future Needs



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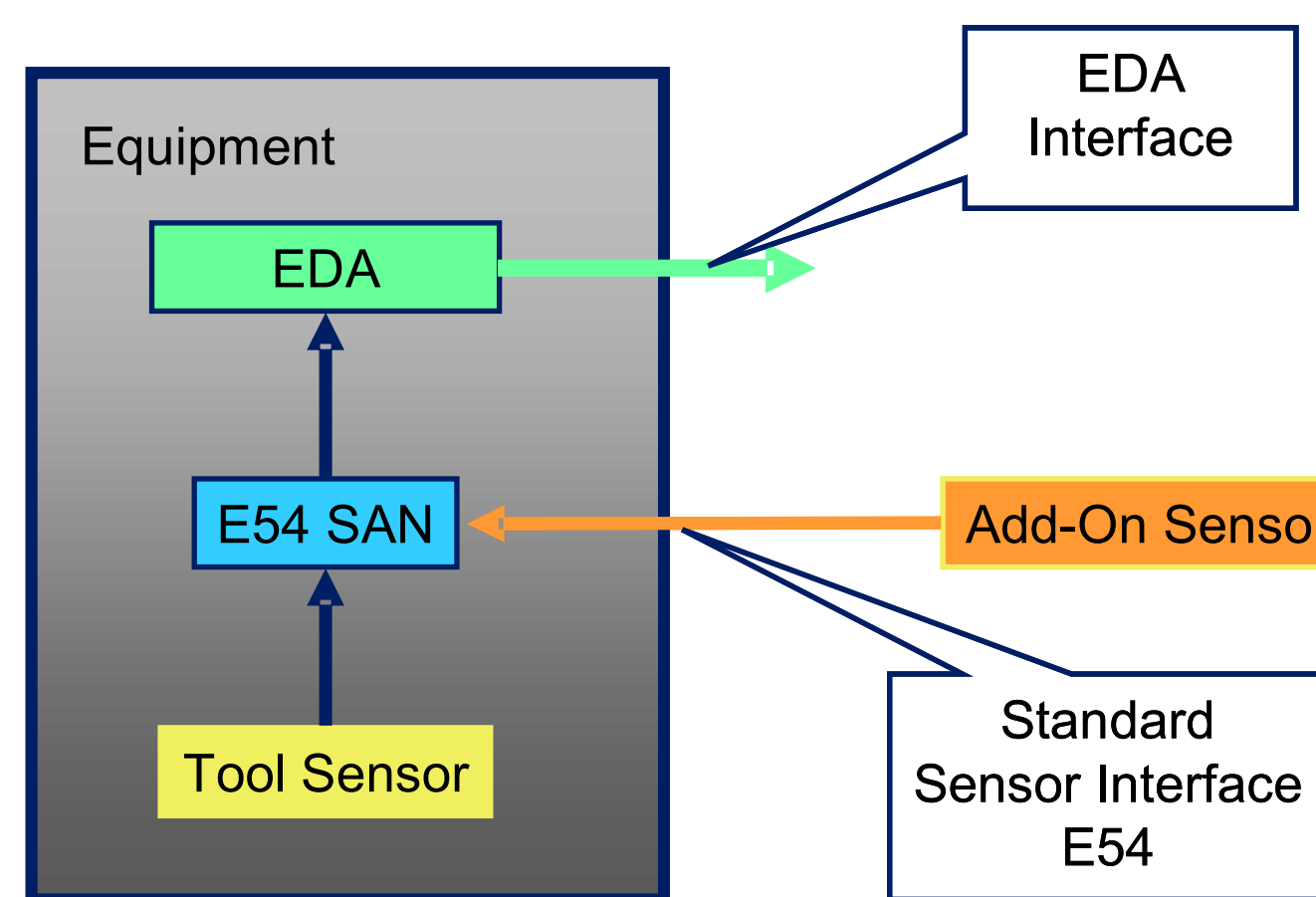
Sensor Integration

- ❑ Aim
The unification of tool and sensor data together with process data like LotID, Recipe etc. is important.
- ❑ Problem
The manufacturing tools are not equipped with a standard data interface. The integration of add-on sensors causes problems. And the EDA interface is not usable for the integration of add-on sensors.
- ❑ Recent situation
IC manufacturers have not seen the necessity of a sensor interface yet. 6 out of 8 device makers do not see an application of SEMI E54 (ISMI - FAST III 2005). Majority of equipment suppliers do not need SAN (ISMI - FAST III 2005)
- ❑ Result
Only tool data will be available with out SAN - no higher level of APC because add-on sensor data aren't usable.

Demands on Sensor Interface

- ❑ For high volume production:
Data reduction is necessary for analysis.
Because of high speed data transfer
Automatic Data Analysis for APC is strongly recommended.
- ❑ Transfer of logistics, e.g.:
LotID, Recipe, Process Step, WaferID.
Logistics are necessary for identifying the data.
Data without logistics are not usable for APC.
Sensor may need logistics for measurement (optical sensor).
- ❑ Process step should be known because:
analysing over the whole process could cause wrong results.
- ❑ Time synchronisation between tool data and sensor data is necessary to analyse time critical data and merge the data off-line.

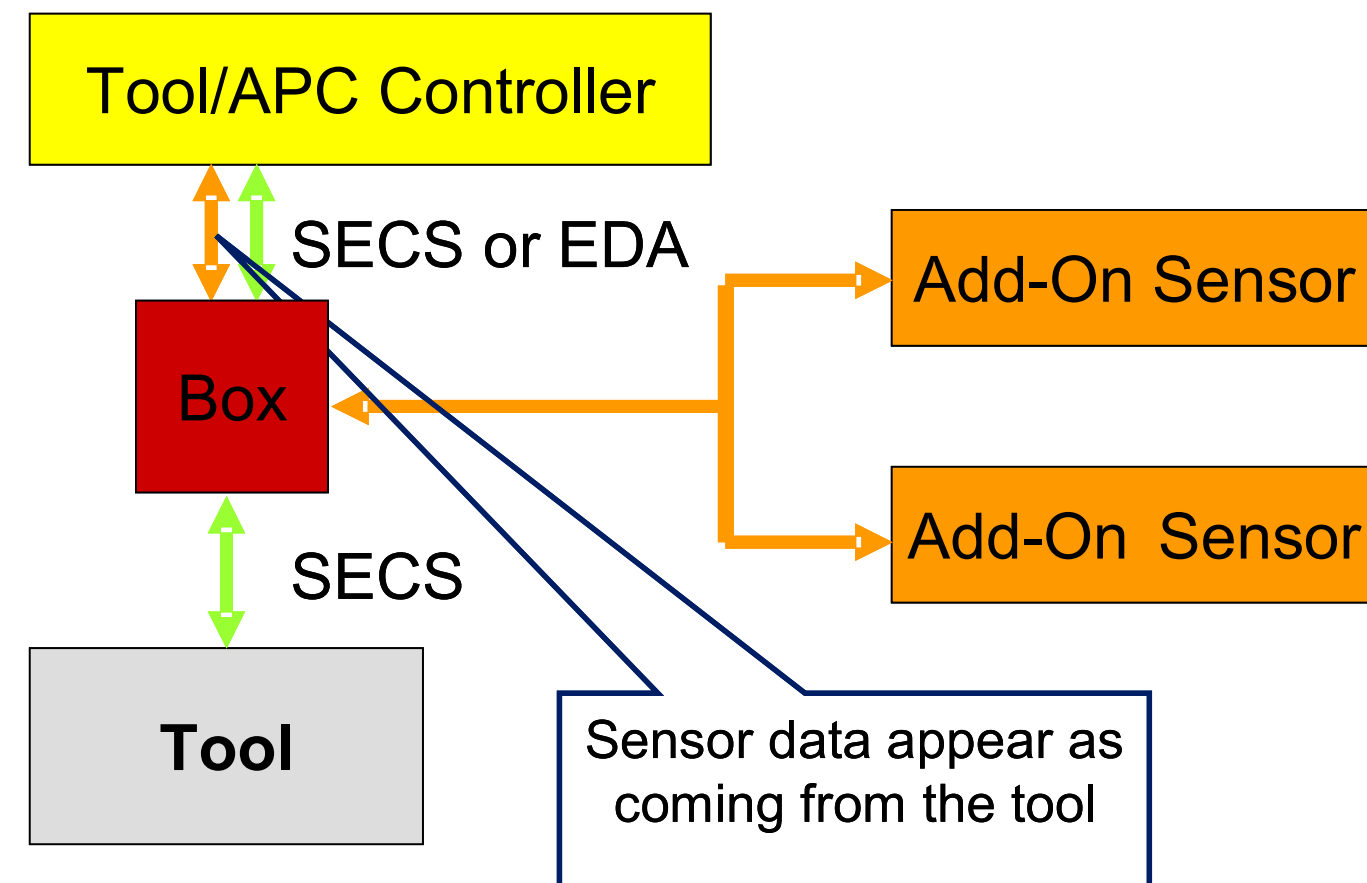
EDA and Sensor Interface



- ❑ EDA interface would be linked to sensor bus and field bus of tool data.
- ❑ The same interface for sensor data and tool data would be usable.
- ❑ The EDA interface does not replace the sensor interface which is necessary to couple the data to the tool.

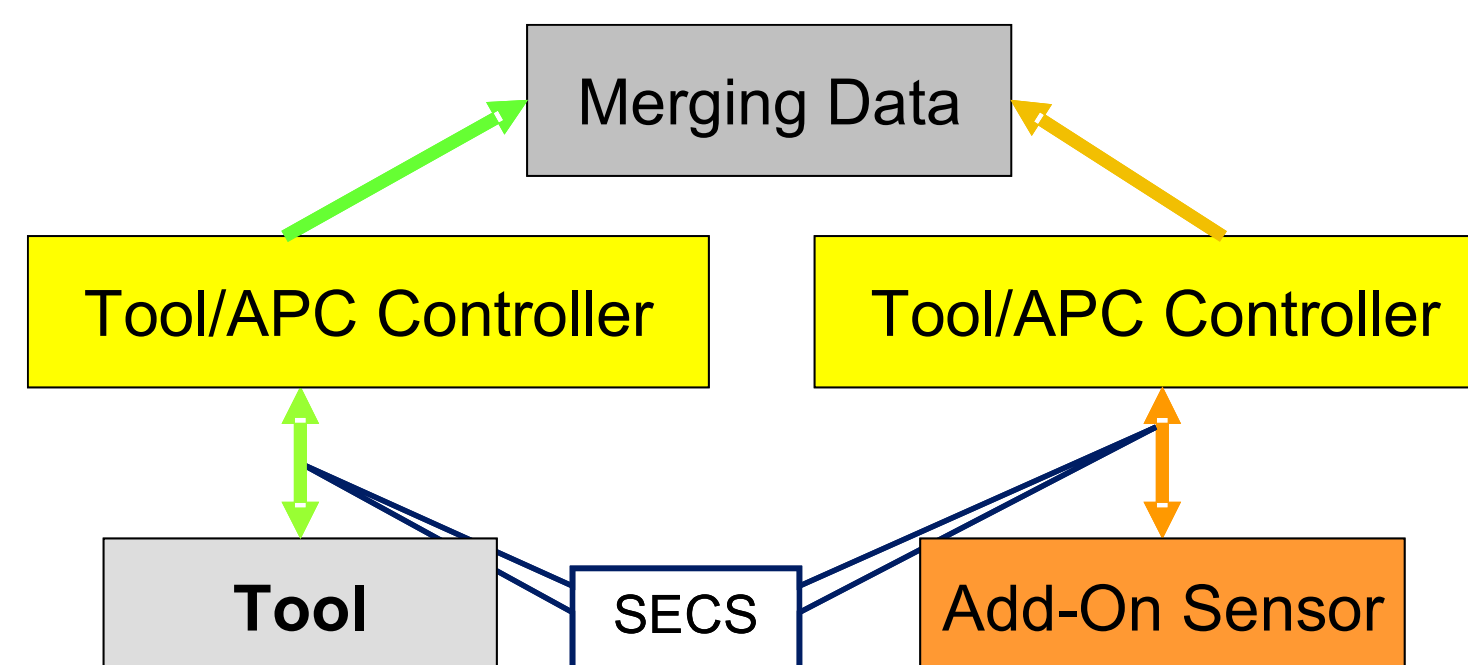
Recent Models applied in Fabrication

Box as SECS path-through



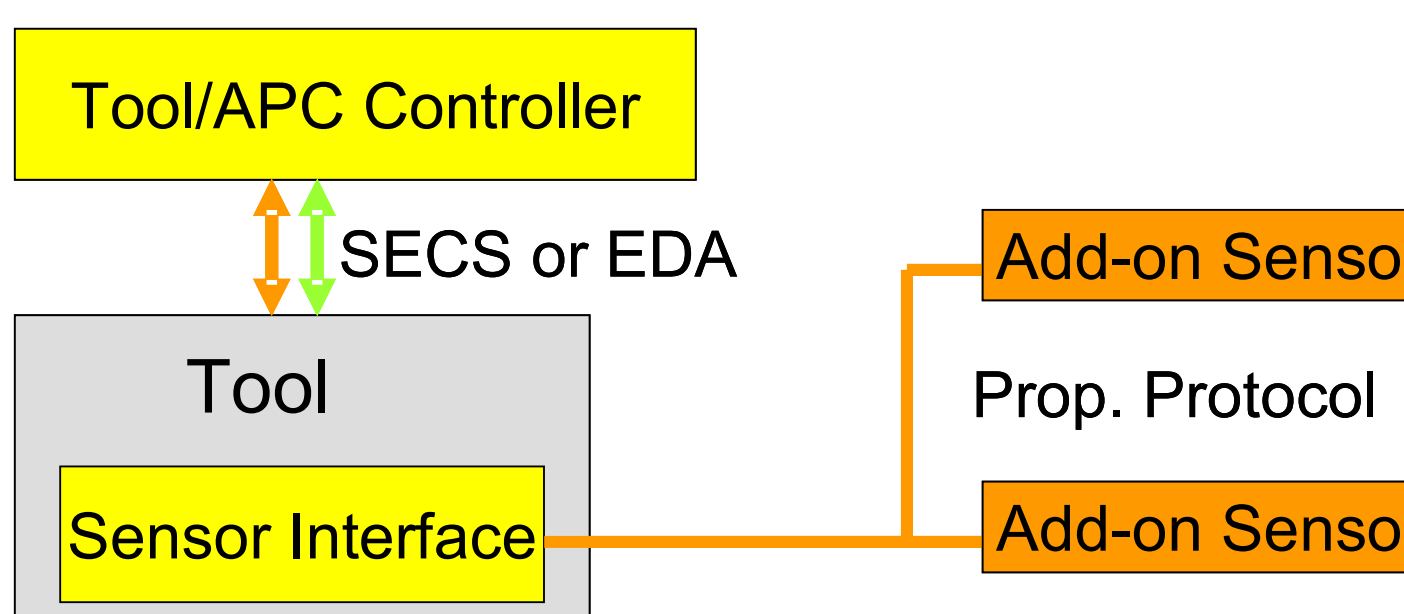
- The box is a host computer working as SECS or EDA path-through.
- The box has a sensor bus with a standardized or proprietary protocol.
- Sensor data and tool data are merged inside the box.
- Boxes integrated in the tool are already available.
- The box solution is recommended for an easy and fast sensor integration.

SECS



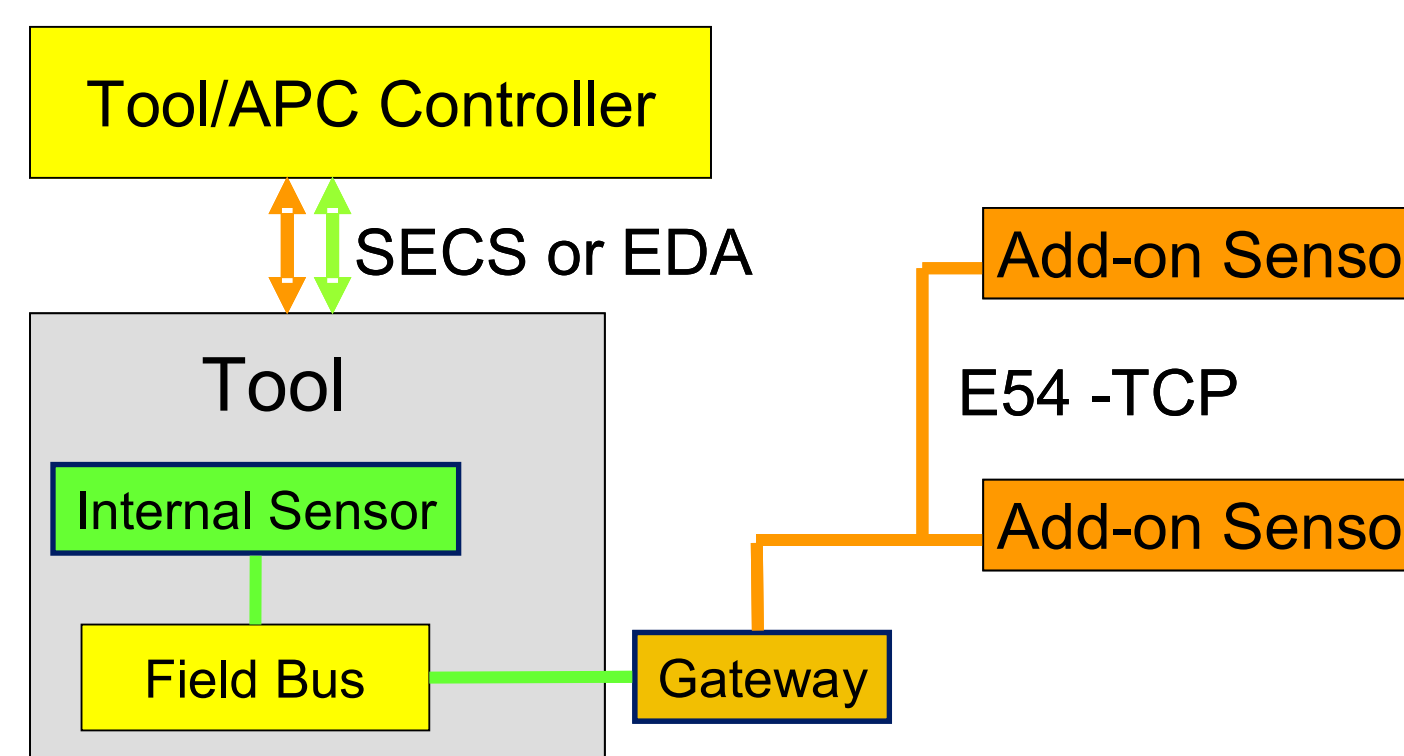
- Sensor has a SECS interface behaving like a tool.
- Transfer of logistics not standardized. A proprietary solution is required.
- Time synchronisation between sensor and tool data is necessary.
- Effort to develop host program and data merging is required.

Proprietary Sensor Interface



- Few equipment suppliers offer a sensor interface, e.g., LAM.
- No further effort to integrate an add-on sensor if sensor supports the protocol.

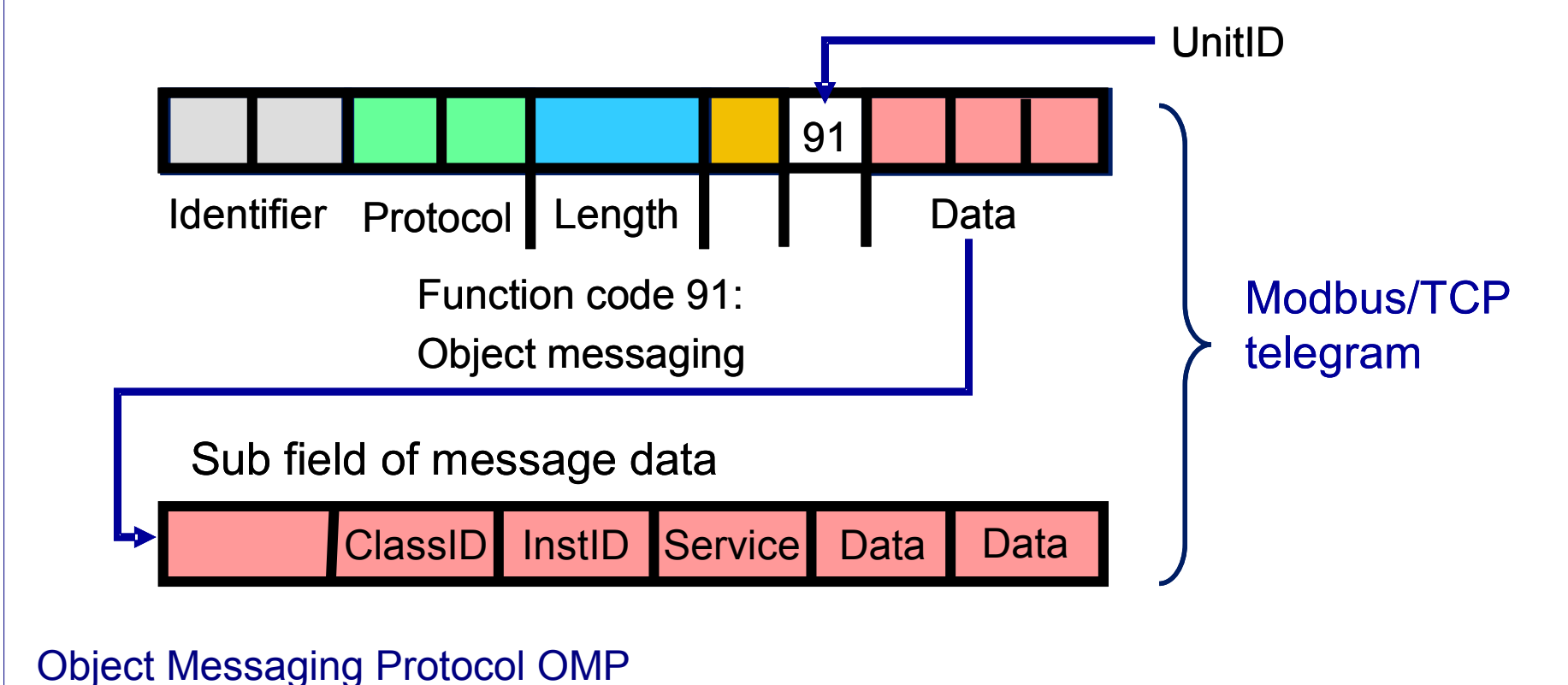
Internal Sensor Bus of the Tool



- The internal field bus of the tool is expanded by a gateway.
- The gateway is connected to a Sensor Network.
- No logistical data available because the field bus does not support the logistic transfer.

Applicable Communication Standards according to E54

Modbus/TCP E54.9

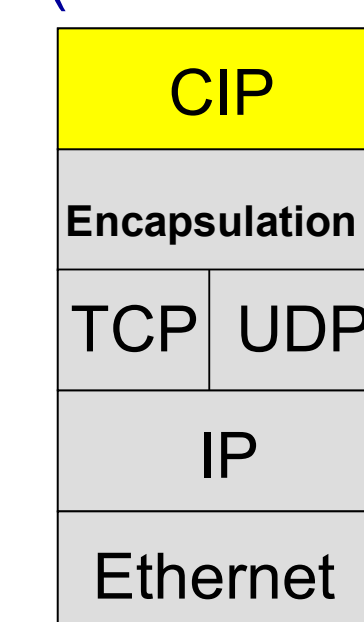


Object Messaging Protocol OMP

- ❑ Add-on sensors are connected to a Modbus network.
- ❑ The network is managed by a host which is not connected to the tool.
- ❑ Caution: Modbus does not mean compliance to E54 automatically.
- ❑ Object Messaging Protocol should be supported (FC 91).
- ❑ The effort required for implementation is lower than for Ethernet/IP.

Ethernet/IP E54.13

- ❑ Transfer of control and information messages
- Control message: short, fast, unacknowledged message transferring real-time data, e.g., sensor data. Transfer via UDP.
- Information messages: longer, error ensured, non-real-time message, e.g., configuration and diagnostics. Transfer via TCP.
- ❑ CIP makes use of abstract object model.
- ❑ Consumer – Producer Architecture:
Producer sends messages as a broadcast. The interested consumers read the message.
- ❑ Sufficient functionality implemented
i.e., time stamp, heart beat, ...
- ❑ Configuration is carried out via a device description file (EDS Electronic Data Sheet).



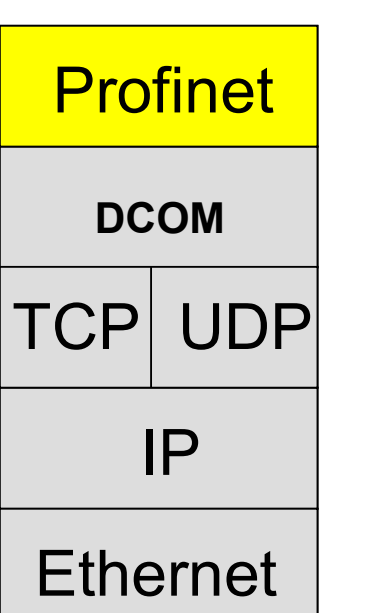
Layer model of EIP

The coupling of Ethernet/IP to DeviceNet is very easy due to the same protocol behind – CIP. Most tools use DeviceNet as internal field bus. An implementation of an external sensor network would be easy.

CIP - Control and Information Protocol

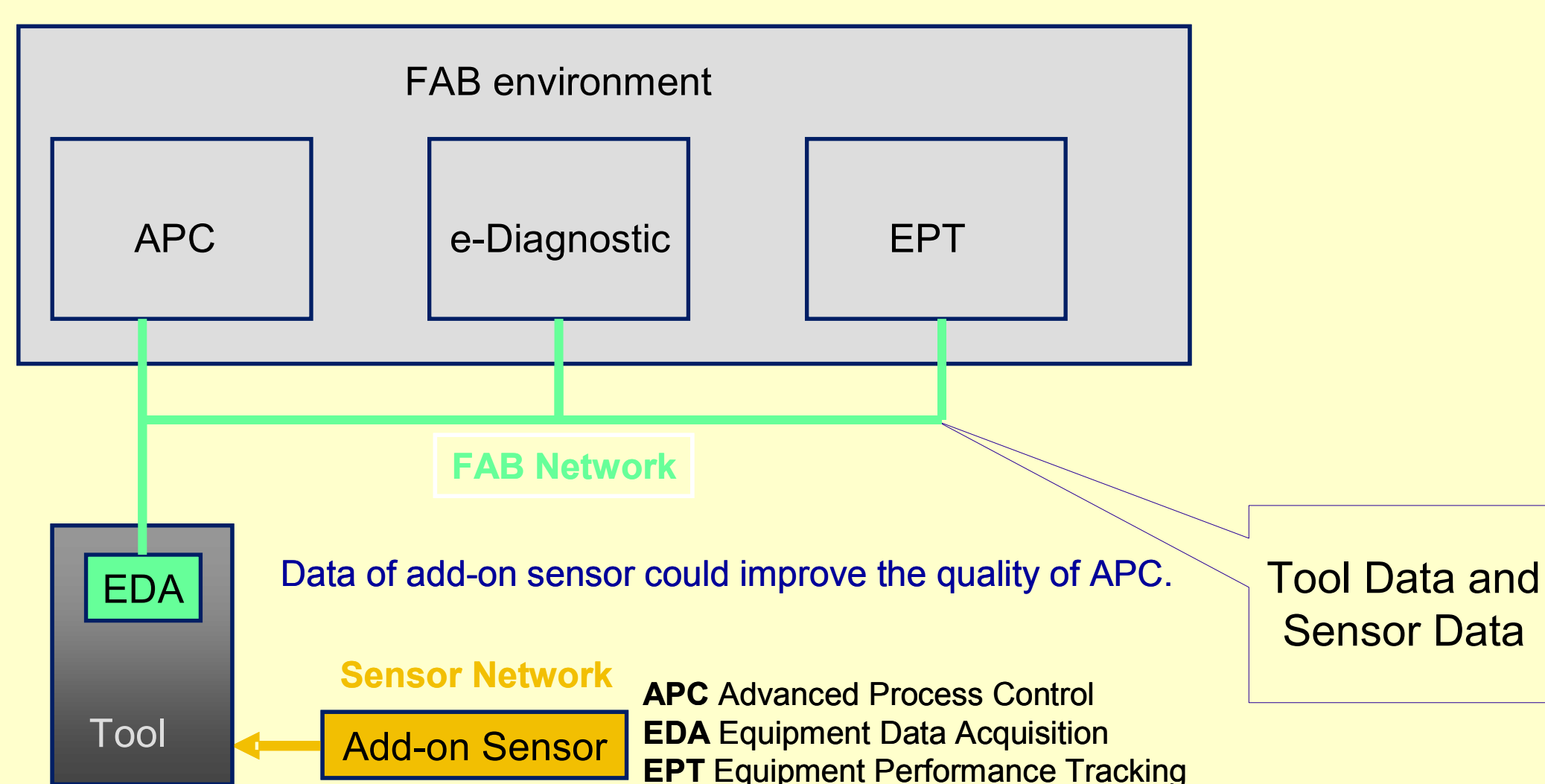
Profinet E54.14

- ❑ Consumer – Producer Architecture is based on Profibus DP.
- ❑ Profinet allows direct interfacing of decentralized sensors on the Ethernet.
- ❑ Configuration is carried out via a device description file (GSD).
- ❑ Coupling with Profibus via a proxy is possible.
- ❑ Sufficient functionality for use in semiconductor production has been implemented.



Layer model of Profinet

Add-on Sensor in FAB Environment



Data of add-on sensor could improve the quality of APC.
Tool Data and Sensor Data

APC Advanced Process Control
EDA Equipment Data Acquisition
EPT Equipment Performance Tracking

Summary

- ❑ APC without using data of smart sensors will not reach higher quality.
- ❑ Manufacturing tool must be equipped with a sensor interface to connect add-on sensors in future. Tool specification has to be changed.
- ❑ The sensor interface of the tool must be based on Ethernet in compliance with SEMI E54.
- ❑ Sensor data and tool data unifying the process tool is the best solution.
- ❑ The EDA interface must deliver tool data and sensor data together. The sensor data appear as coming from the tool.
- ❑ Tools with sensor interface for add-on sensors are available, e.g., LAM.
- ❑ The Box meets the demands on a sensor interface. The installation is very easy.