



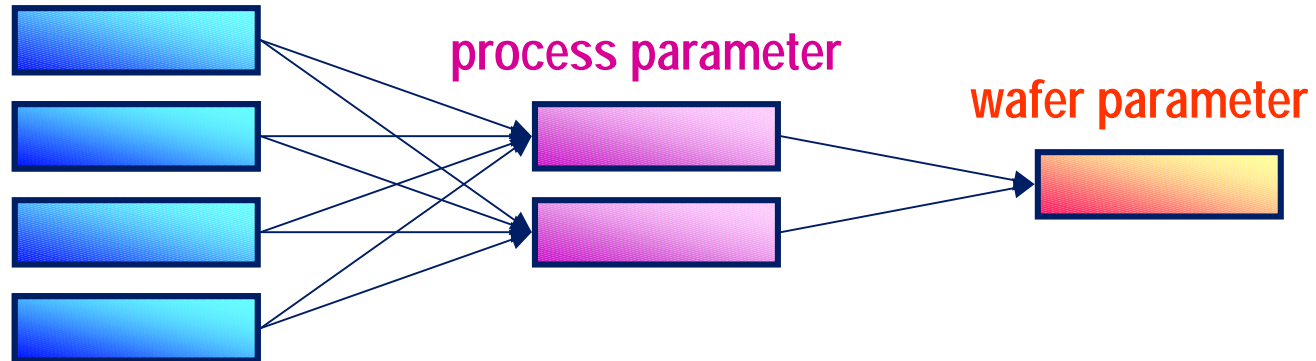
Concepts of Plasma Data Analysis and Equipment Coupling

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Tool and process parameters

Measurement of complex process parameters

tool parameter



Monitoring of complex process parameters, indicating tool and wafer conditions (e.g., endpoint time or plasma parameters) reduce the number of parameters, checked regularly.

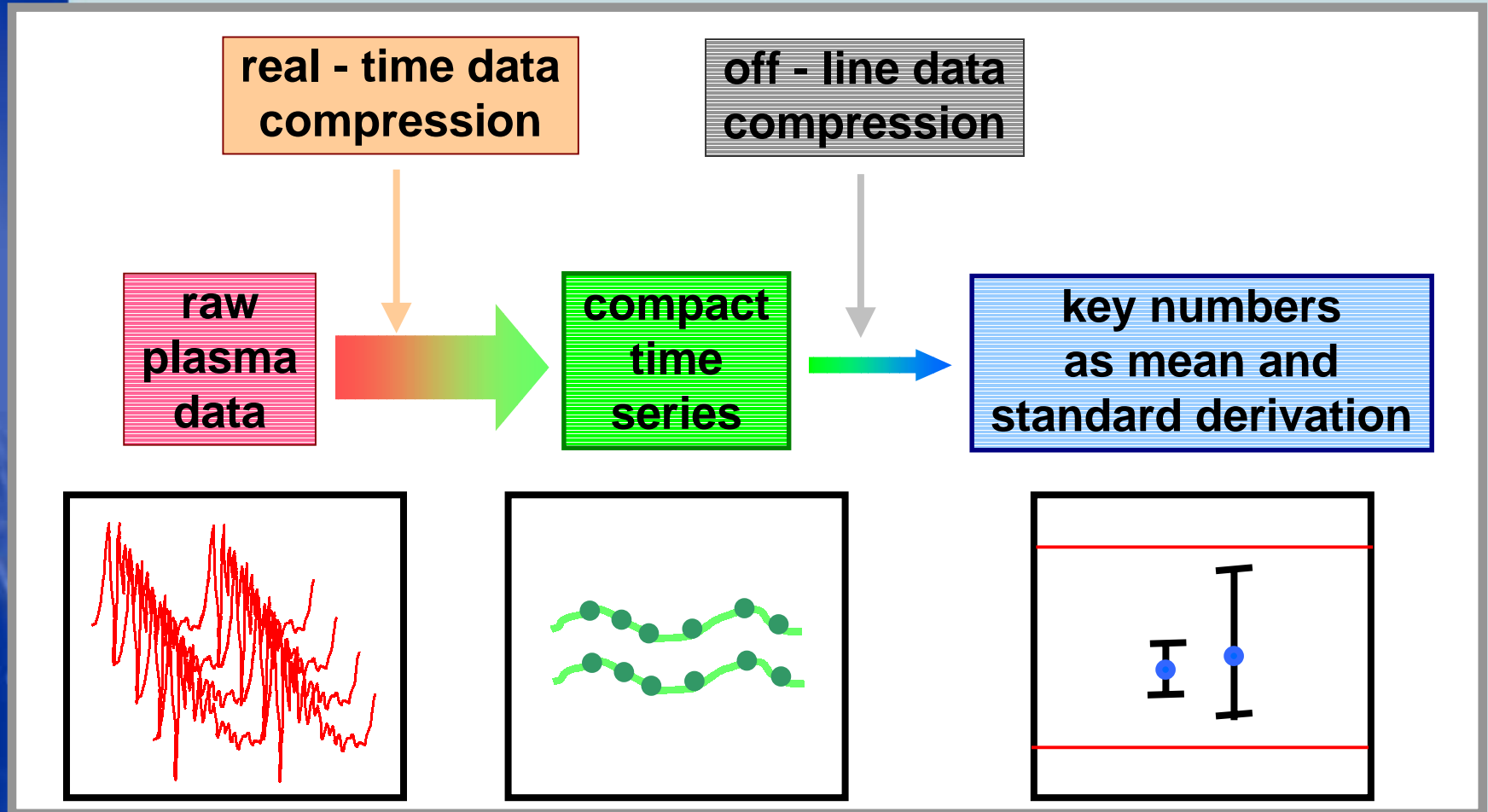
Stable values of these complex process parameters indicate stable process condition.

In case of process variations additional analysis of tool and wafer parameters is needed to identify the reasons in detail.

Source: U. Nehring, et.al. (Infineon Dresden), 2nd Workshop of SEERS, Dresden, Germany, 2000.

Fundamental APC data concept

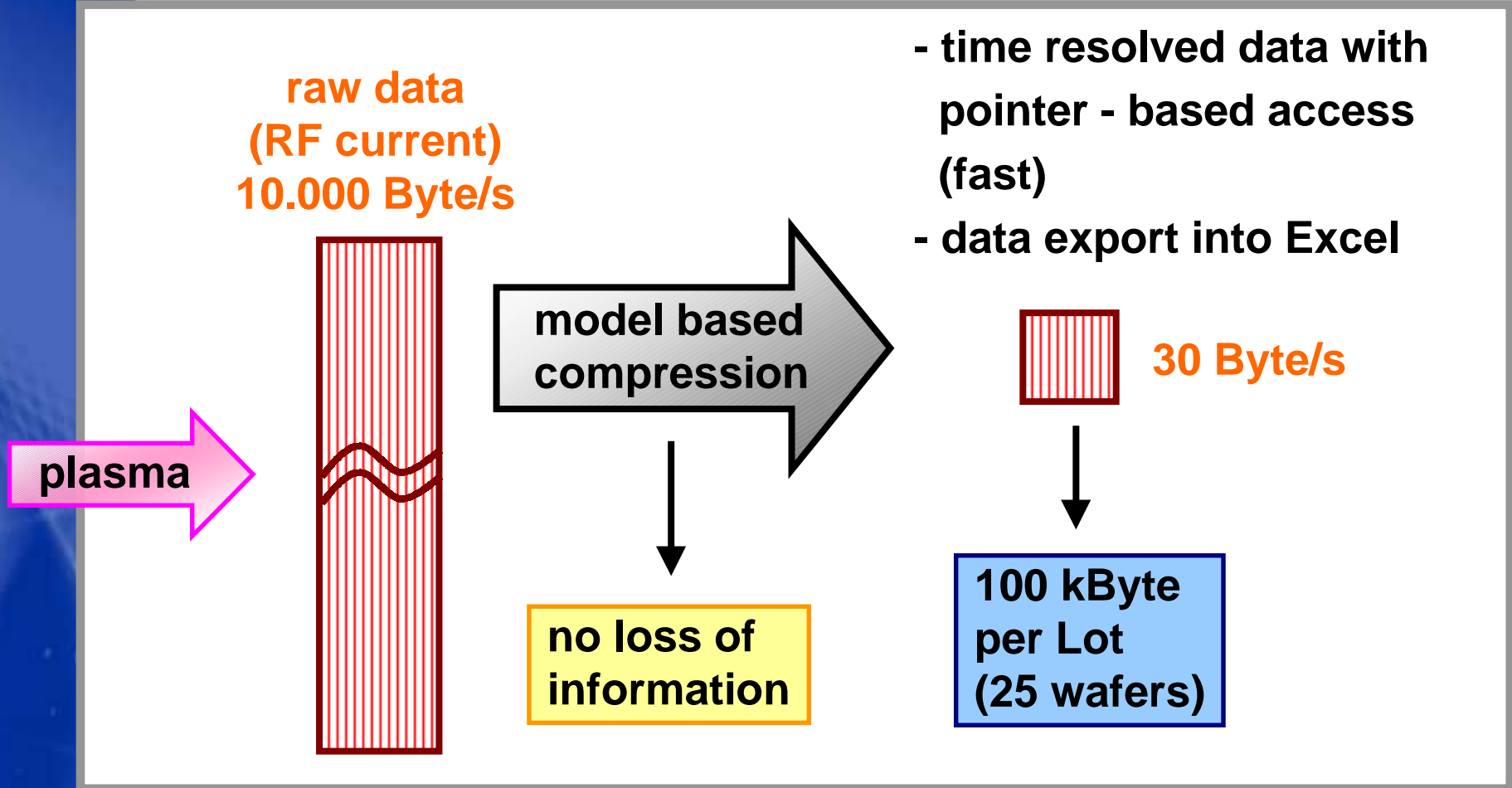
Two step data compression by Hercules





Real-time data compression

Data compression of physics



Motivation of Equipment Coupling



- link logistical data (LotID, ToolID, Step, etc.) to sensor data
- unification of data streams of the tool and the sensor

sensor is coupled with the tool

Fault detection and APC possible

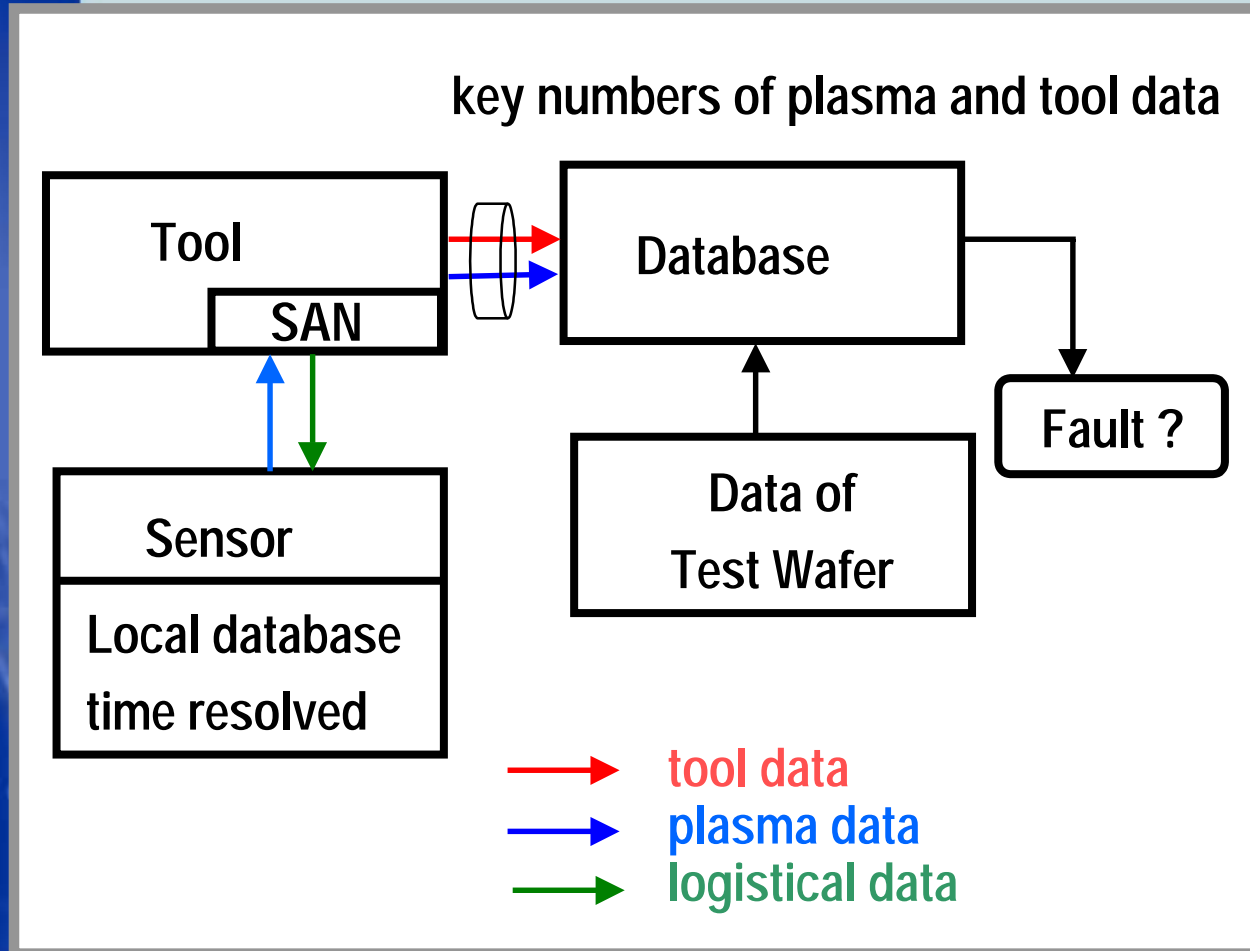
Equipment Coupling

- the basic requirement for APC and fault detection

Add-On-Sensor

- necessary to get process relevant data

The Aim of Equipment Coupling



SAN integrated in the tool
unification of data streams in the tool
only key numbers of relevant data are stored

→ data compression!

in case of detected fault - time resolved data for deeper analysis

ADVANTAGE: plasma data integrated in the tool data

SAN: Sensor-Actuator-Network

Equipment Coupling Concepts of Hercules




1. SECS
2. Brookside's Hercules option
3. TICS (Infineon-Standard) one way connection, only logistical data
4. LAM - pnp - Sensor Interface
5. Silverbox
6. Data transfer using analog interface
7. **S**ensor-**A**ctuator-**N**etwork: Modbus

SEMI-Standard E54

- Modbus/TCP is one of 5 possible network communication standards

- SAN is not yet implemented in the etch-tools

 has not found wide application yet

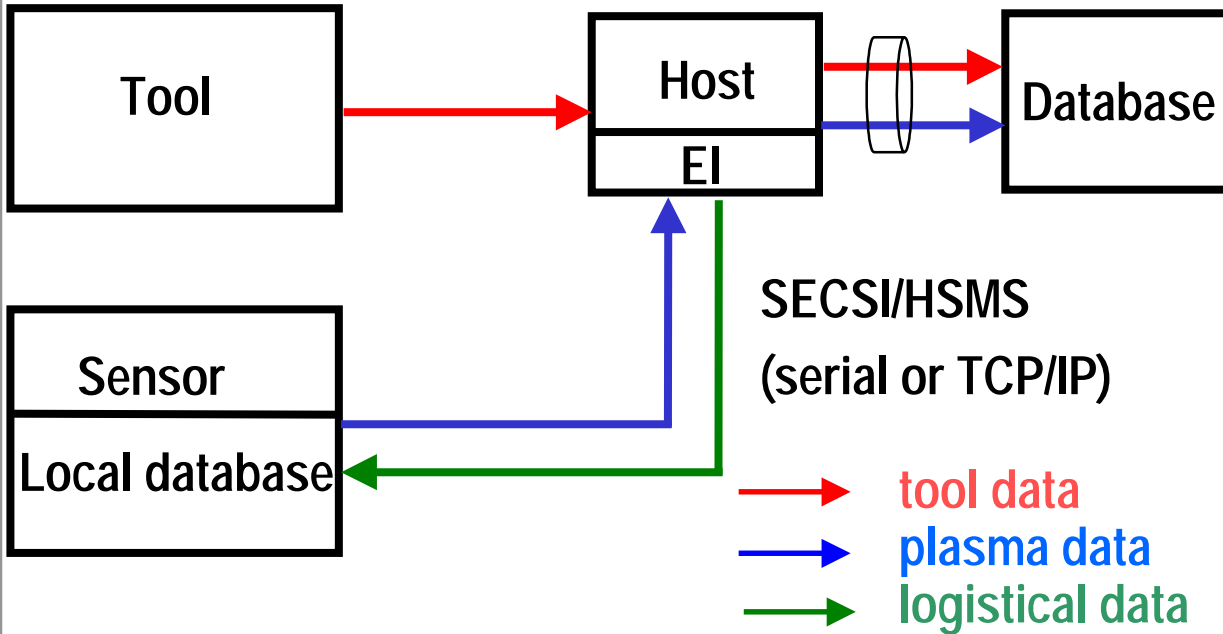
SAN: Sensor-Actuator-Network



SECS II

SEMI Standard E5

a few commands supported, not GEM compliant

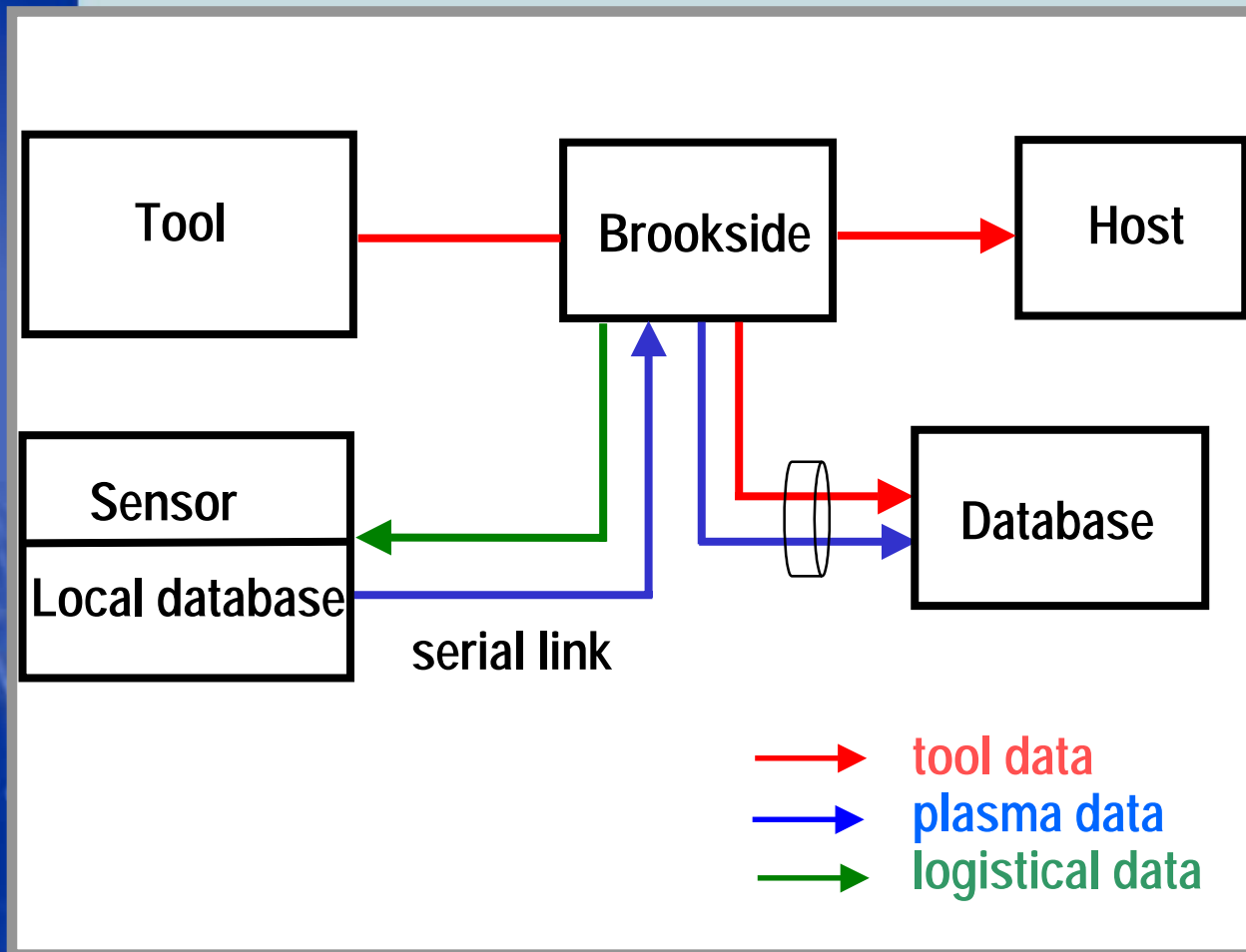


- for each sensor one Equipment Interface (EI)
- transfer of sensor data by data tracing

PROBLEMS:

- data unification
- step information delayed
- time synchronisation of tool and sensor to reduce delay

Brookside's Hercules Option



data exchange via Brookside's „Hercules interface“

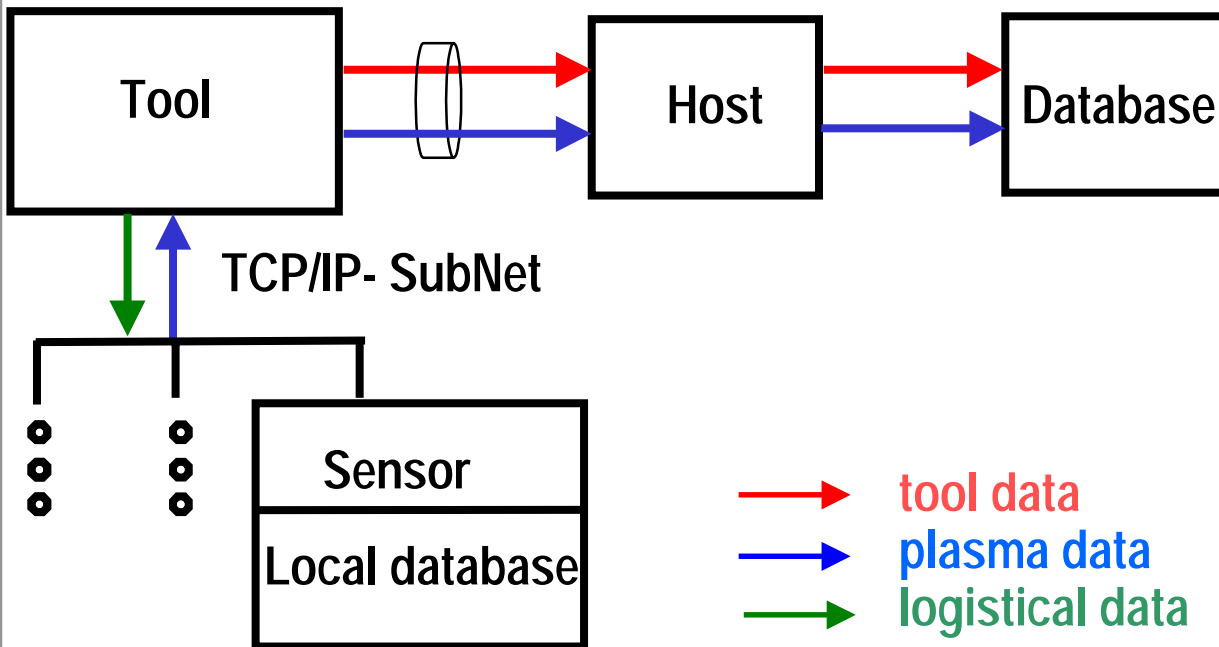
- step information included
- Brookside contains all tool data and plasma data

ADVANTAGE: fast and easy implementation

LAM - PnP Sensor Interface

Plug and play Sensor Interface

First implementation of a sensor interface into a tool



similar to the SAN

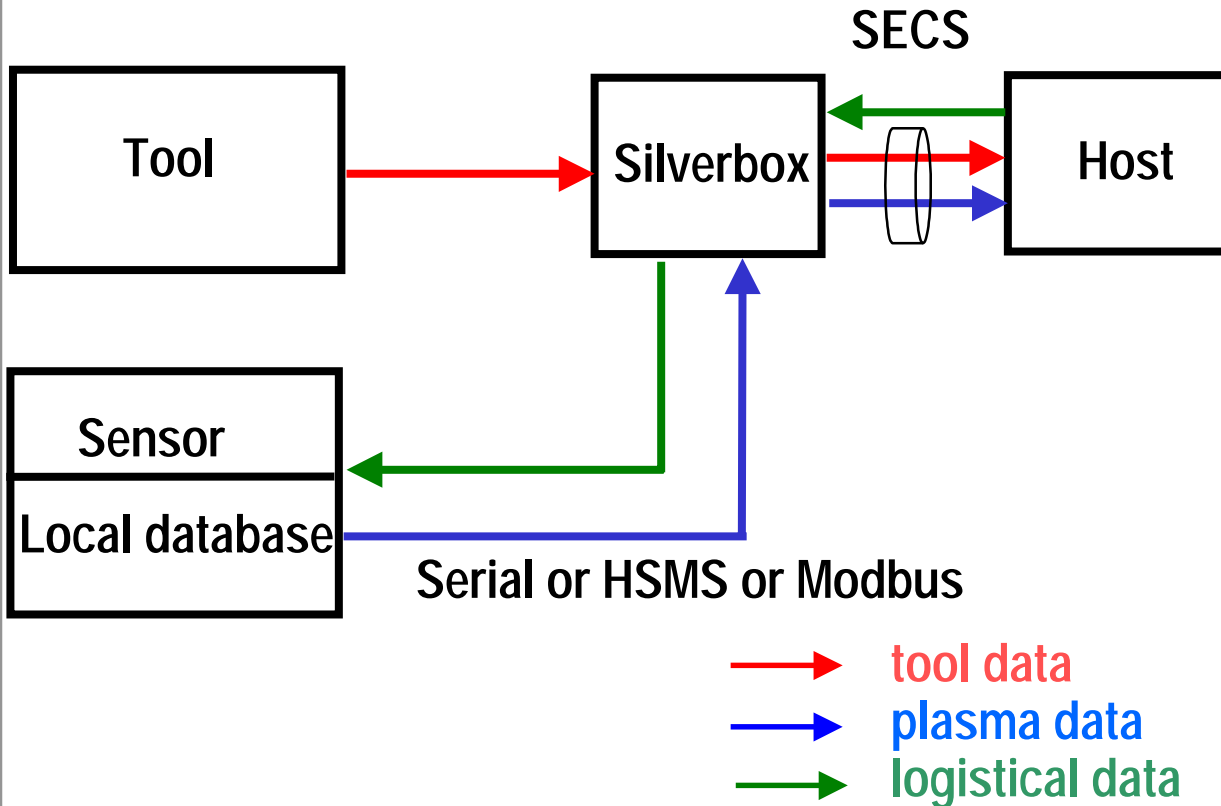
best available solution
for sensor integration

all data are unified in the
tool

Silverbox or other



SECS-path-through with sensor interface



„SECS-relay“ with integrated sensor interface

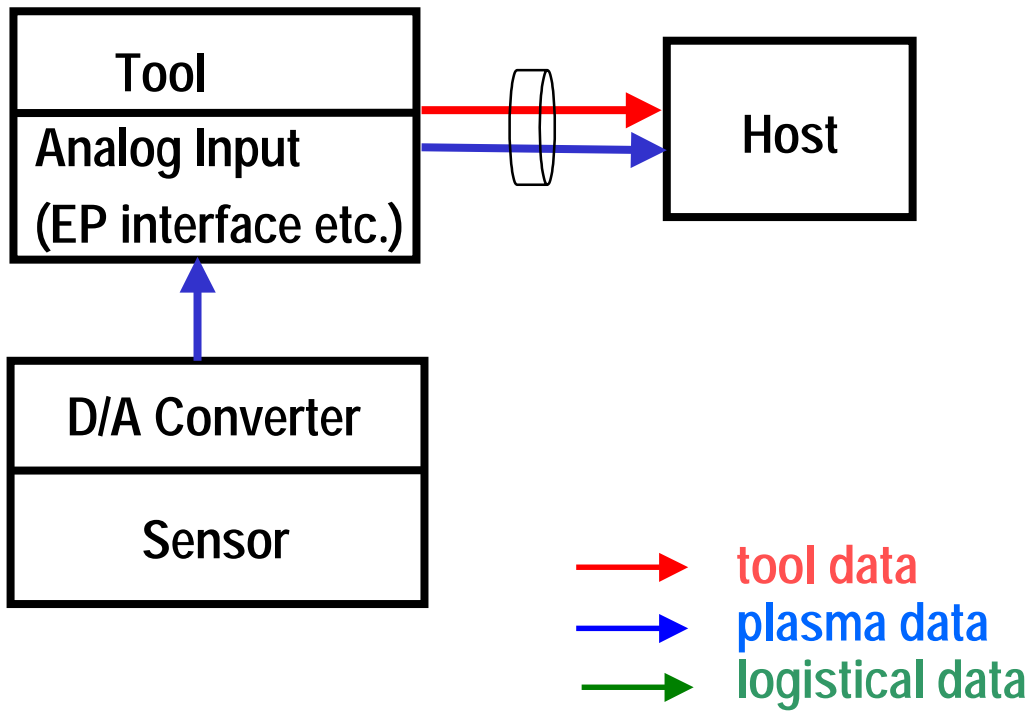
pre-filtering of the data possible

supports more than one sensor

easy implementation



Analog Data Interface



data unification in the tool

tracing of plasma data via SECS-Interface of the tool possible

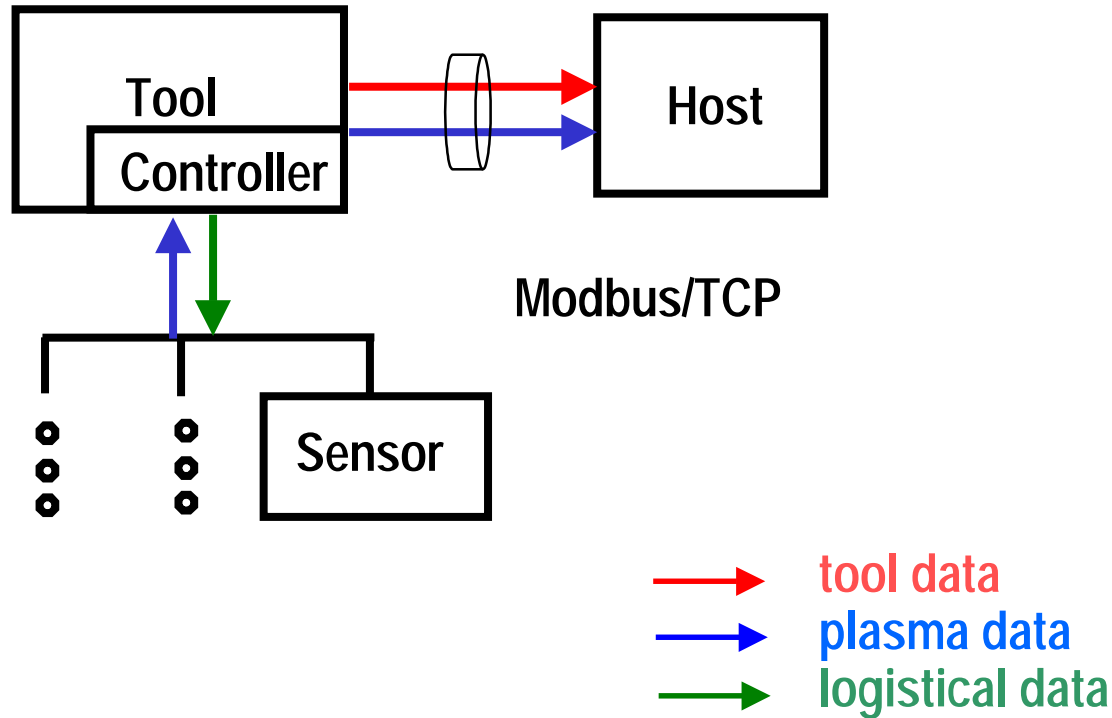
quick and easy implementation

DISADVANTAGE:

- restricted resolution
- data range is limited

SAN (Modbus)

Modbus SEMI E54

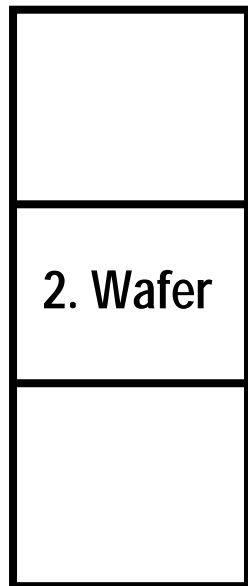


Common Network Communication Standard (NCS): TCP

- more than one sensor
- Plug and Play
- link to tool data including logistical information
- data unification in the tool
- Will be Modbus the solution of the future?

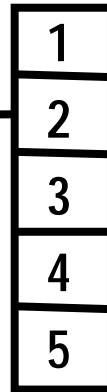
Local Data Base of Hercules

Lot_name.hpl



Data-file (resolution 1s)
fast access

Lot_name.hdx



Index-file

direct access to
information

Pointer based byte format:

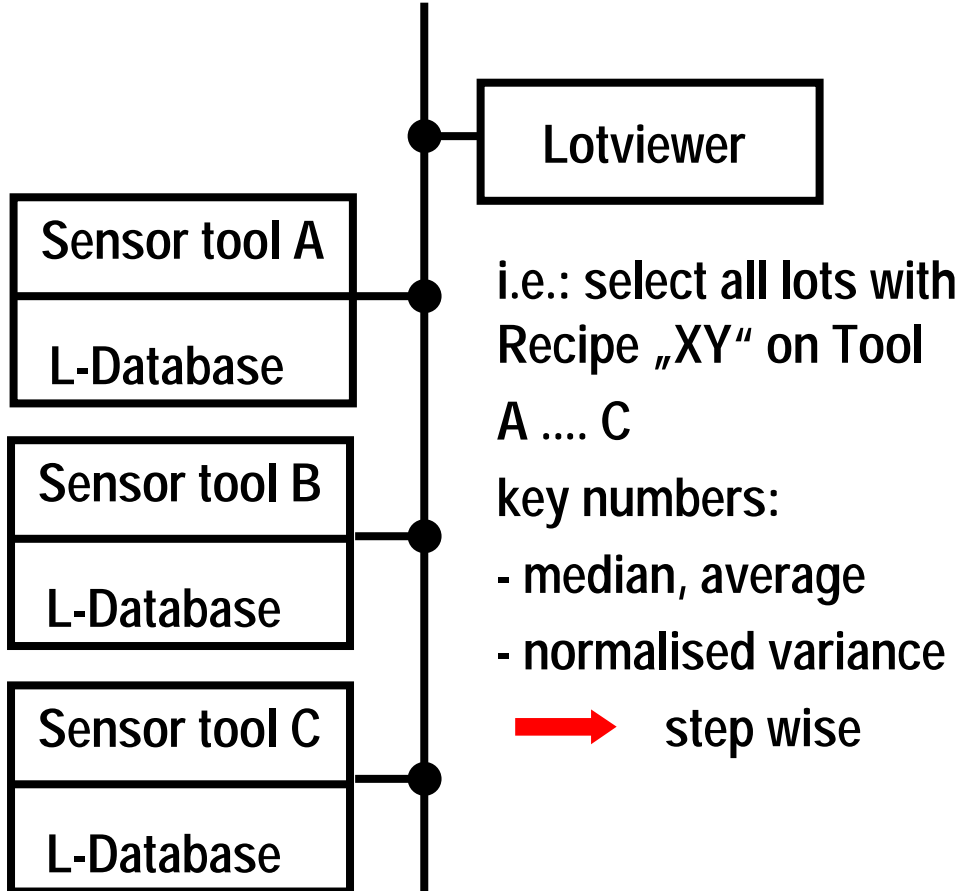
- data compression (for time depended raw data, ASCII is not recommended)
- fast access
- easy unification of plasma data of different sources
- data selection by logistical data
- export to ASCII/Excel

Local solution is important for:

- backup
- deep analysis in case of faults
- time resolved data



Lot Viewer



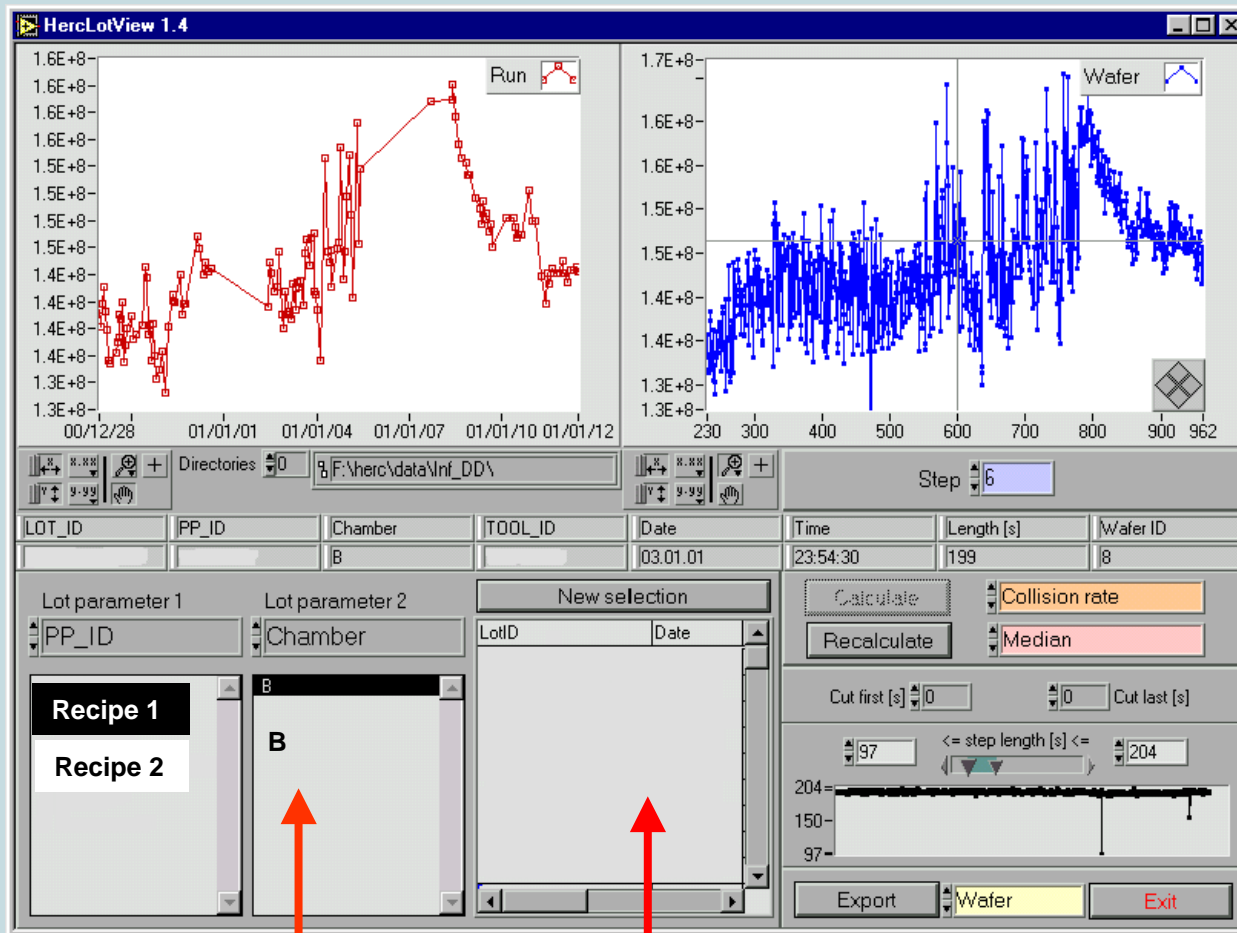
- fast access to plasma data
- trend analysis on the basis of statistical quantities
- key numbers for each wafer
- select wafer by WaferID within a lot → wafer tracking possible
- Export → ASCII

selection criteria:
 LotID
 RecipeID
 ToolID
 Chamber
 Recipe Step



Data handling by Hercules

Hercules LotViewer



Selection of logistical data Selected runs (lots)

Comparison of Data Coupling



	Logistical Data	Step Information	Plasma Data Transfer	Recommended
SECS	x	x^{*)}	x	(x)
Brookside	x	x	x	x
TICS	x	x^{*)}		
LAM-PnP	x	x	x	x
Silverbox	x	x	x	x
Analog Interface			x	
Modbus	x	x	x	x

^{*)} temporal delay