

# The Future of MEMS chip testing

JUNE 5 - JUNE 6, 2019

## Welcome!



# A warm welcome to our guests!

**TERADYNE**

**SRON**  
Netherlands Institute for Space Research

**elmos<sup>®</sup>**

 **Cohu**

**MINDCET.**  
Custom  
Integrated Power  
Management  
Solutions

**TMC** | PEOPLE  
DRIVE  
TECHNOLOGY

 **boschman**  
advanced packaging technology

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**UNIVERSITY  
OF TWENTE.**

**LioniX**  
INTERNATIONAL

 **NATIONAL  
INSTRUMENTS<sup>™</sup>**

 **MARVIN TEST  
SOLUTIONS**

 **Bronkhorst<sup>®</sup>**

**PHILIPS**  
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**Sensata**  
Technologies

**SAXION**  
HOOGESCHOOL

  
**MASER**  
ENGINEERING

**Chroma**

 **NEWAYS<sup>®</sup>**

 **Solidus Technologies, Inc.**  
MEMS Test Equipment & Semiconductor Engineering

# Salland Engineering at a glance

## Test Application Solutions

- *Fast & Qualified new product introduction*



## ATE Instrument Solutions

- *Industrializing your Test Solutions*




## Supply Chain & Test Services

- *Delivering qualified Parts, Products & ATE Solutions*



# Last year: Launch *Test Technology Center*

*Advanced test production including engineering support*

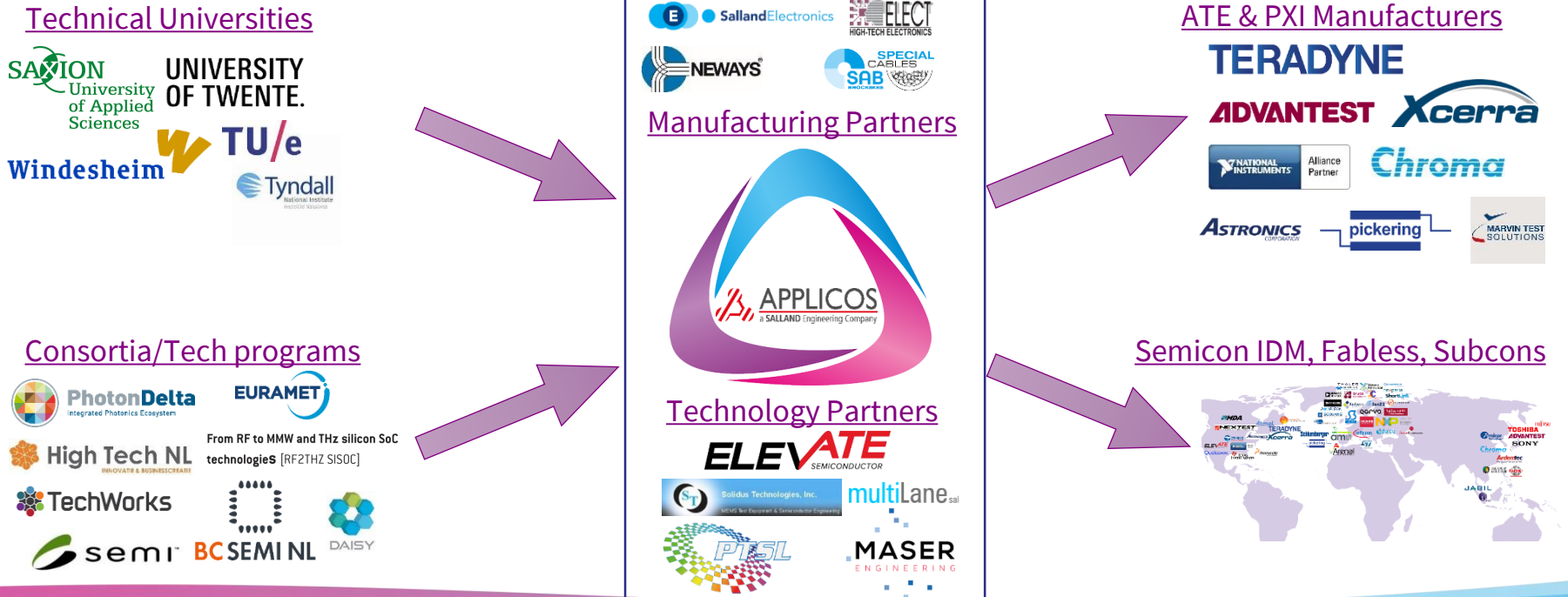
- Development of “fundamental test technology”
- Acquisition of  **APPLICOS**  
a SALLAND Engineering Company
- Cooperation with Technical Universities
- Working on new test technology for
  - ▶ IO and (HV), DPS Core’s
  - ▶ MEMS, RF/Radar, SerDes, Photonics
  - ▶ Tooling to make Test & Instrument engineering easier
- Deliver testsolutions to
  - ▶ All key ATE players
  - ▶ Many semiconductor companies

**UNIVERSITY  
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# Our role in the Test Technology Eco system...

*Close cooperation with end customers and partners to deliver solutions that work*



# ...Makes us Partner of industry market leaders





# Supply Chain & Test Services

PCB design, Manufacturing and low to mid volume Production Testing

# Sample and (medium) volume production test

*With extensive engineering support*

## We offer

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- **Seamless Product Qualification**
  - ▶ According to JEDEC & Q100
- **Sample & Production test**
- **Product Engineering**
  - ▶ Data, yield analysis → optimization, test
- **Direct engineering NPI support**
  - ▶ Mature process parameters
  - ▶ Fast & advance analysis

## Our capacity & capability

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- **Equipment available for**
  - ▶ Engineering & Qualification (NPI)
  - ▶ Production test
- **Turn Key processing**
  - ▶ Testing, Go/NoGo
  - ▶ Retest & QA cycle's
  - ▶ Temperature cycle & read points
  - ▶ Packaging: bake, sealing
- **Reporting**



# Supply Chain & Production Test Services

*Quick, Reliable & Independent Production Test including Test Engineering*

## ATE equipment

Teradyne UltraFLEX 24-slot

- ▶ RF UltraWAVE24

Teradyne UltraFLEX 12-slot

Teradyne FLEX-RF &  $\mu$ FLEX

Teradyne J750

- ▶ 1024 channel head

**Exploring other platforms**

## Handling equipment

TEL P-12XLm prober

- ▶ 6, 8 & 12" with hot chuck

TSK - UF200 prober

Chroma 3160C

- ▶ Production handler 3-temp.

Exatron 903, Esmo Talos

- ▶ Engineering handler 3-temp

Thermonics T-2500E

## Services

Final (sample) testing

Wafer test at 6, 8 and 12"

Characterization

Quality & Reliability analysis



# New technology development

*Tooling and Test Technology that cover the real needs..... Will be available as OEM blocks*

- **Data Analysis tool for quick and advanced Analysis**
  - ▶ Made by the inventors & creators of SEDANA
  - ▶ Tooling for both Application and Instrument Engineering
    - Quick analysis of large amounts of data
    - Easy site/channel correlation & investigation → find the “needle in the haystack”
- **High Density, low-cost Pin channel up to 500MHz**
- **Extreme low Current and low Capacitance test circuitry**
- **High Voltage DPS/VI to address 80V and higher**
- **SerDes test modules up to 100<sup>+</sup>Gb (PAM4/x)**
  - ▶ Including ATE-drivers, integration and application support
- **Exploring new technologies together with our partners**
  - ▶ Photonics testing
  - ▶ **MEMS Testing without physical stimulus, incl. correlation/validation service**

# Data Analysis Tool 'DPLUS'

Easy data analysis for Application and Instrument Engineers

# Positioning of DPLUS

Test Data analysis tool  
to support engineers

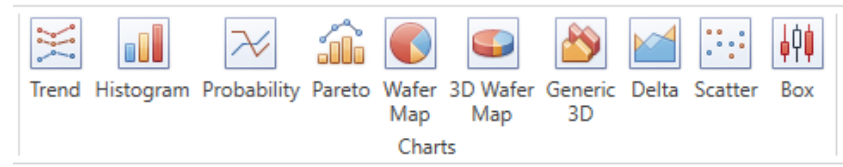
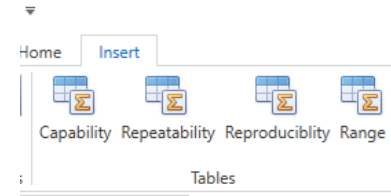
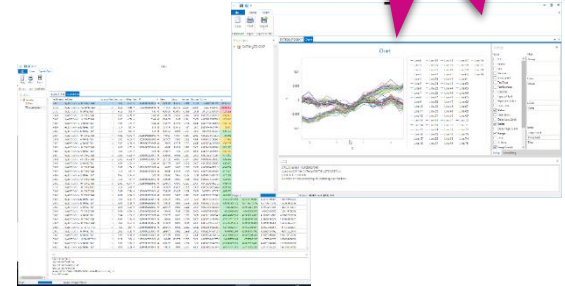


Not for plant optimization  
or process control

# Engineering Data Analysis Tooling

*Easy to find “the needle in the haystack”*

- Focusing on right data
  - ▶ Selection data
  - ▶ Filtering (site, channel, etc.)
  - ▶ Limit management/simulation
- Tables to select main topics
- Graphs to discover trends



# High Level Feature List

Group	Use cases	Result
<b>Reader</b>	Load a dataset and view dataset information	Basic Table
<b>Writer</b>	Export dataset	
<b>Filter</b>	Filter out unwanted information	Filtered Table
	Split dataset using filters	Multiple Filtered Tables
<b>Limit</b>	Create and edit limit set	Limit Table
	Applying a limit set	Updated raw table, statistics table
	Import and export limit set	
<b>Chart</b>	Create a trend chart	Trend chart
	Use histogram to view distribution	Histogram
	Create pareto summary plot	Pareto chart
	View normality of tests	Probability chart
	Analyze wafer binning	Wafer bin map
	Analyze wafer measurements	Parametric wafer map (3D)
	Compare measurements in 3D plot	Generic 3D plot
	Compare variations between trials and appraisals	Delta chart
	Check consistency of 2 appraisers	Scatter chart
	Compare measurements from multiple data sets	Box chart
<b>Table</b>	Check dataset result	Basic table
	Check test capability	Capability table
	Check test repeatability	Repeatability table
	Check test reproducibility	Reproducibility table
	Custom data set columns	Updated basic table
	Auto detect number of test runs	Updated basic table
	Check measurement variability	Range table
	Change the order of tests in dataset	Updated basic table
<b>Project</b>	Automation of data processing (GUI)	Save as project, load project
	Automation of data processing (CLI)	Command Line Interface

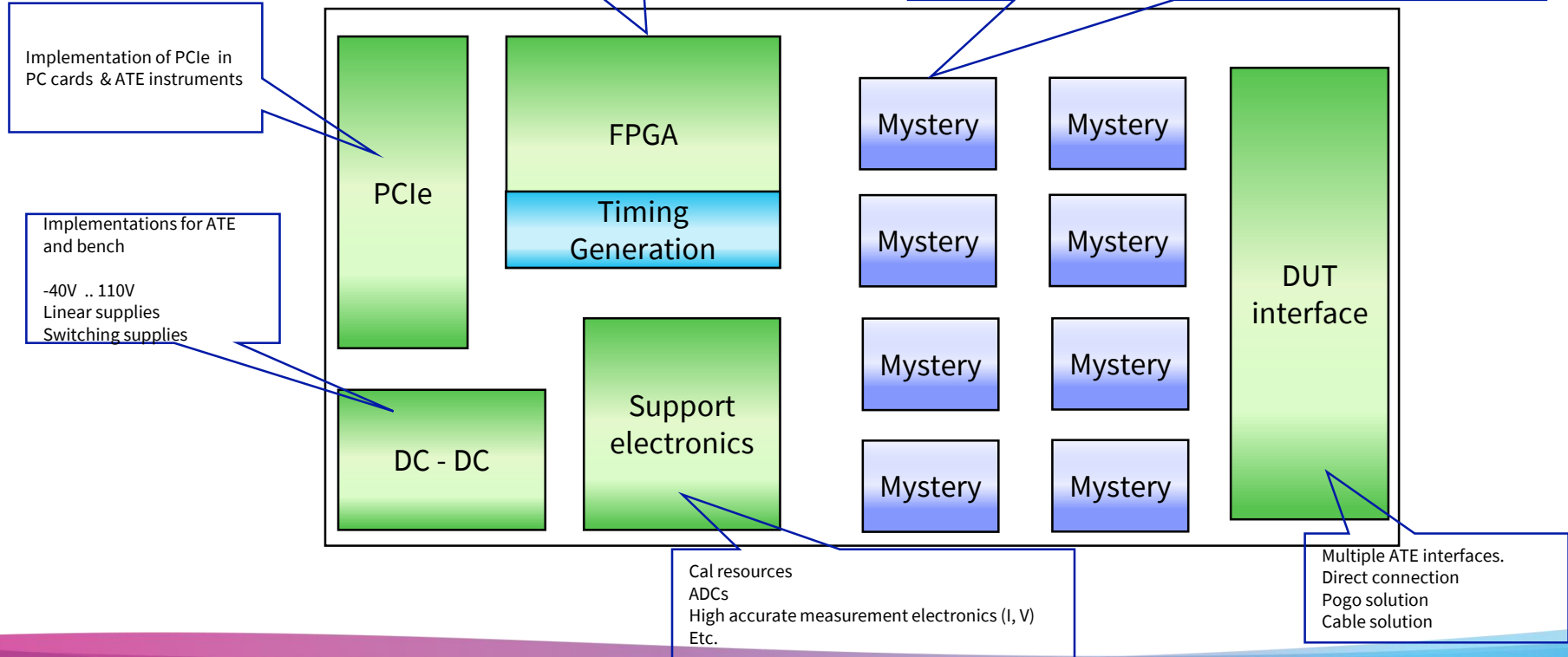
# SE-DPIN

New Salland PXIe Instruments

*Confidential*



# SE experience overview



# SE-DPIN Specification (200+MHz)

- **Pin Electronics Driver/Comparator**
  - ▶ Dual Mode 3-level Driver with Hi-Z Capability (DVH, DVL,
  - ▶ 5 Current Ranges ( $\pm 2\mu\text{A}$ ,  $\pm 20\mu\text{A}$ ,  $\pm 200\mu\text{A}$ ,  $\pm 2\text{mA}$ ,  $\pm 50\text{mA}$ )
  - ▶ Programmable Voltage and Current Clamps
- **Resistive Load Function (5 Selectable Resistor Values)**
- **Per Pin Active Load**
  - ▶ -  $\pm 24\text{mA}$  Maximum Current
  - ▶ - Independently Programmable Current Source, Current Sink, and Commutating Voltage levels
- **Per Pin Timing Deskew**
  - ▶ Propagation Delay Adjustment
  - ▶ 5ns Delay Adjustment Range
- **Per Pin PMU**
  - ▶ FV, FI, MV, MI
  - ▶ 4 Quadrant Operation
  - ▶ 2V to +6V FV/MV Range

# High-Density DPS PXIe board

Concept

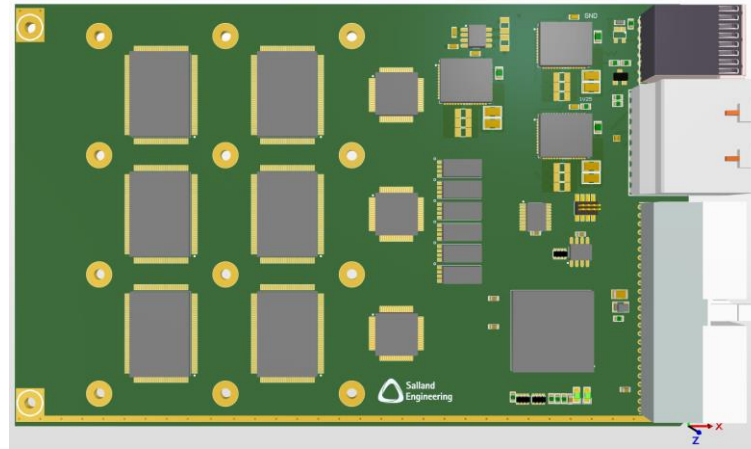
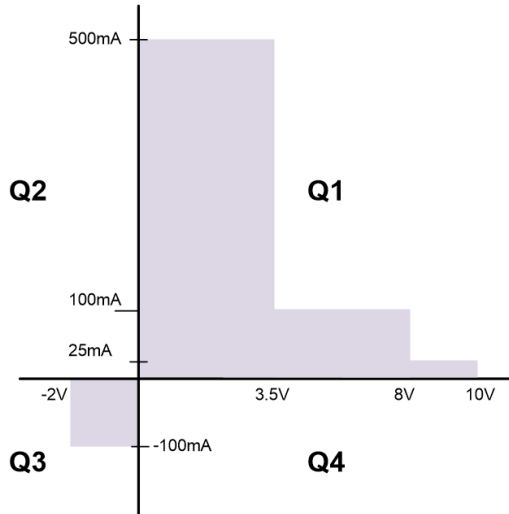


# Preliminary Specification

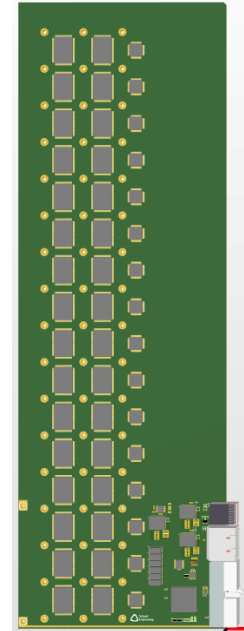
In AXI Format we expect we can fit 192 DPS channels per card. (Power/cooling to be checked)

Specification	Configuration A	
Form-factor	Single slot, 3U PXI	Single slot, 19" PXI
Channel quantity	48 DPS	256 DPS
Connections	48x(HiF, HiS), 6x DGS, GND	256x(HiF, HiS), 32x DGS, GND
Mode	FV, FI, MV, MI, HiZ	
Voltage / Current	10V , 500mA -2V, -100mA	
Ganging I	8 channels	
Channel independency	Yes	
Per channel ADC	Yes	
Voltage and current clamps	Yes	
Max sampling rate	200kSPS	
Capture / Source memory	4k per channel	
Temperature sensor	Per 8 channels	
Protection	Over-temperature alarm Over-current alarm Kelvin alarm	

# SE-DPS concept



Single slot, 3U PXI



Single slot, 19" PXI

Notes:

- Maximum voltage / current not available on all channels simultaneously because of the PXIe slot power restrictions (maximum 82W)
- During instrument development a calculation tool will be provided which supports the user to calculate the actual board power.
- For 19" formfactor assumed there are no restriction in terms of power and cooling capacity

# New technology: Photonics testing

We participate in  **PhotonDelta**  
Integrated Photonics Ecosystem

## Targets photonic eco system

- ▶ Reliable production in the Netherlands
- ▶ Application driven
- ▶ Shared infrastructure

## Targets Salland Engineering

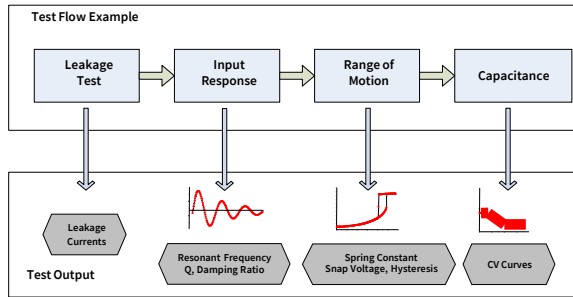
- ▶ Offer Reliable test solutions
- ▶ Instrument development
- ▶ Application support

Nederlands ecosystem



# New technology: Dynamic MEMS Solution

*Best of both worlds!*



## Regular ATE

- ▶ DPS
- ▶ Digital I/O
- ▶ PMU
- ▶ AWG/DIG
- ▶ DUT Power
- ▶ Supplies



## MEMS Solution

### Hardware

- ▶ Pico PMU (pA/nA)
- ▶ Capacitance (pF/fF)
- ▶ External LCR connections
- ▶ Memory/uC to collect and pre-process data (STDF & CSV)

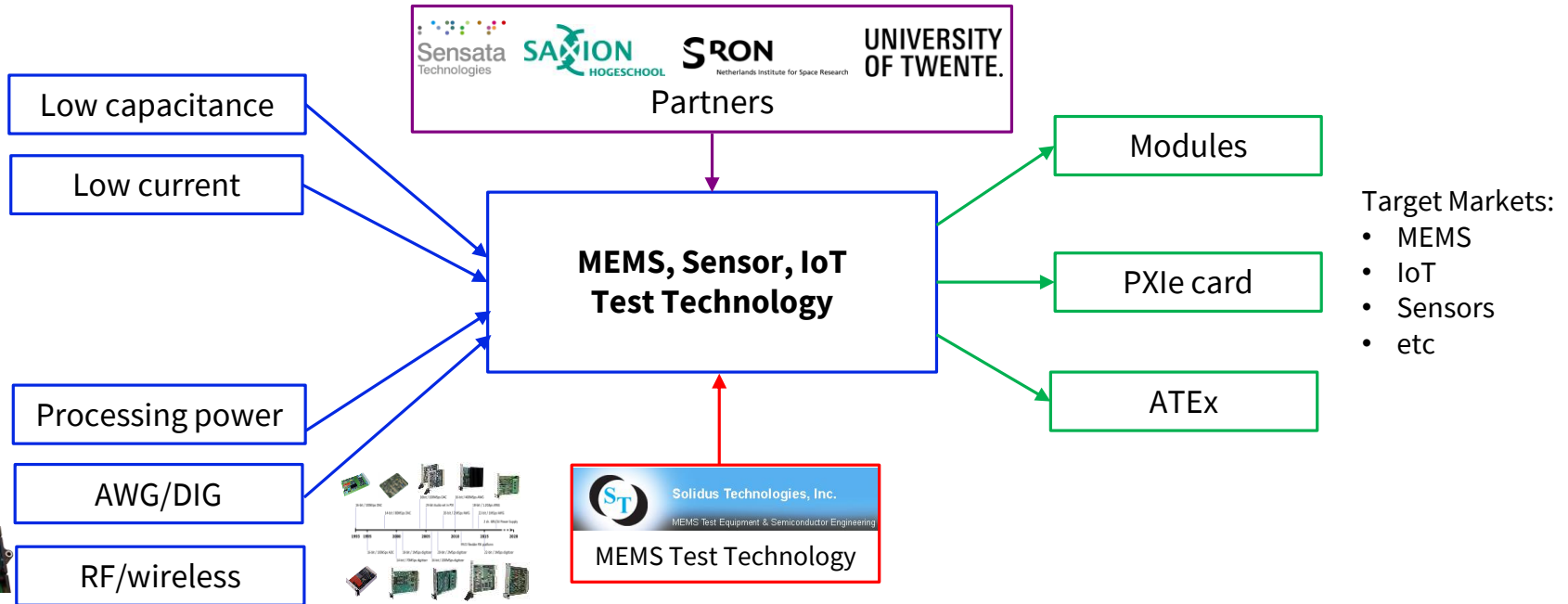
### Tooling

- ▶ Hardware control
- ▶ Data Analysis



# Salland will combine IP to offer new solutions

*Most of the IP is already developed or is ongoing and needs to be combined*



# Agenda Wednesday, June 5

<b>MAC<sup>3</sup>PARK</b> <b>Business Logo</b>	12:00-12:45	Registration & lunch buffet	
	13:00 - 14:30	Session 1 - MEMS GENERAL	
	14:30-14:45	BREAK	
	14:45 - 16:15	Session 2 - MEMS TECHNOLOGY	
	16:15-16:30	BREAK	
	16:30 - 17:30	Session 3 - MEMS SUPPLY CHAIN	
	17:30 - 18:00	Walk to Salland	
	Salland	18:00-19:00	Tour Salland Engineering facilities
	Lumen	19:30	Social Network Event (drinks and dinner)