



SWTEST
2026 CONFERENCE

35th
ANNIVERSARY

Marvell ATE Test Cell DTFL Architecture & Implementation



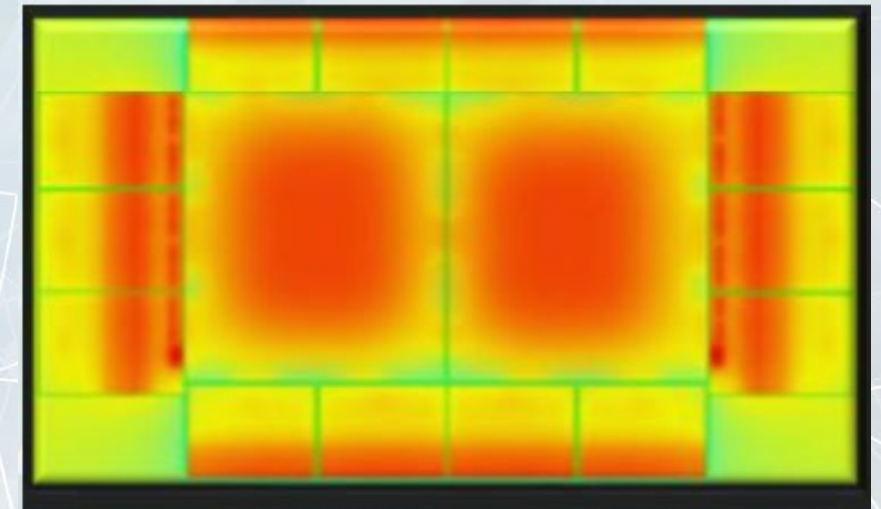
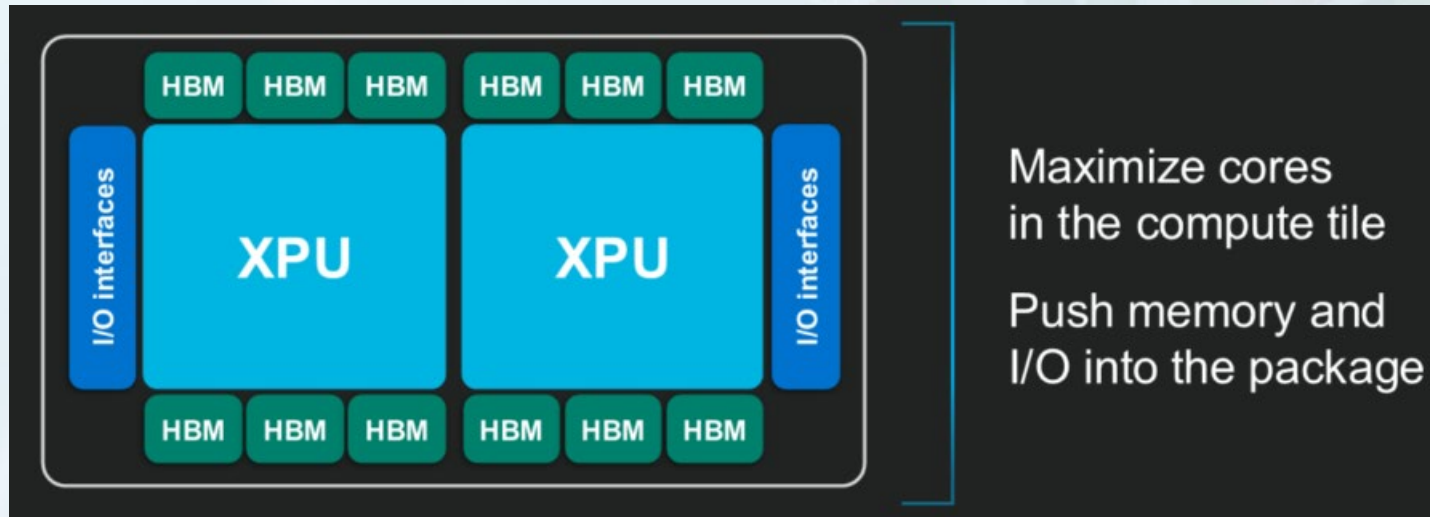
Enrico Zschemisch

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Marvell Core Test Technology Group

Why Digital Thermal Feedback Loop for ATE Test Cells ^{35th} ANNIVERSARY

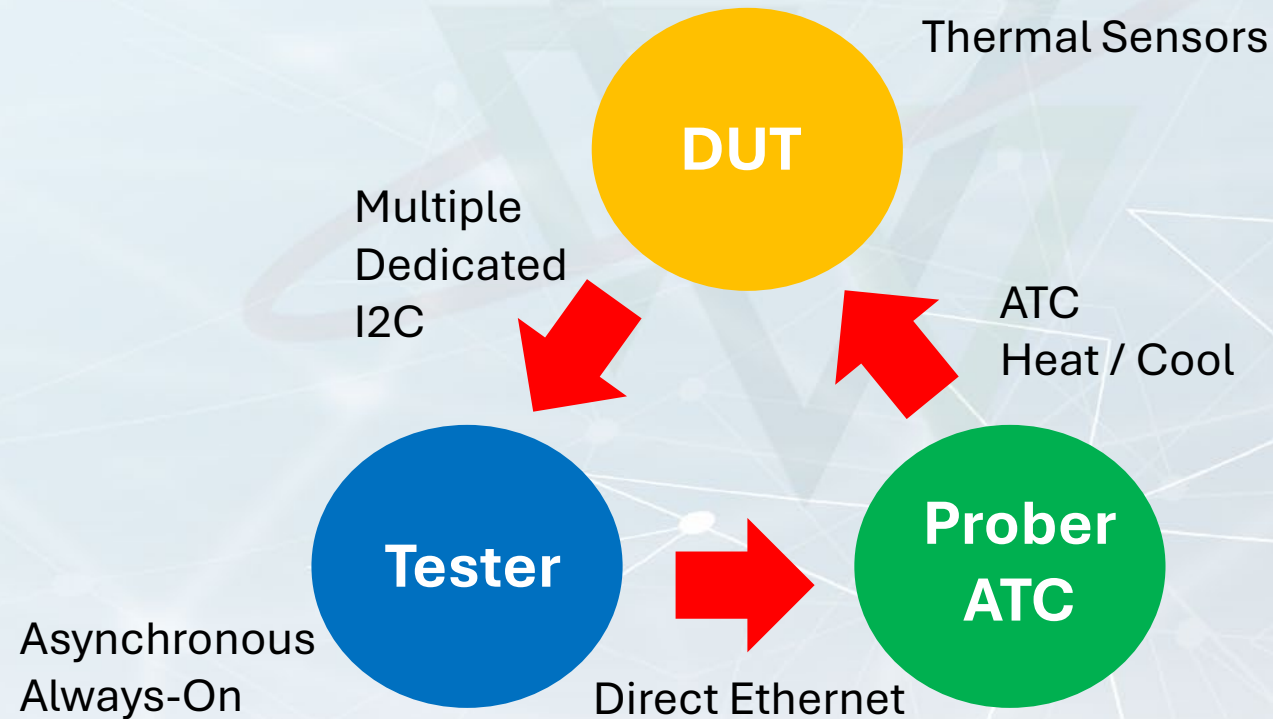
- Marvell's New XPU Architectures Require Power at 3000W / Die → 350 W/cm²
- Needs a real-time, full-time control loop (much more than a safety stop button)
- Improves test coverage & margins by keeping critical blocks at Test Set Temp
- KGD → 95% ^ 20 = 36% ... really bad in a capacity constrained world!



(source: Marvell Industry Analyst Day Presentation 2025)

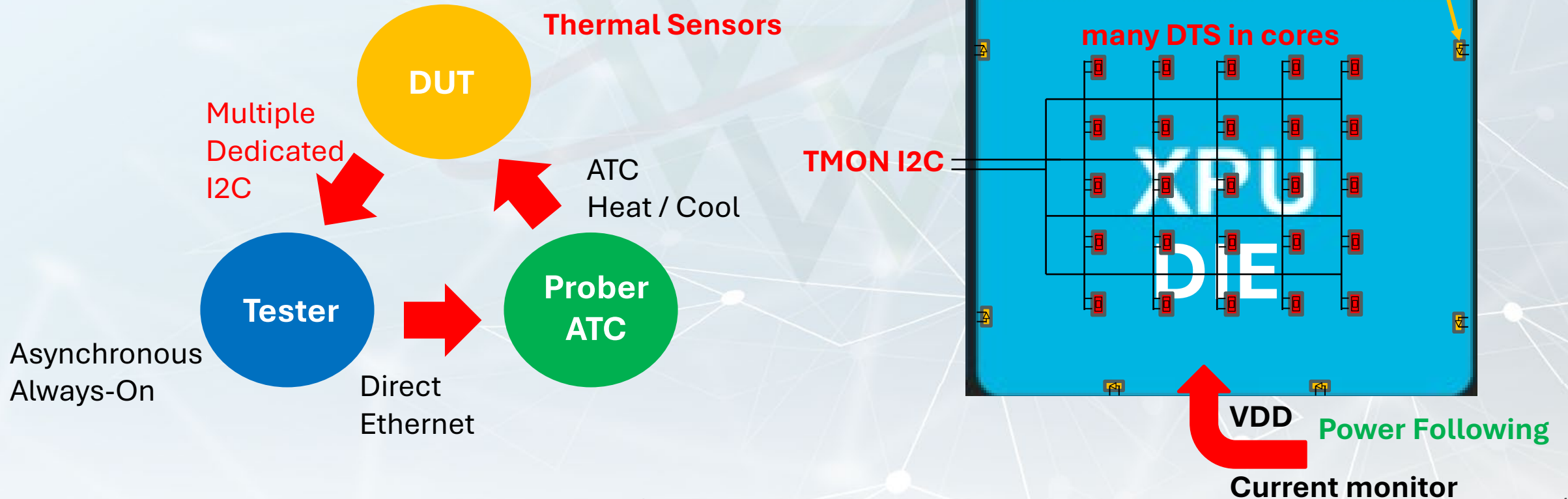
Marvell's DTFL Architecture

- **Tester / DUT / Prober ATC (automated temperature compensation) Loop**
- **ATE Software Controlled – Algorithm running on the ATE in parallel to test program**
- **1ms Control Loop Time Constant**



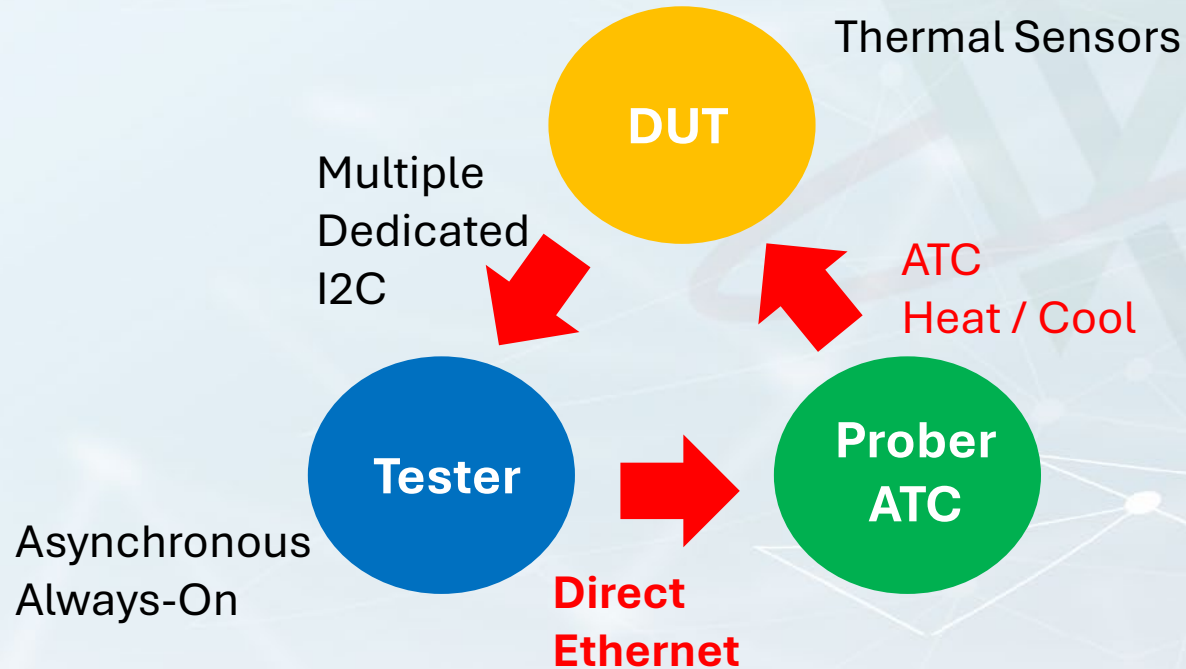
Marvell's Triad of Thermal Sense Inputs

- (1) Thermal Diodes
- (2) DTS (digital thermal sensors) through a Dedicated TMON I2C
- (3) Power Following



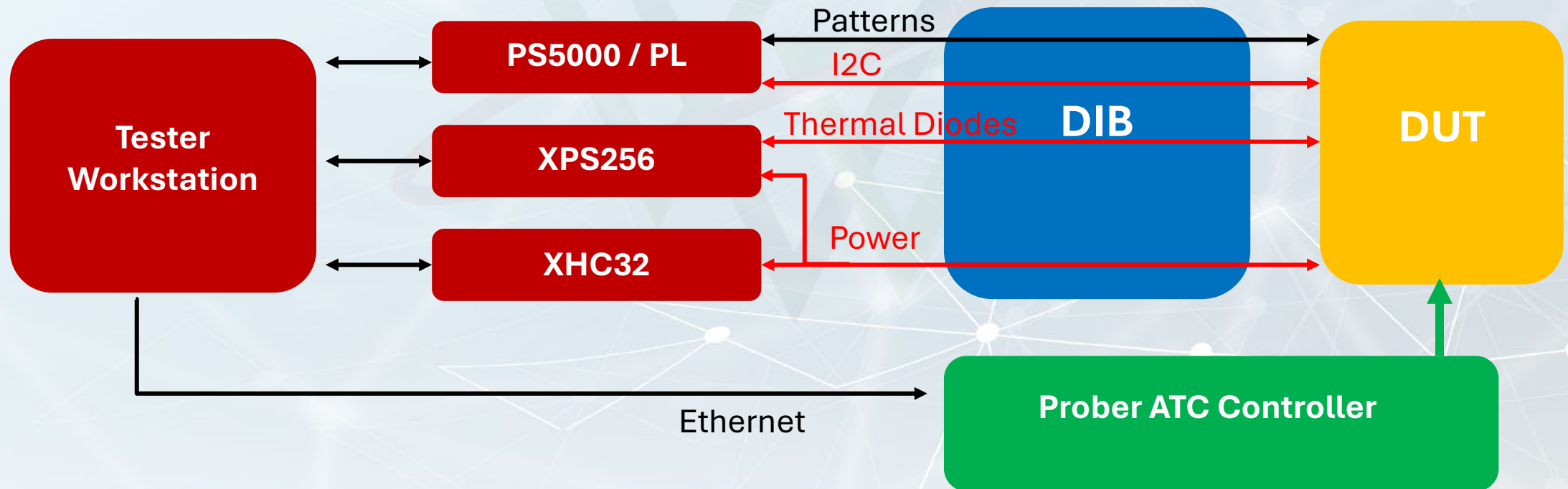
Marvell Prober ATC Connect with Direct Ethernet

- Tj (software derived) Feedback
- Low Latency Ethernet Connection directly into the ATC Controller



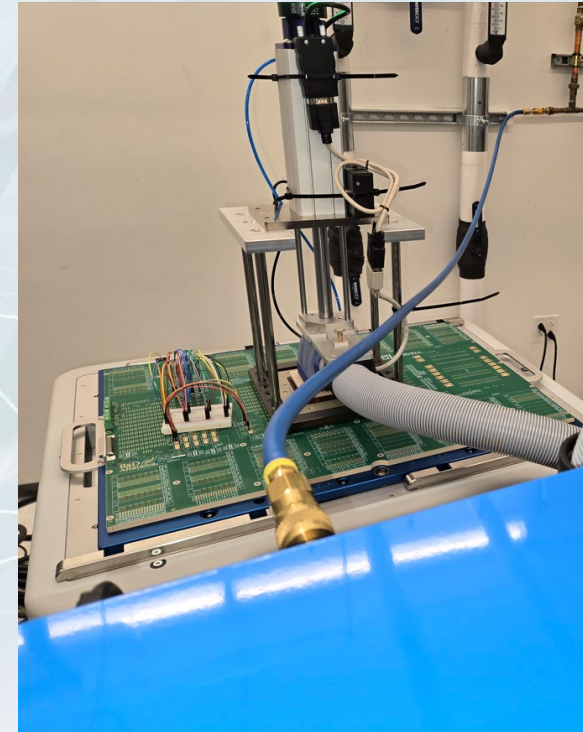
Marvell DTFL Software Implementation

- Runs on the 93K Exa Tester as a parallel program to the main ST8 test program
- Constantly monitors the Triad of Power Sensor
- Algorithmically generates a forward-looking Tj to send to the Prober ATC

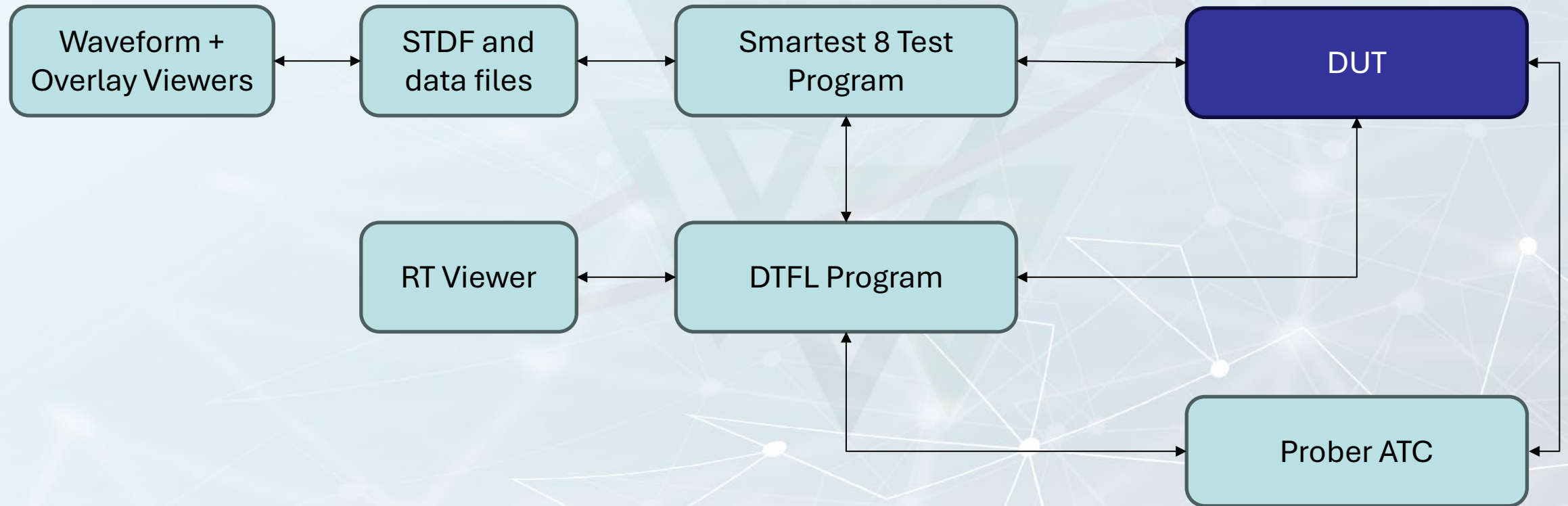


Marvell DTFL Software Demo

- We're not here developing a Marvell ATC. We leave that to our Partners
- Most of our large Marvell XPU devices are custom. We can't show you that. Sorry
- ... so we'll demo our DTFL with a Marvell thermal TV & a Chroma SeaCobra...



Marvell DTFL Software Flow



Marvell DTFL Software Stack

Software Stack is split into two parts:

1. DTFL measurement program:

Interfaces with DUT thermal sensors, diodes, power supplies

Interfaces with Prober ATC

Data Management

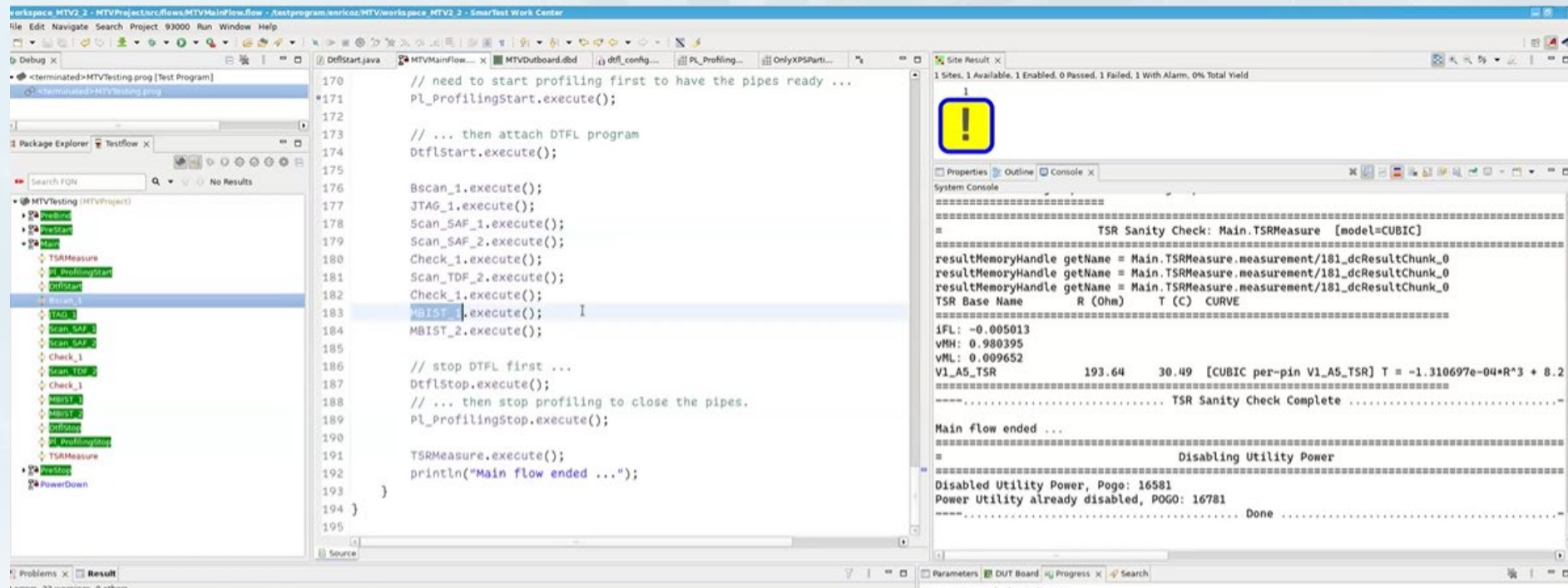
2. Data Viewers and Analysis Tools:

Many millions of data points need specialized software for processing

A Few Different tools for different views

Marvell DTFL Measurement Program

- High-resolution data capture from DTS's, Thermal Diodes, XPS256 and HXC32
- Integrates with the ST8 test program, including STDF datalogging of all data
- Temperature checks vs configured limits → alarms + shuts downs
- Configurable data storage: high res or optimized storage per sensor/power rail
- Temperature prediction Algorithms to send Tj feedback to Prober ATC



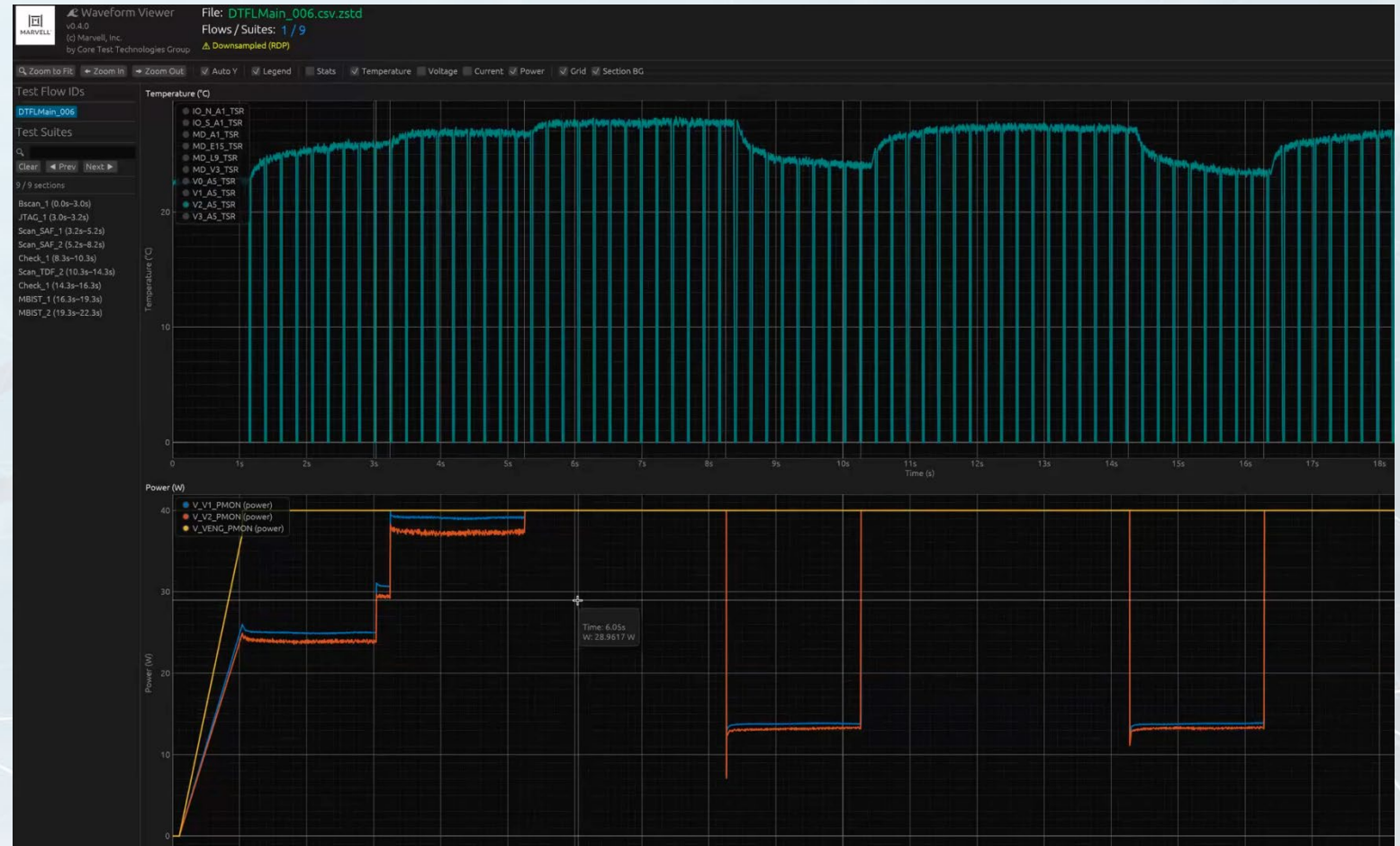
Marvell DTFL Data Viewers & Analysis Tools



- **Real-Time Viewer:**
 - Scope-like viewer (local or over the net) for both power and thermal data
- **Waveform Viewer:**
 - To view, analyze and export any of the captured data
- **Thermal Overlay Viewer:**
 - User can place sensor locations on a top-down view of the chip
 - Shows per-test suite power and thermal data and how it changes over time
 - Not a physical simulation

Marvell DTFL Waveform Viewer

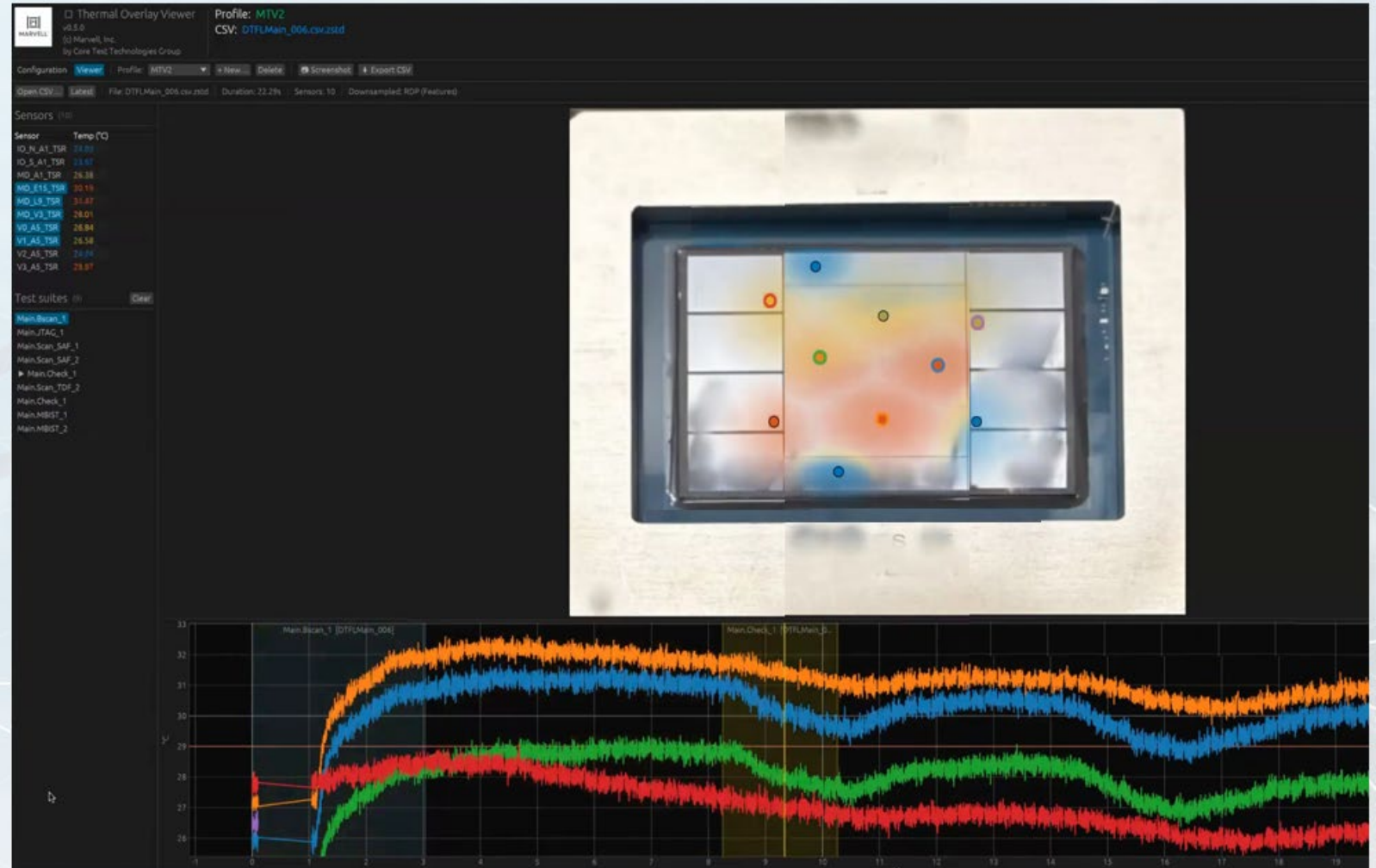
- Real Demo using the Chroma SeaCobra & Marvell's Thermal TV device
- Data for the whole test program
- Temperature at the top (artifacts are known hw bugs)
- Current on the main power rails as it runs through at the bottom
- Alarms and limits not shown
- Shows ST8 test suites on the left



Marvell DTFL Thermal Overlay Viewer

- Real Demo using the Chroma SeaCobra & Marvell's Thermal TV device

- Data for the whole test program
- Temperature on the bottom
- Smartest 8 test suites on the left
- Yellow highlights are the current test flow replay location



Marvell Conclusions, Follow-On Work

- Thermal control is an integral part of the ATE test cell solution
- Marvell's Target is 400 W/cm² at probe (module test handlers much higher)
- Die Level Probers such as the TEL Prexa SDP (DLP) are the critical next step



(source: Enrico made this with AI)



(source: Pomona Car Show, Feb 2026)



(source: <https://www.tel.com/product/prexa.html#prod3>)