



NOVELLUS

Innovative Technology. Trusted Productivity.

Novellus Interface A

SEMICON West e-Manufacturing Workshop

Janeway Dong

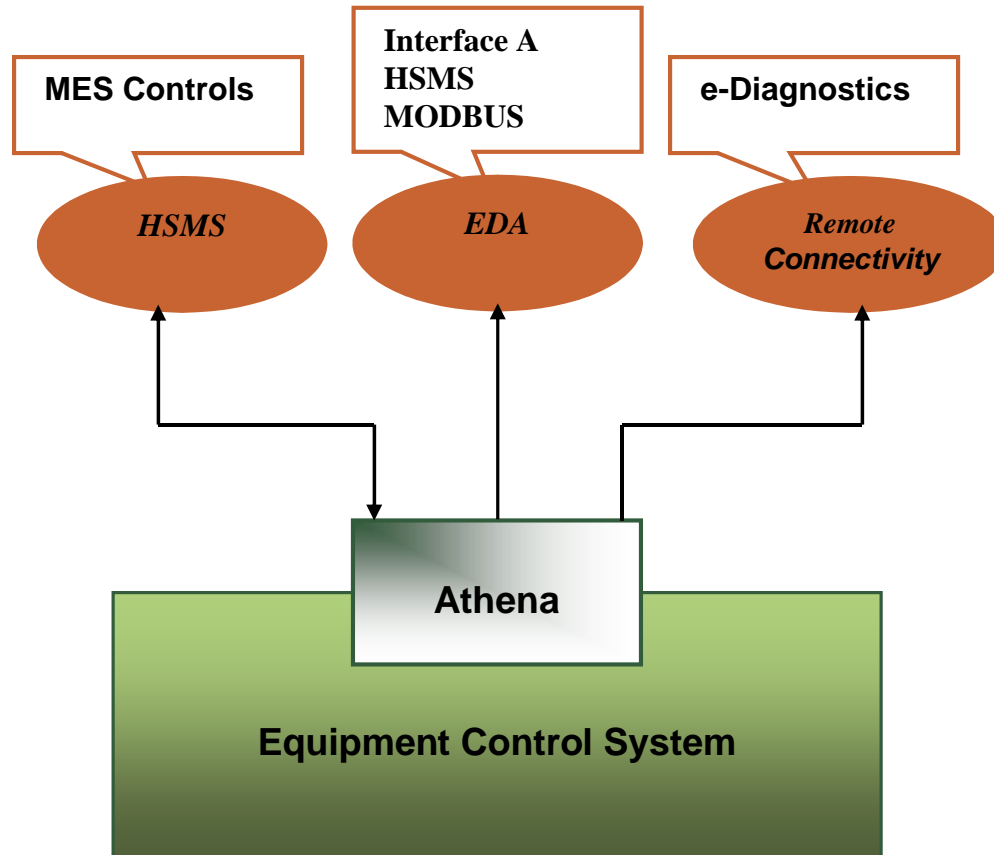
July 14, 2006

Interface A Highlights



- **Novellus Interface A solution is running on production tools at multiple fabs**
- **Fully compliant with Interface A Standards**
- **Successfully connected to multiple EDA Clients**
- **Data throughput exceeds 10,000 data points per second**

Tool Architecture with Athena



→ Key Capabilities

- Factory automation (HSMS)
- EDA port for high speed data access supporting multiple protocols:
 - Interface A
 - HSMS
 - MODBUS
- Capability for remote access and diagnostics
- Athena Knowledge Base for data collection and analysis

Athena Capabilities – Novellus solution for e-Manufacturing

→ **Compliant with Interface A Standards**

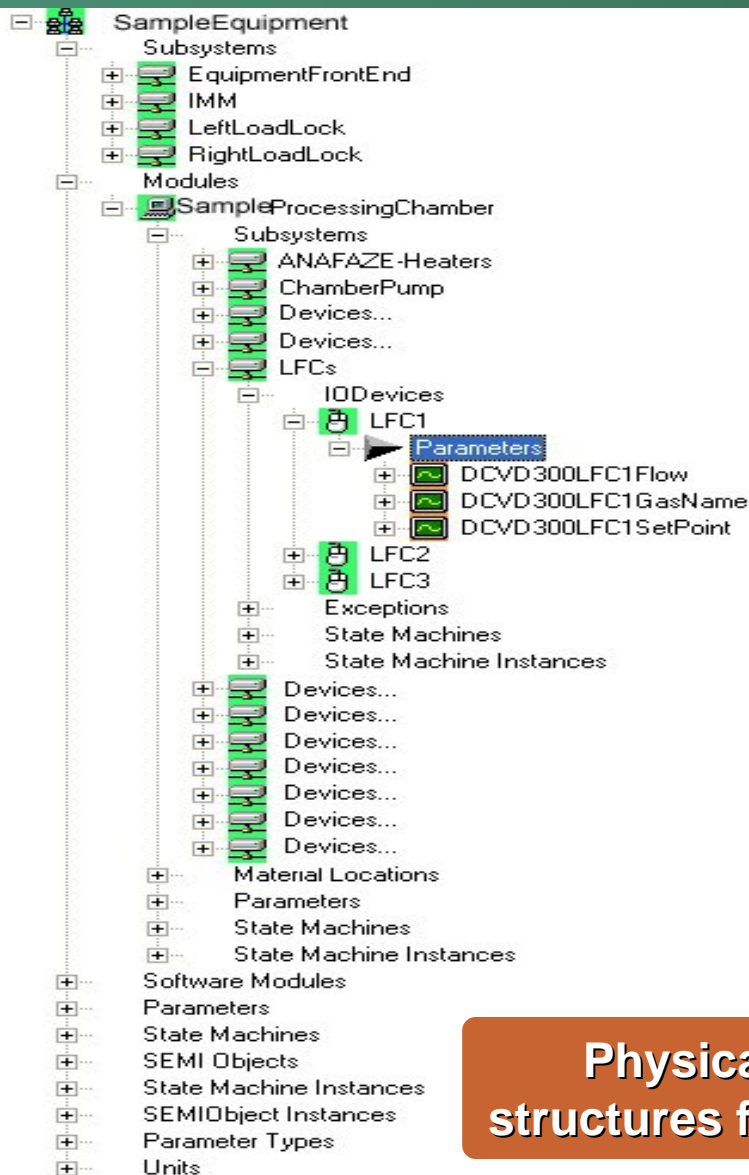
- E120-1104, Common Equipment Model
- E125-1105, schema-0305, Equipment Self Description
- E132-1105, schema-0305, Client Security
- E134-1105, Data Collection Management

→ **Facilitating Easy Fab Deployment**

- Administrator access for Interface A runtime configuration and performance tuning
- Encrypted tool model packages
- Built-in data collection plans for examples and recommendations

Novellus successfully deployed Interface A in multiple fabs

Common Equipment Model Representation



→ Examples of Modules

- PVD, CVD, CMP and other equipment processing chambers
- PreClean, Degas or other preparation modules

→ Examples of Subsystems:

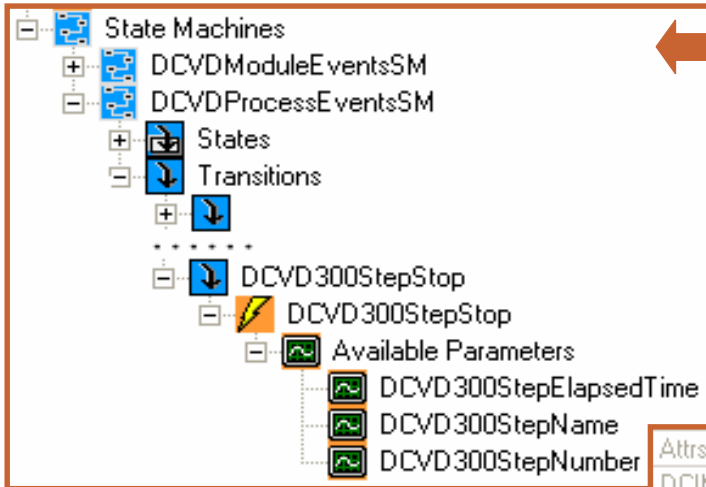
- Loadports
- Robots
- Loadlocks
- Transfer chamber
- Group node for device category

→ Examples of IODevices:

- Mass Flow Controllers (MFC)
- Gauges and Meters
- Sensors
- PowerSuppliers
- Pumps
- Pressure Controllers
- Software Counters

Physical and logical assemblies of equipment sub-structures for accurate and clear equipment representation

Equipment Self-Describing Data



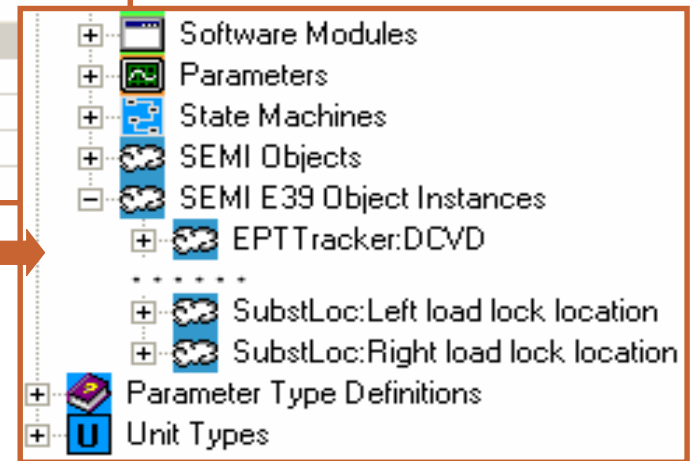
StateMachine Example:

- StateMachine defines the equipment behavior once and it contain events for different transitions.
- List the available parameters that associate to the event when it occurs
- Used LocationParameter value to identify each stateMachineInstance

➔ Parameter Attributes:

- ParameterType
- IsTransient
- ParameterClass

Attrs	1409286185
DCIMInstance	AFA DCIM
Node	
Description	Liquid flow controller1 actual flow
Locator	Vector/Vector ProcessingChamber/LFCs
Name	DCVD300LFC1Flow
NodeType	Parameter
Parameter	
Constraints	Parameter Constraints
IsTransient	False
ParameterClass	cxpcData
ParameterType	FloatType



➔ Parameter Types

➔ SEMIObjects and SEMIObjectInstances

➔ Units

Interface A Implementation Verification Method



- ➔ **Used ISMI EDA Evaluation Method as test guideline**
 - Tested basic functionalities and normal cases and scenarios
 - Followed the defined sequences and procedures to test APIs by each standard
 - Test cases are not complete or detailed enough for fab qualification
 - Performance testing needs more concrete test plans
- ➔ **Used ISMI EDA Client Connection Emulator (ECCE) as project testing tool**
 - Great testing tool for equipment Interface A implementation testing
 - Clearly displayed the elements of equipment metadata for verification
 - Capabilities for both admin, non admin or multiple simultaneously connections
 - The diagnostic tools and loggings are useful for API verification
 - Intuitive user interface on DCP creation and management
 - A valuable reference for other EDA client development
- ➔ **The Interface A in fab deployment was connected and tested successfully with four different EDA clients**

Utilize ISMI established verification method for capability testing

Successful In-FAB Interface A Deployment



Std. No.	Compliance Testing	Result
<i>E120 - 1104</i> <i>E125 - 1105</i>	Defined and deployed the equipment model	Pass
<i>E132 - 1105</i>	Establish single and multiple simultaneous sessions – with and without SSL	Pass
<i>E132 - 1105</i>	Authorization functions with secure admin session	Pass
<i>E125 - 1105</i>	All APIs with metadata management	Pass
<i>E134 - 1105</i>	All APIs with data collection management	Pass
<i>E134 - 1105</i>	Data collection plan creation and data collect reports for trace, event and exception requests	Pass
<i>E125 - 1105</i> <i>E132 - 1105</i> <i>E134 - 1105</i>	Tested equipment Interface A capability with different EDA client applications	Pass

Novellus Interface A software is fully compliant with Interface A standards

→ **Single client throughput capability**

- Trace 1 parameter – buffering group size 1 - 50ms
- Trace 1 parameter – buffering group size 1 - 25ms
- Trace 200 parameters – buffering groupSize 1 – 100ms
- Trace 200 parameters – buffering groupSize 20 – 100ms
- Trace 500 parameters – buffering groupSize 1 – 100ms
- Trace 500 parameters – buffering groupSize 20 – 100ms
- Trace 500 parameters – buffering groupSize 1 – 50 ms

→ **Three clients throughput capability when connected simultaneously**

- Trace 500 parameters – buffering groupSize 1 – Interval 100ms simultaneously

Performance exceeds industry established requirement

Summary



- **Novellus Interface A is running successfully on production tools in multiple fabs**
- **The software is fully compliant with ISMI freeze version of Interface A standards**
- **Novellus Interface A software has high data throughput**
- **Novellus Interface A capabilities can support EES and APC applications for improving tool performance and yield**