www.cimetrix.com

EDA/Interface A Overview

A brief introduction into the SEMI Interface A Equipment Data Acquisition (EDA) Standards

cimetrix®

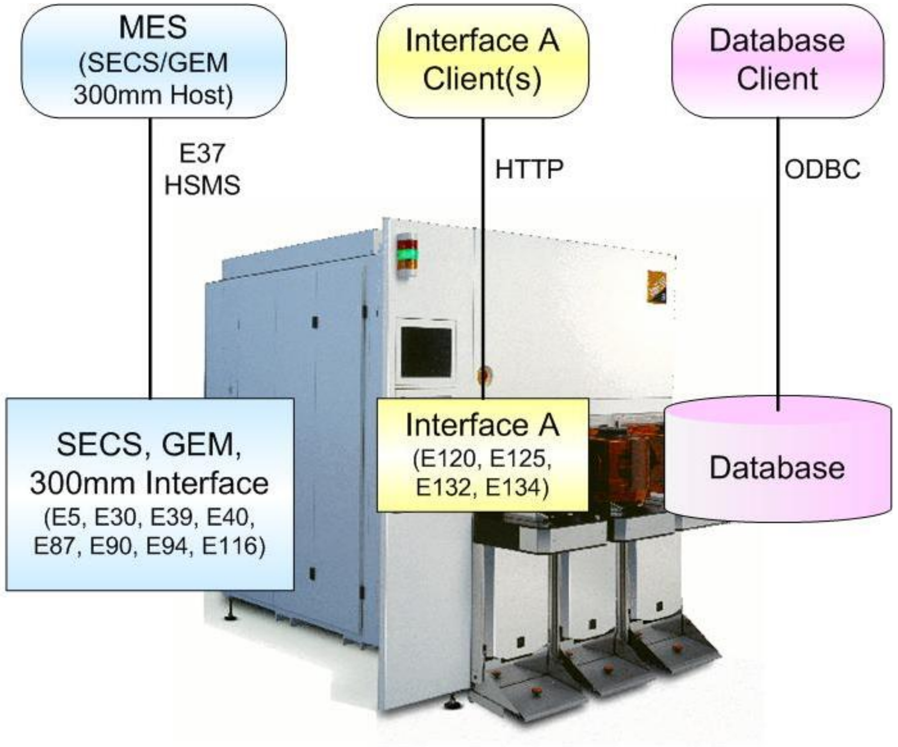
Summary

- EDA = Interface A
  - Terms are synonymous and common
- SEMI Standards
  - E120, E125, E128, E132, E134, E138, E164
- Adoption growing since 2006

Where EDA fits
Manufacturing equipment context

Integrated Device
Manufacturer Software

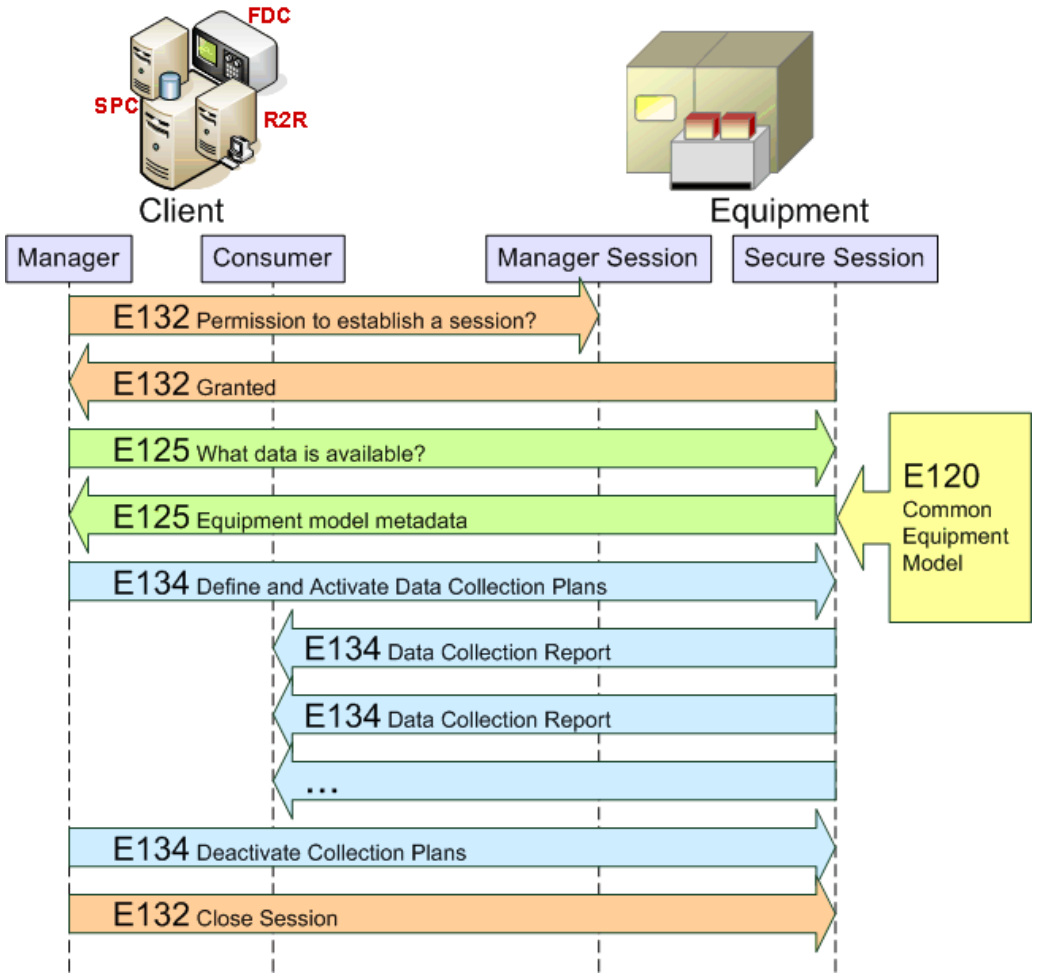
Semiconductor
Equipment



EDA standards background
Original industry motivation and benefit

- GEM/GEM 300 interface is associated with the MES system and cannot be changed or interrupted easily
  - Weeks/months to alter data collection
- Needed flexible approach for collecting and distributing high-density real-time equipment and process data
  - Fault detection algorithms were evolving from lot-level post-process application to within-process diagnosis and tool interdiction capabilities
  - Run-to-run control applications moving from lot level to wafer level
- Only alternatives were custom interfaces or vendor-specific data collection systems (i.e., expensive)
- EDA opened the door for standard approach across tool types supporting a common client/host data collection system
  - Enables process engineers to modify data collection plans to access needed information in minutes

How the EDA services work together



cimetrix®

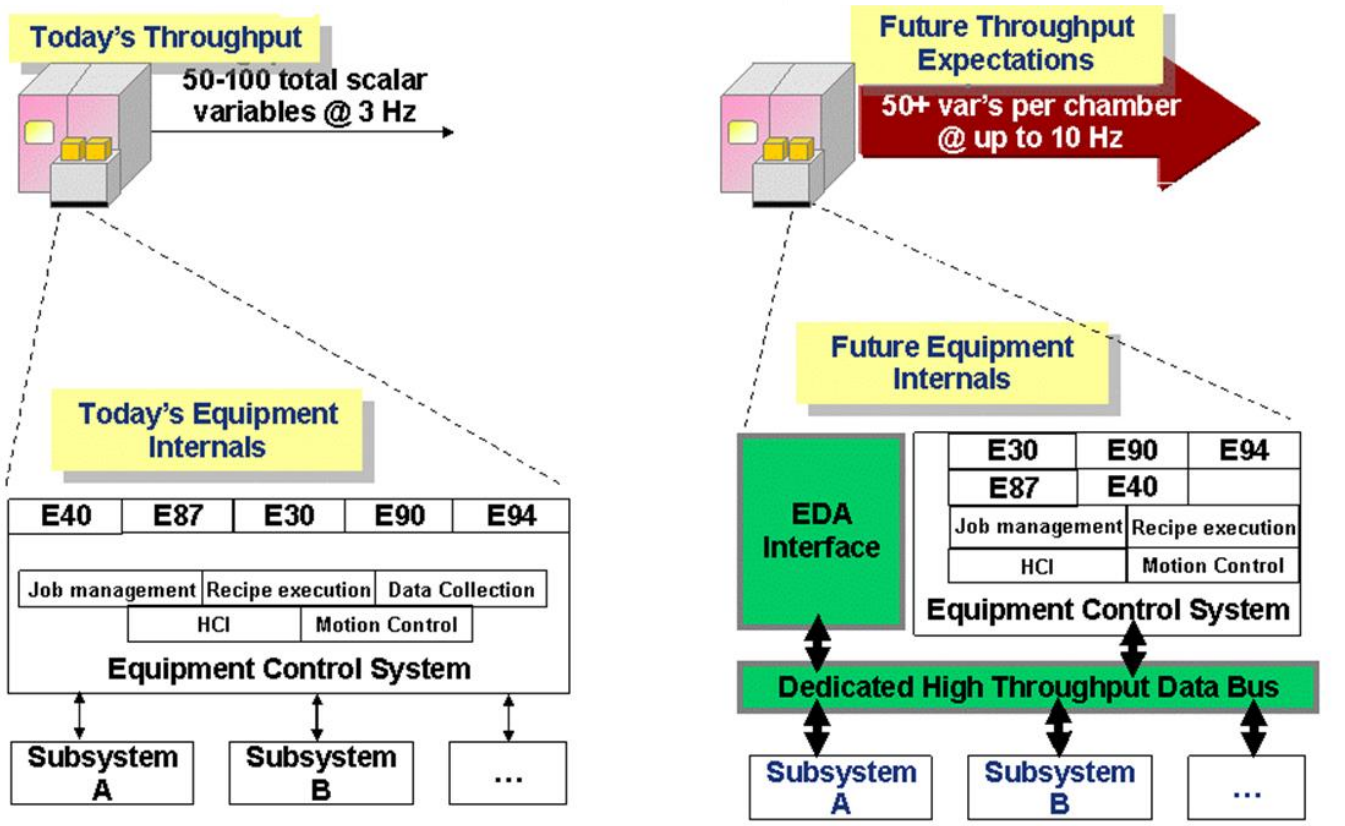
Key Features of Interface A

- Data gathering only
  - SECS/GEM and GEM300 Control/Configuration
  - Events, Exceptions, Parameters, E39 objects
- Multiple independent client access
  - Semiconductor manufacturer
  - Third party
  - Equipment supplier
- Restricted access
  - Access based on client credentials

Key Features of Interface A

- Self-Describing interface
  - Minimal documentation required
  - Enables Intelligent Clients
- Common Internet technology
  - Web Services
  - HTTP/SOAP using XML Schemas
- Data context
  - Data is associated with equipment components

Original Equipment Expectations
Implementation architecture and performance



- Equipment internals behind the EDA interface must be designed to provide dedicated high-throughput data acquisition while maintaining equipment run rates
- For this reason, ISMI will be focusing on current and future generations of 300 mm tools for EDA implementation

INTERNATIONAL SEMATECH ISMI MANUFACTURING INITIATIVE

cimetrix®

Current EDA requirements
Performance expectations

- GEM-based data collection limitations
  - Maximum trace data frequency typically 1 Hz
  - Collection event granularity aligned with substrate movement and recipe start/stop
  - Sufficient for material tracking, OEE monitoring and lot-level FDC and R2R control
  - GEM interface fixed or "locked down" to avoid tool performance problems
- Process engineers needed more/better data on their terms
  - At least 10 Hz frequency at recipe step boundaries
  - 100 Hz frequency for critical, rapidly changing parameters
  - Precise data "framing" for advanced predictive algorithms
  - Dynamic sampling in response to changing process conditions
  - Define new data collection plans (within limits) without additional sign-off

SEMATECH Freeze Versions

- SEMATECH/ISMI defined freeze versions to facilitate client/equipment compatibility
- Freeze Version I (1105)
  - Widely available
- Freeze Version II (0710)
  - Limited availability, implementations emerging
  - Best when implemented with E164 & E157

Establish Communication

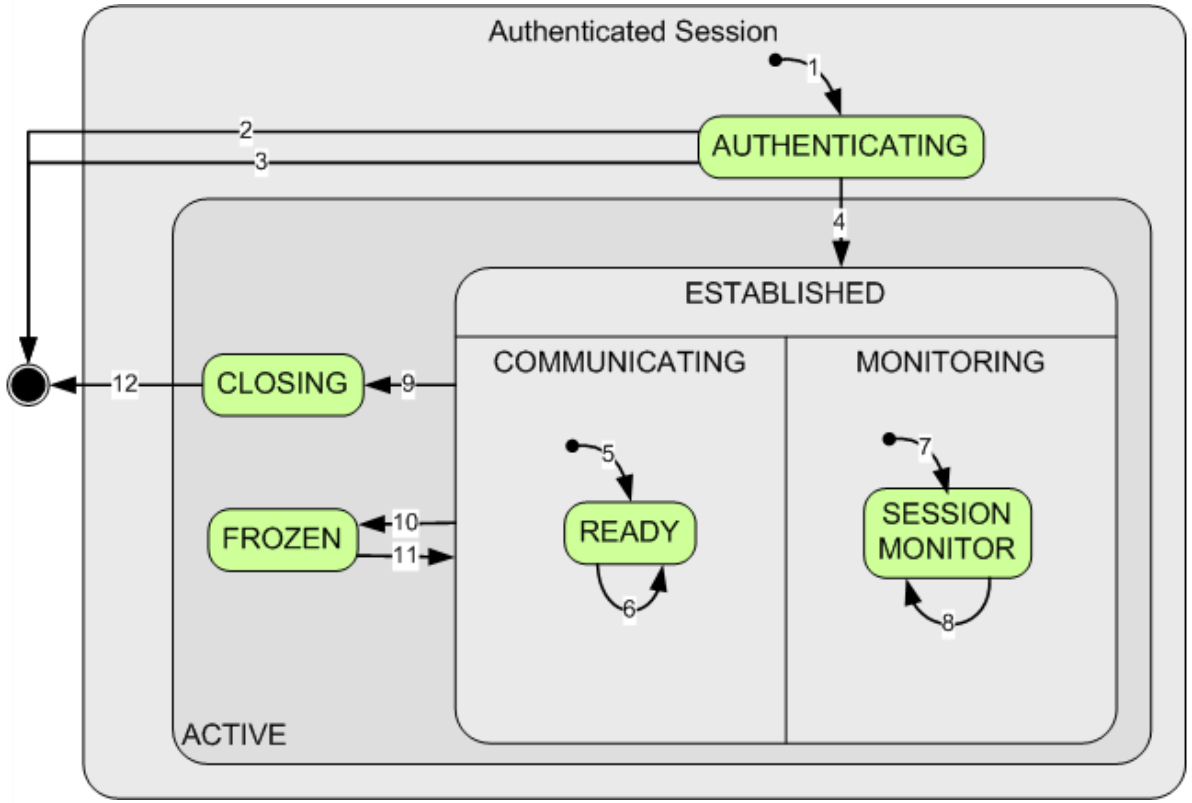
E132 Specification for

Client Authentication & Authorization

cimetrix®

Authentication process

Session lifecycle



E132 – Equipment Services

- EstablishSession
  - Request to establish a new authenticated session and to set the client endpoint, the consumer for all notifications from the equipment
- PersistSession
  - Request the Equipment to maintain the session, even after shutting down the Equipment
- SessionPing
  - A check to see if the Equipment is still active
- CloseSession
  - Request to terminate the session

E132 – Client Services

- SessionPing
  - Used by the equipment to check if the client is still active
- SessionFrozen
  - Notification to the client that the session will be frozen
- SessionClosed
  - Used by the equipment to close an active session

E132 – Equipment Admin Services

- GetDefinedPrivileges
  - Request the list of all defined privileges
- GetACL
  - Request the list of all defined Access Control List entries
- AddACLEntry
  - Add a new ACL entry
- DeleteACLEntry
  - Delete an existing ACL entry
- GetActiveSessions
  - Request the list of information on all active sessions
- SetMaxSessions
  - Sets the maximum number of active sessions
- GetMaxSessions
  - Requests the maximum number of active sessions

Equipment Modeling

E120 Specification for the Common Equipment Model

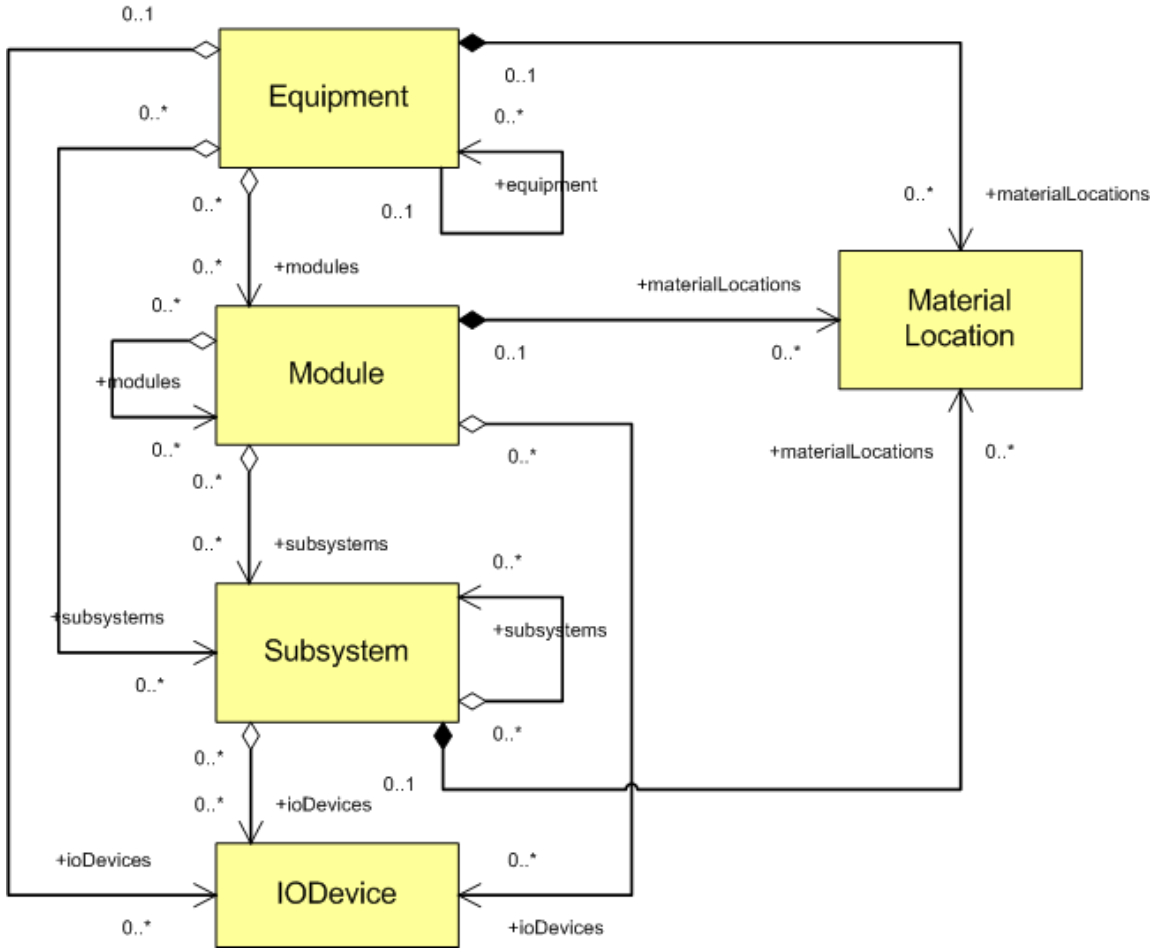
E125 Specification for Equipment Self-Description

E164 EDA Common Metadata

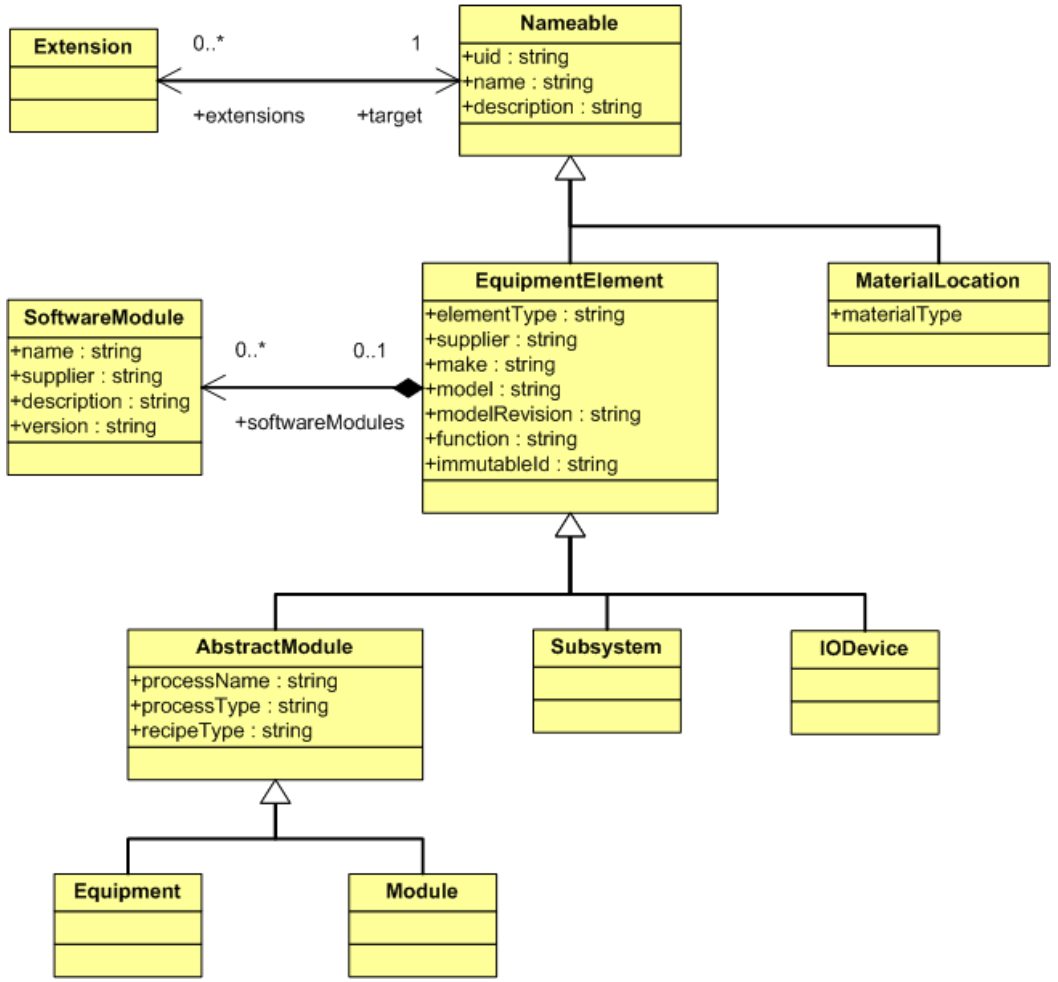
cimetrix®

E120 Common Equipment Model

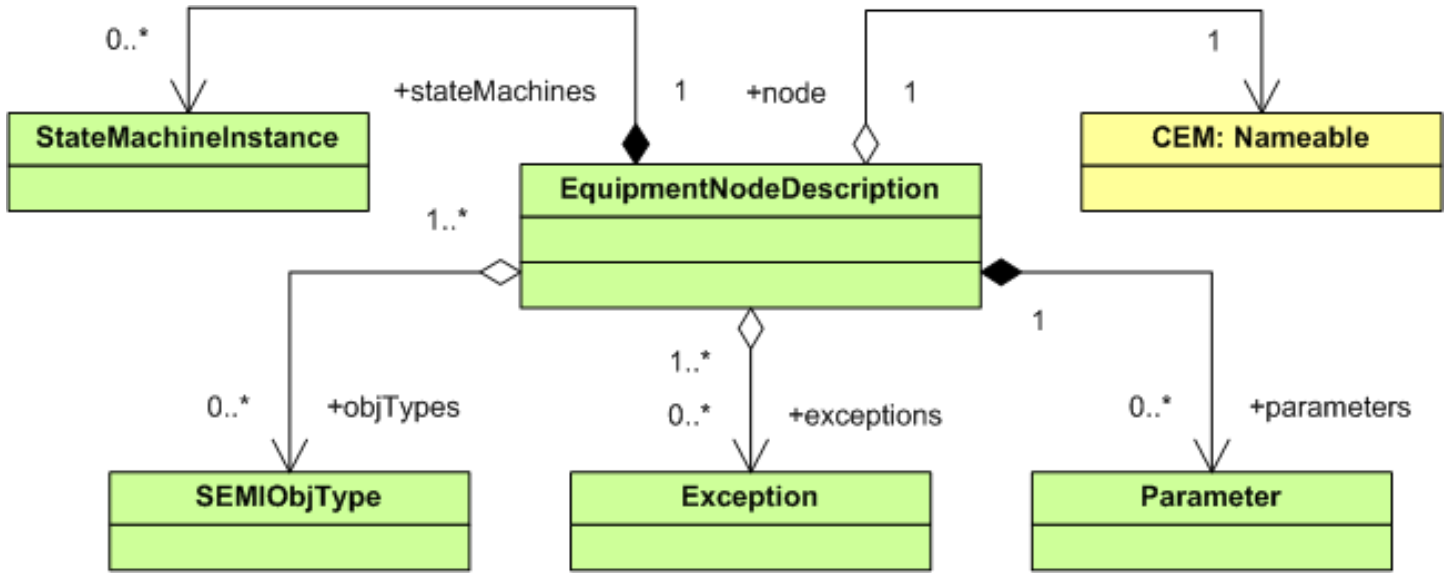
Relationship view of node types



E120 Common Equipment Model
Inheritance Hierarchy

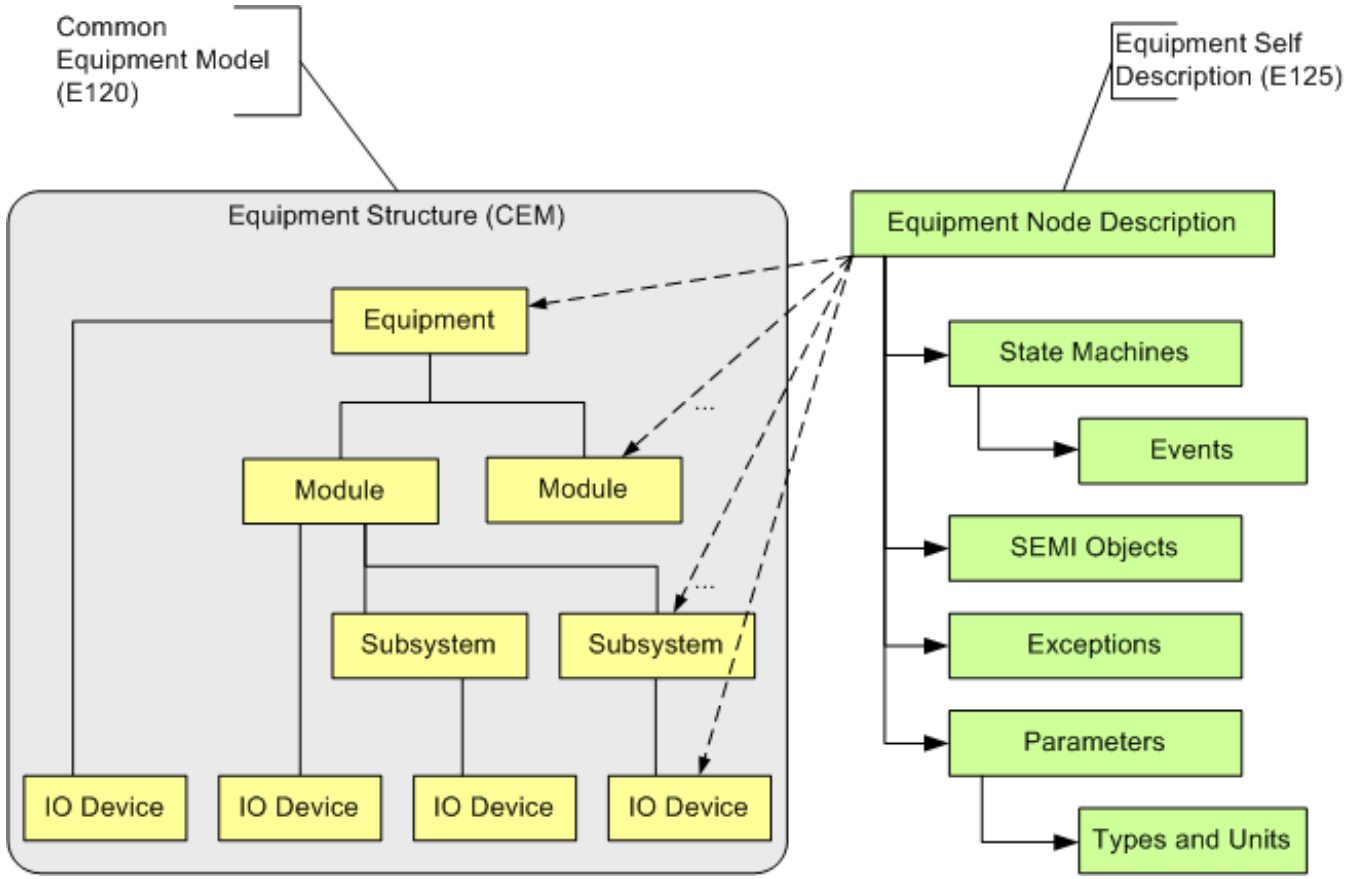


E125 Equipment Self-Description
Node associations



E120 and E125 together

Structure and behavior of equipment model



E125 – Equipment Services

- GetUnits
  - Retrieves unit metadata
- GetTypeDefinitions
  - Retrieves parameter type metadata
- GetSemiObjTypes
  - Retrieves E39 object type metadata
- GetExceptions
  - Retrieves exception metadata
- GetStateMachines
  - Retrieves state machine metadata

E125 – Equipment Services

- GetEquipmentStructure
  - Retrieves all equipment node metadata in a hierarchal structure
- GetEquipmentNodeDescription
  - Retrieves individual equipment node metadata including:
    - Parameters associated with this node
    - E39 objects/SEMIObjTypes that are associated with this node
    - State machine instances that are associated by this node

E125 – Equipment Services

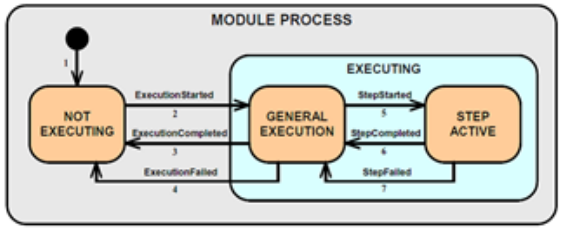
- GetLatestRevision
  - Retrieves the last data and time at which the equipment metadata was revised
- NotifyOnRevisions
  - Request that the equipment notify the client when changes to the metadata are made

E125 – Client Services

- MetadataRevised
  - Notifies the client that the equipment metadata has been changed

What does E164 specify?
Structure and content of equipment metadata

- E120/E125 Common Equipment Model usage/content
  - Nodes and parameters must have meaningful descriptions
  - Equipment element attributes for all E120 nodes must have meaningful values
  - All definitions (exceptions, SMs, parameter types, units, SEMI object types) must be referenced
  - Strict event name enforcement



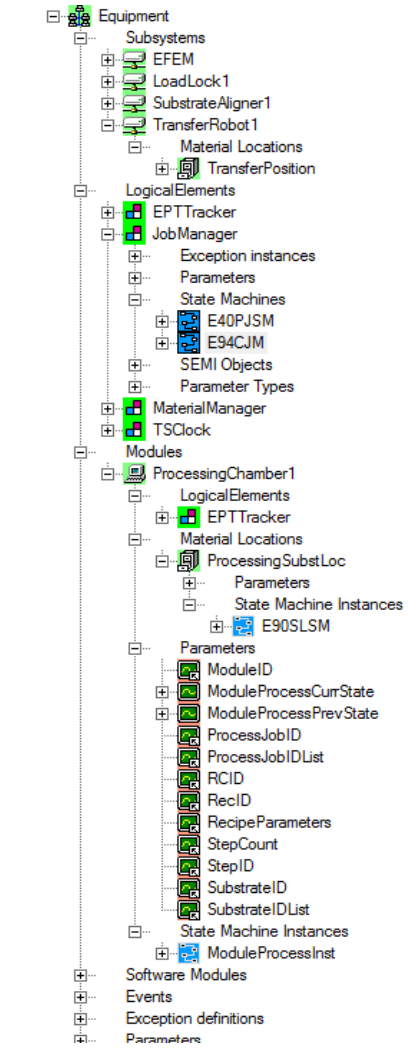
- State Machines
  - Strict State Machine definitions
  - Requires E157 State Machines for all process modules
  - Requires E90 State Machines for all substrate locations
  - Requires all Parameters, Events and Exceptions defined in Freeze II standards to be present
  - State and transition names must match GEM300 standards

cimetrix®

Why is E164* so important?
Common metadata results in…

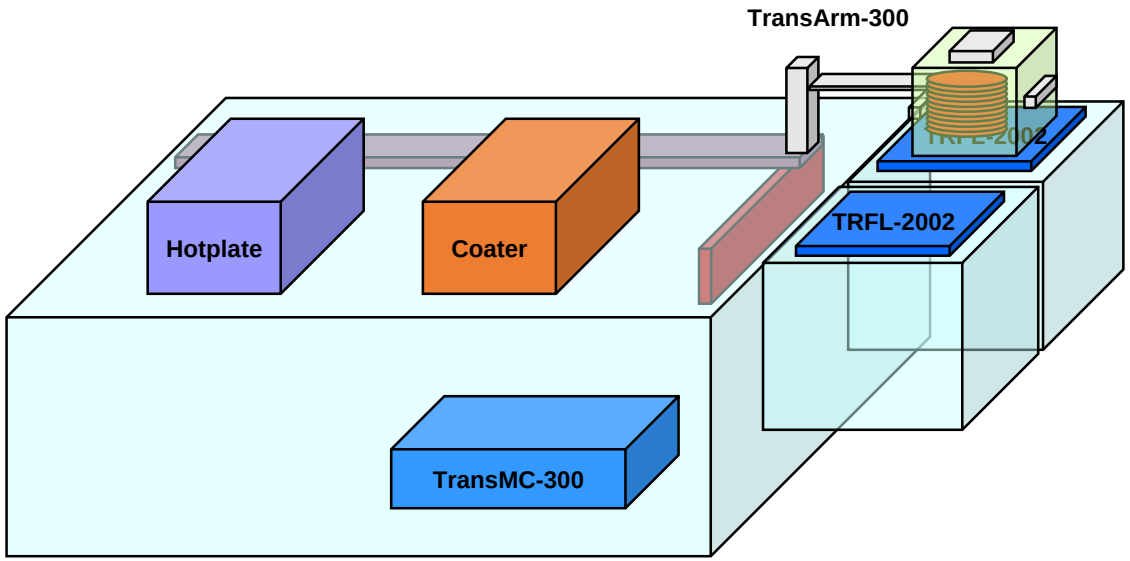
- Consistent implementations of GEM300
- Commonality across equipment types
- Automation of many data collection processes
- Less work to interpret collected data
- Enables true "plug and play" applications
- Major increases in engineering efficiency

E164 is to EDA what GEM was to SECS-II



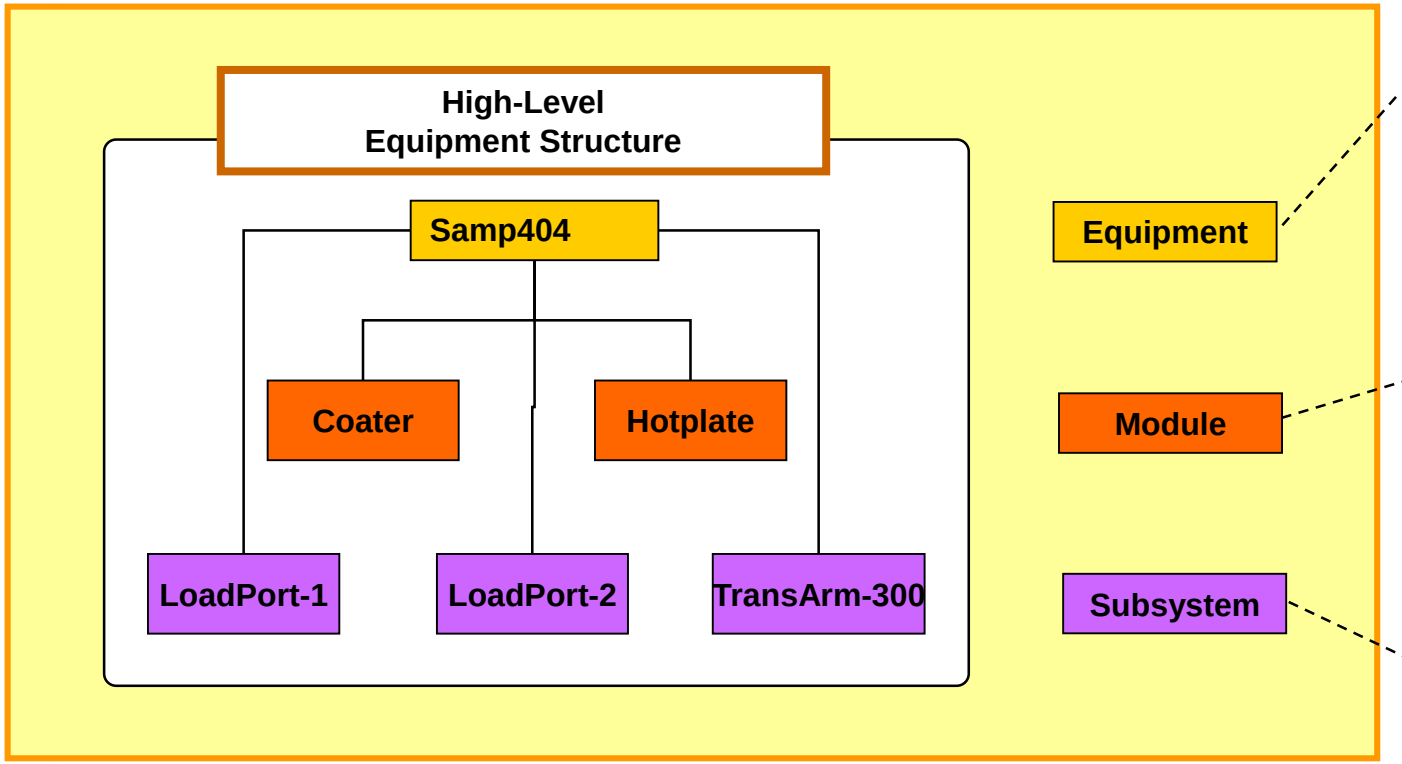
* EDA Common Metadata standard

“Samp404” Tool



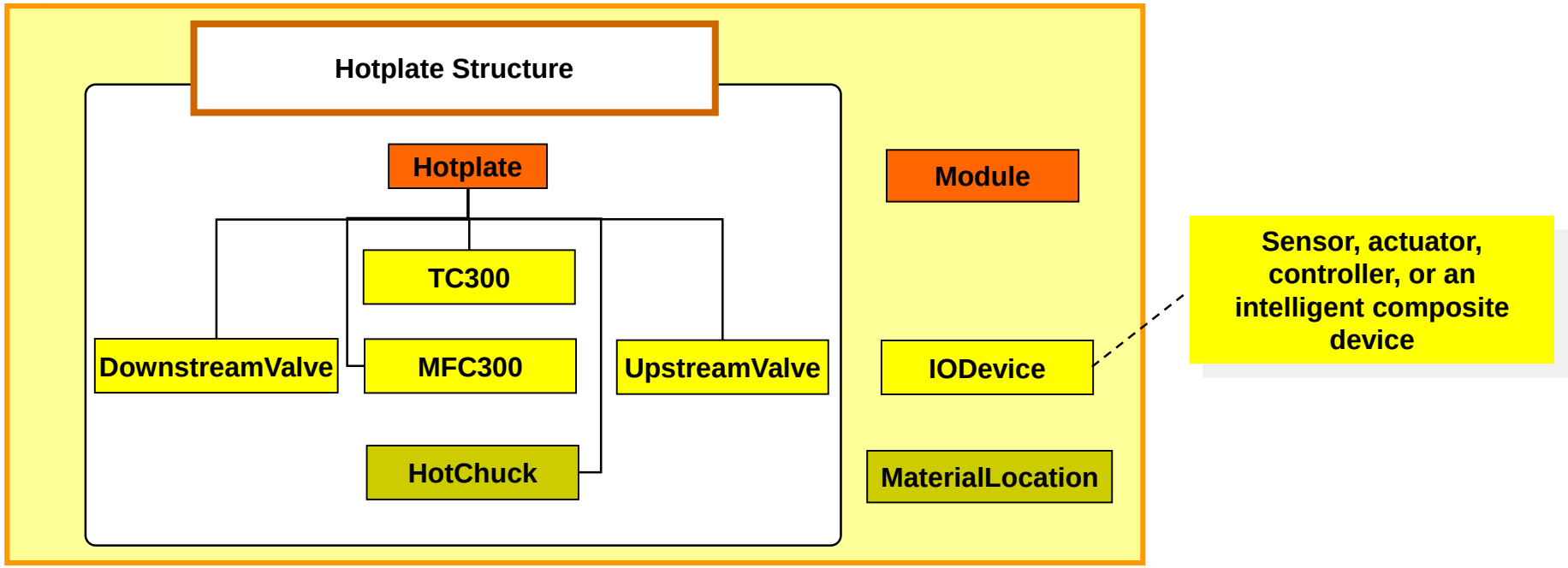
- Sample tool
  - 2 Load Ports
  - 1 Wafer transfer robot
  - 1 Spin coater
  - 1 Hotplate

CEM Representation - Equipment



- Major modules are the hotplate and coater
- Major subsystems are the load ports and transfer arm

CEM - Hotplate



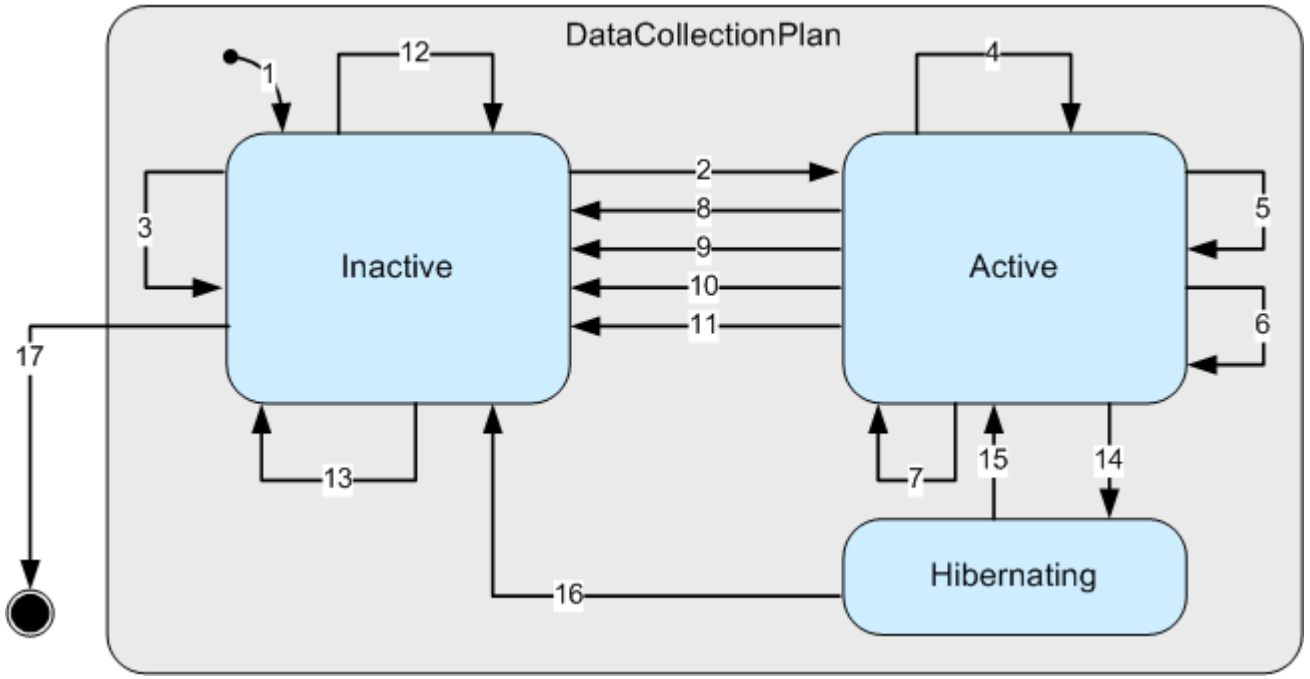
- Chamber hood, pins and associated actuators all modeled together as a Module
- Temperature controller and sensor modeled as a single IODevice
- Each valve and its controller modeled together as a single IODevice
- Hot chuck modeled as a MaterialLocation belonging to the hotplate Module

Data Collection

E134 Specification for Data Collection Management

cimetrix®

DataCollectionPlan (DCP) lifecycle



E134 – Equipment Services

- DefinePlan
  - Submit a Data Collection Plan (DCP), which includes a set of trace requests, event requests and/or exception requests
- GetDefinedPlanIds
  - Request a list of all Data Collection Plan IDs
- GetPlanDefinition
  - Retrieve the definition of a Data Collection Plan
- ActivatePlan
  - Activate the defined DCP
- GetActivePlanIds
  - Request a list of all activated DCP IDs

E134 – Equipment Services

- DeactivatePlan
  - Deactivate the DCP
- DeletePlan
  - Delete a DCP
- GetParameterValues
  - Ad-hoc request to retrieve the current values of one or more E125 parameters
- GetObjTypeInstanceIds
  - Request a current list of unique instance IDs for one or more E39 ObjTypes
- GetCurrentPerformanceStatus
  - Retrieve the current Equipment performance status

E134 – Client Services

- NewData
  - Data Collection Report from an active DCP. This includes trace, event and/or exception data
- PerformanceWarning
  - The Equipment detected performance degradation
- PerformanceRestored
  - The Equipment has detected a return to normal conditions
- DCPDeactivation
  - Notification that an active DCP for that consumer is deactivated
- DCPHibernation
  - Notification when one or more persisted DCP are put into the hibernation state as part of Equipment shutdown

Trace Request

- Polling frequency
- Set of non-transient parameters to collect
- Group size
- Optional triggers
  - Event or exception start trigger, to start data collection and reporting
  - Event or exception stop trigger, to stop data collection and reporting
  - In 0710, a trigger can have a Condition which checks a parameter value
    - Such as “stepNumber > 10”

Event Request

- Event ID & Source
- Event Data available
  - Associated transient parameters
  - Any non-transient parameters

Exception Request

- One or more exception criteria
  - ID
  - Severity
  - Equipment Node
- All matching exceptions are reported when SET or CLEAR
- Set of available parameters in the report is fixed in the equipment model

Data Buffering

- Optional buffering interval, in minutes
- If used, all data reports are cached, then sent all at once
- Dramatically improves XML over HTTP performance

For More Information…

- Cimetrix SEMI Standards web page
- Cimetrix EDA/Interface A web page
- SEMI Standards (www.semi.org)
  - E120
  - E125
  - E132
  - E134
  - E164
- Request the Cimetrix EDA/Interface A white paper

cimetrix®

감사합니다
唔該
Merci
Danke
多謝
ありがとうございます
Thank you

cimetrix®