

# EDA: Enabling Realization of the e-Manufacturing Vision



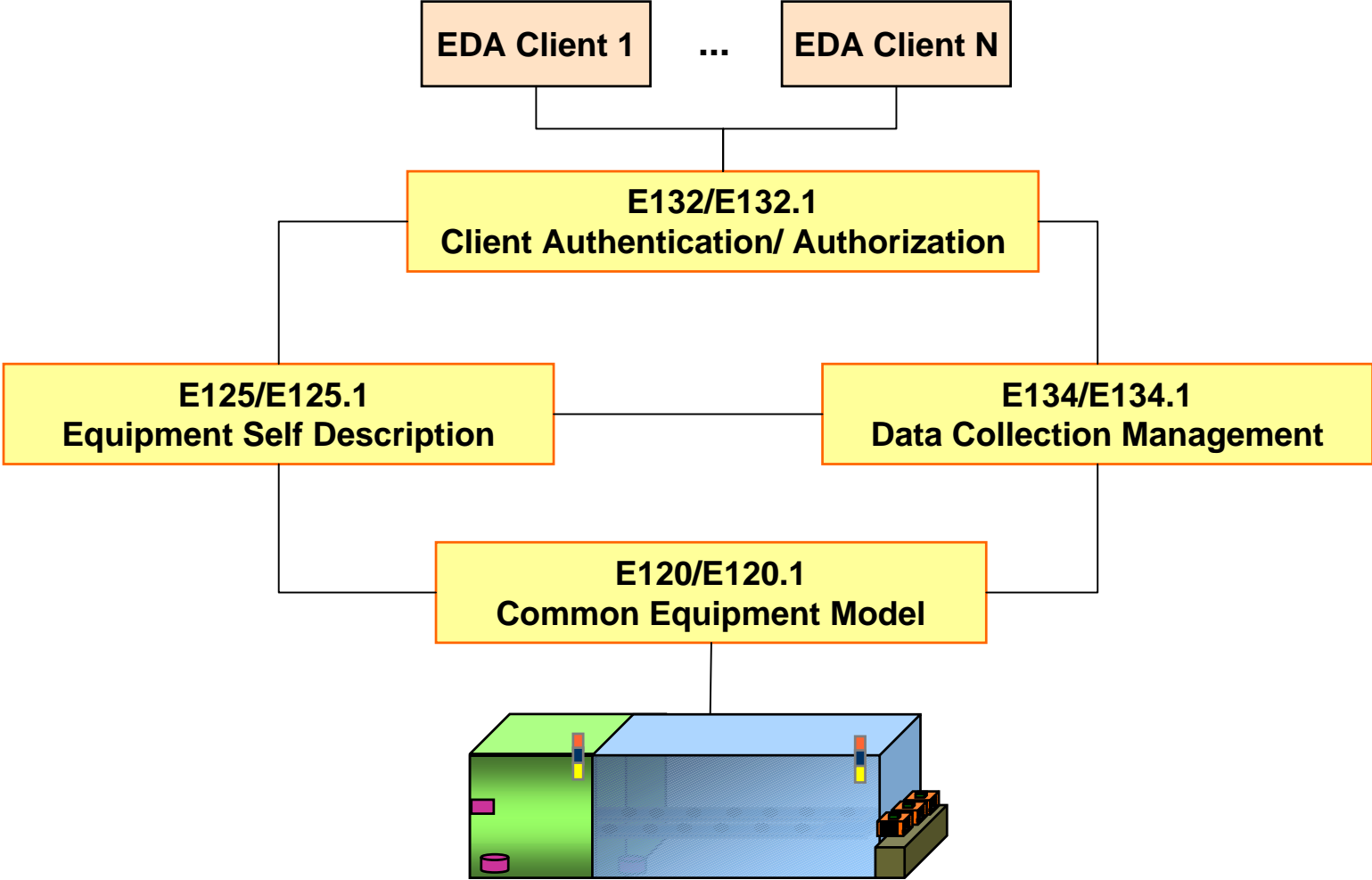
*October 2004*  
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*Asyst*

**ASYST**  
ASYST TECHNOLOGIES INC.

# EDA Standards and Implementation Experience Reports:

- Common Equipment Model (E120)
- Equipment Self Description (E125)
- Data Collection Management (E134)
- Authorization and Authentication (E132)

# EDA Standards Working Together



## E120 – Common Equipment Model (CEM)

- Consistent vocabulary for describing an equipment's structure
- Method for OEM's to describe the physical structure of their equipment using common attributes and terminology
- Framework for other Semi Standards to reference an equipment's structure

**“No Behavior, No Data”**

# E125 – Equipment Self Description: Behavior and Data

Comprehensive set of data structures to describe

- data available from the equipment
  - the behavior of the equipment
- 
- Unit and parameter type information
  - State Machines
  - Exceptions
  - SEMIObjTypes
  - Equipment Node Information
    - Parameters, SEMIObjTypes, exceptions, state machine instance ID

***“Full Tool Description = E120 Description of Tool + E125 Description of Data”***

# E120 and E125: Equipment Modeling

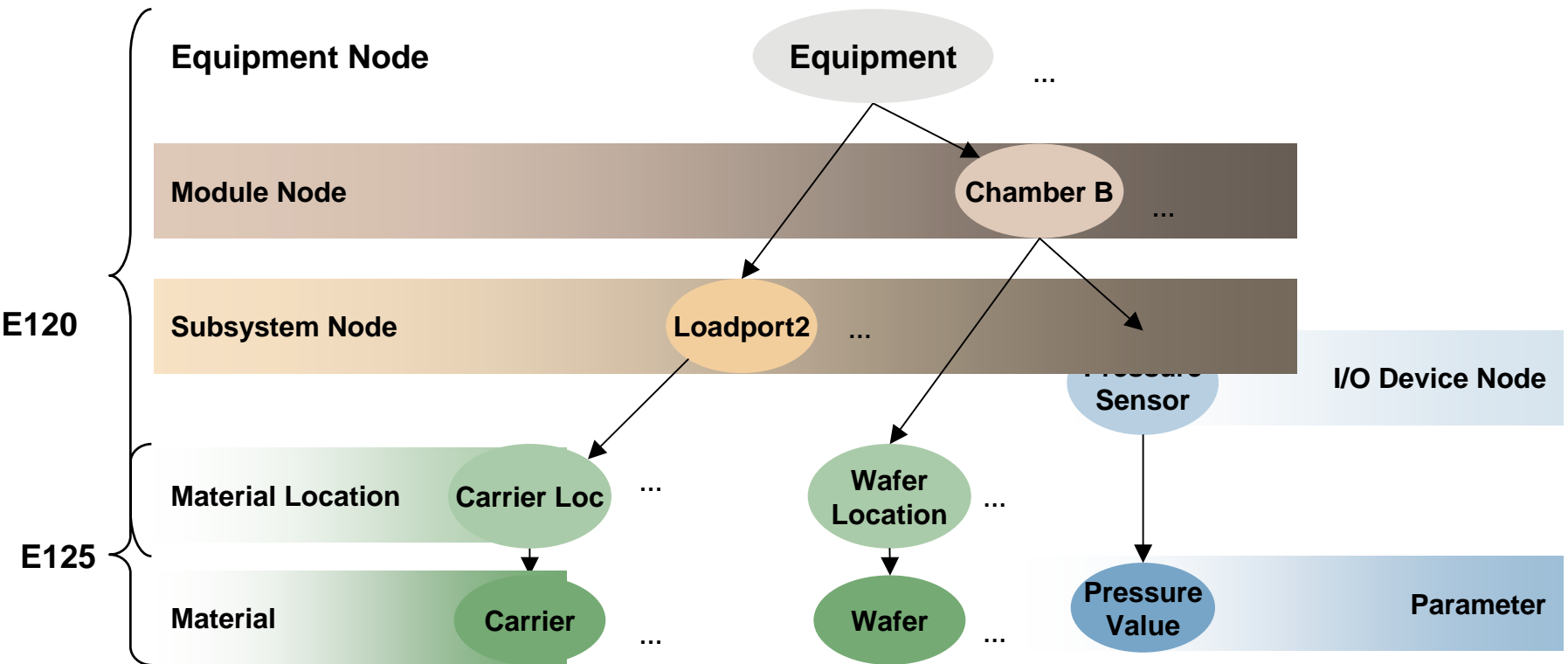
Very few rules:

Material Location must be a child of a Subsystem, Module, or Equipment

Only Equipment or Modules may process material

Equipment Node:

any of Equipment, Module, Subsystem, IODevice, Material Location



*“modeling flexibility does not need to be a concern”*

# E120 and E125 Equipment Model: TrackSys

The screenshot displays the Model Builder interface for the TrackSys404 model. The left pane shows a hierarchical tree structure of the model, including components like Clock, ExceptionConditions, Modules, Coater, HotPlate, and EdaInterface. The right pane shows the 'Attributes' tab for the selected object, TrackSys404, which is of type 'Equipment' and located at 'TrackSys404'. Below this, a table lists various attributes and their values.

Name	Value
objID	TrackSys404
uid	b4fb6055-659e-45bd-bdd0-b279ab56132f
element Type	Track
function	Coat and Bake
immutableID	TrackSys404-01
make	TrackSys
model	TrackSys404
modelRevision	0.1
supplier	TrackSys, Inc.
processName	CoatBake
process Type	Process
recipe Type	CoatBake
description	Exhaust-less Spin Coat and Bake tool
service State	
userCan RemoveFrom Service	false
nickname	
processCapabilityList	Coat;Bake
process Setup	
control State	
eqp Name	Track01

Model successfully opened.

# E120 and E125 Equipment Model: TrackSys

Model Builder - C:\ACS\EIB\samples\ToolModels\TrackSys.xml

File Edit Import Tools Help

State Machine Definitions

- CameraClamp
- DispenseArm
- Hood
  - TopState
    - Substates
      - HoodClosed
      - HoodOpen
      - HotChuckOccupied
      - HotChuckUnoccupied
      - PinsDown
      - PinsUp
      - TemperatureAdjusting
      - TemperatureStable
    - Transitions
      - HoodClosedToOpen**
      - HoodOpenToClosed
      - HotChuckOccupiedToUnoccupied
      - HotChuckUnoccupiedToOccupied
      - PinsDownToPinsUp
      - PinsUpToPinsDown
      - TemperatureAdjustingToStable
      - TemperatureStableToAdjusting
  - State Machine Events
    - HoodClosed
      - TransitionRef
    - HoodOpened
      - TransitionRef
    - PinsDown
    - PinsUp
      - TransitionRef
    - TemperatureAdjusting
    - TemperatureStable
    - WaferPlaced
    - WaferRemoved
- MFC
- PhotoresistPump
- SpinChuck
- TransferArm
- Valve

Attributes Comments

Object: HoodClosedToOpen Type: Transition

Locator:

Name	Value
<b>name</b>	HoodClosedToOpen
<b>id</b>	HoodClosedToOpen
<b>sourceStateName</b>	HoodClosed
<b>targetStateName</b>	HoodOpen
<i>description</i>	

Transition

Model successfully opened.

## E125 – Equipment Self Description: Messages Access to CEM and ESD Information



- Defines methods which clients can utilize to access this equipment definition
- Provides access to Equipment Description as opposed to E134 Data Collection plan which provides access to data
- Full discoverability is something people have struggled to achieve for a long time and is appreciated

*“Full Discoverability is appreciated”*

# E125 – Equipment Self Description: Messages

- The equipment structure *description* (tool configuration)
  - Retrieves all equipment structural metadata  
`GetEquipmentStructure (RR from client)`
- The *description* of data available from an equipment node
  - Retrieves all equipment node metadata  
`GetEquipmentNodeDescription (RR from client)`
    - Parameters
      - list of typed parameters provided by this equipment node.
    - E39 objects
      - list of the SEMIObjTypes that are associated with this equipment node.
    - Exception
      - list of exceptions that can be reported by this equipment node
    - state machine instance ids
      - list of state machines instances that are supported by this equipment node

.....

**“RR == Request/Reply    FF == FireAndForget”**

# E125 – Equipment Self Description: Messages

- The equipment node components *description*
  - Retrieves all Unit and ParameterType metadata
    - GetUnits (RR from client)
    - GetTypeDefinitions (RR from client)
  - Retrieves all Semi object type metadata
    - GetSemiObjTypes (RR from client)
  - Retrieves all Exception metadata
    - GetExceptions (RR from client)
  - Retrieves all state machine metadata.
    - GetStateMachines (*RR from client*)

....

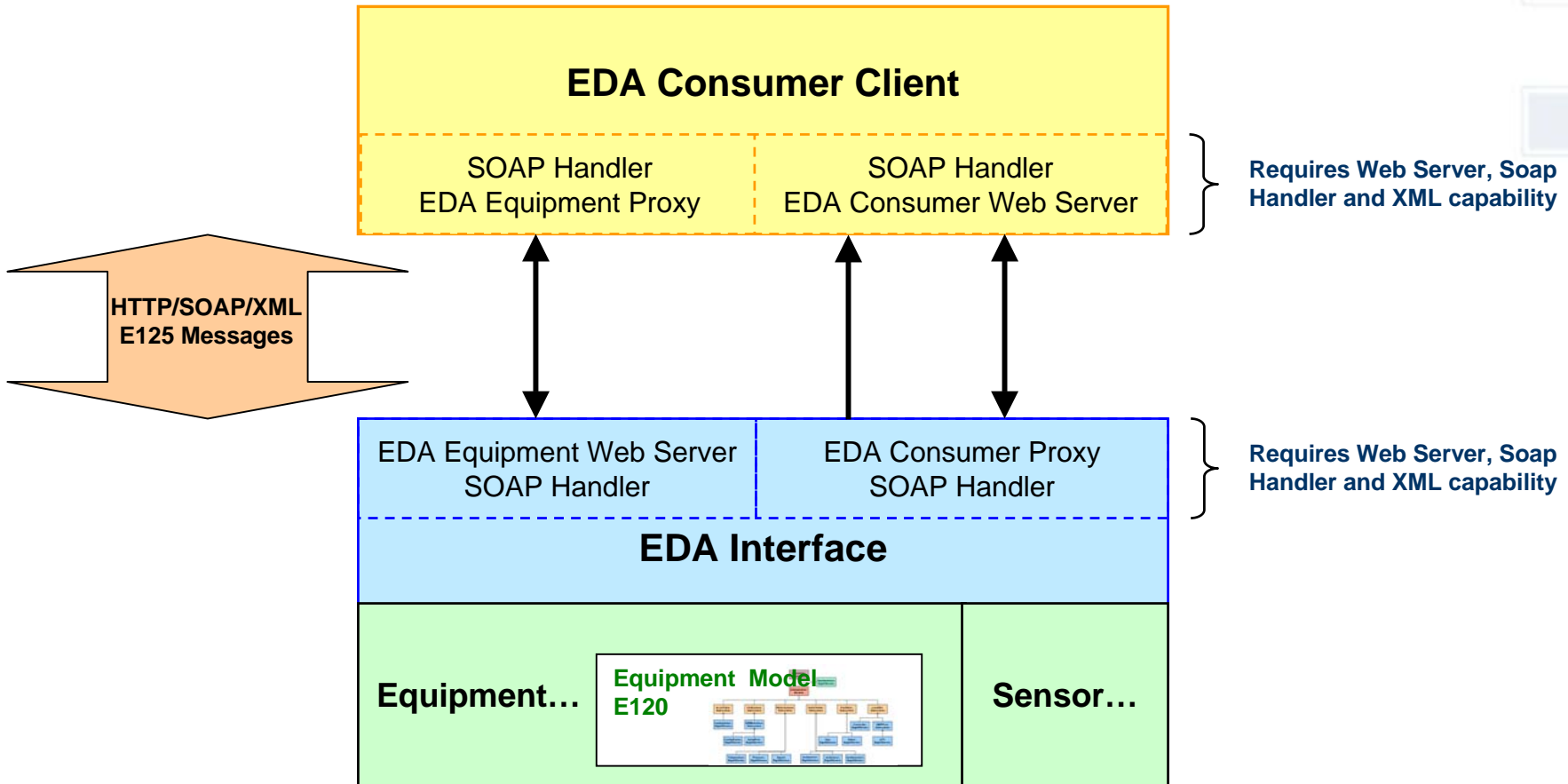
***“WSDLs and Schemas are a great way to clearly define this”***

# E125 – Equipment Self Description: Messages

- The equipment metadata revision *description*
  - Retrieve the last date and time at which the equipment metadata was revised  
`GetLatestRevision (RR from client)`
  - Request that the equipment notify the requestor when changes to the metadata are made  
`NotifyOnRevisions (RR from client)`
- MetadataRevised *notification*
  - Notifies the client that the metadata has recently changed.  
`MetaDataRevised (FF from Equipment)`

***“The EDA quickplace website is invaluable”***  
***[http://teams.semi.org/QuickPlace/stds\\_icdda/Main.nsf](http://teams.semi.org/QuickPlace/stds_icdda/Main.nsf)***

# E125 Messages: Transporting them



*“We changed webservers to improve performance and compliance”*

# CEM and EDA Experiences

- Yes – there are a lot of “technologies” to master (WSDL, Schema, uids, ....) – but they are all IT industry standards that are well supported
- Equipment today is complex and consequently modeling it involves some detail – but proper tools facilitate this
- Tool events can be modeled within the context of a state machine - but it requires thinking about the tool operation in a different way than we have typically done in the SECS/GEM world

*“Glad to see standards using ‘technologies’ common to other industries”*

# CEM and EDA Experiences:

## Coordination of Standards: E39 and 300 mm standards

- Control Job, Process Job, Material Location, Material, EPT
- Material Locations are CEM Objects and are also defined as E39 SEMobjects
  - CEM identifies where in the equipment structure the location is positioned
  - E90 defines an E39 object type to provide the stateful behavior of the location (occupied, unoccupied, ...)
- 300 mm mapping requires some thought – task force is addressing it
  - E90, Substrate Object State Model: cannot currently model with EDA state machine definition (issue with transitions 7 and 9)
  - EDA specs currently do not require any SECS state variable values to appear in the state machine in any way : Working on how to tie in things such as E94.1 state variable values like
    - 0 - QUEUED
    - 1 - SELECTED
    - .....
    - 5 - COMPLETED

***“Time well spent to have EDA Task force coordinate related standards”***

## CEM and EDA Experiences: Dynamic SEMIObjects

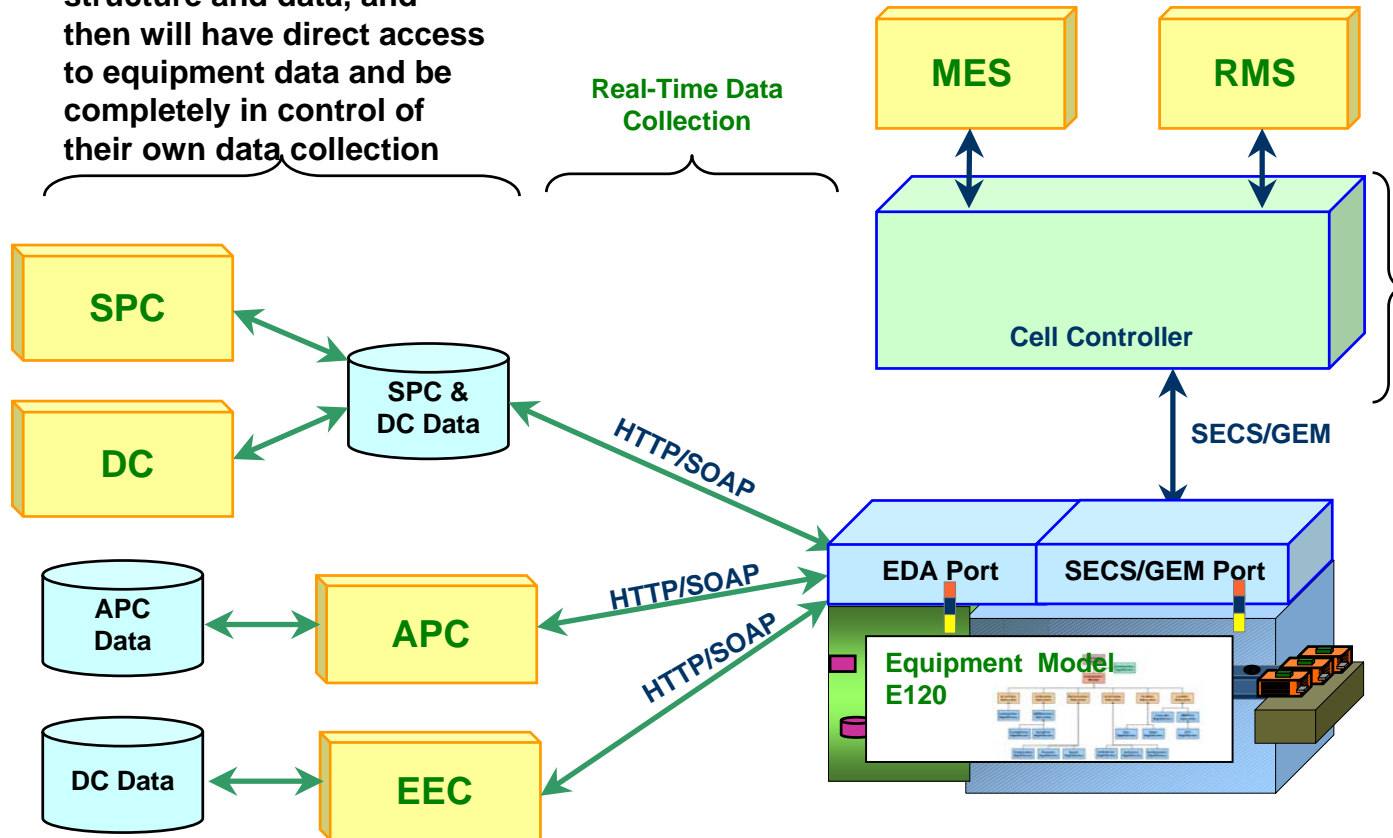
- The transient nature of these objects makes them the most interesting and most challenging to manage and report
- The standard requires that these objects be accessible through CEM nodes – that may not rule out additional access via “Managers”
- The most challenging situations occur when you consider “nested” dynamic objects: e.g. Carrier Location, contains a Carrier, which has Substrate Locations, which contain Substrates.

***“EDA will not correct perceived flaws in the 300 mm standards: It will just make them discoverable and reportable”***

# E120 CEM and E125 EDA: Redefine the Next Generation Equipment and Cell Controller

Data Consumers will be able to interrogate equipment to determine its structure and data, and then will have direct access to equipment data and be completely in control of their own data collection

Real-Time Data Collection



*“Discoverability and Multi-Client HTTP/SOAP/XML Access Have ‘Changed the Rules’ ”*