Improved Geometry Transfers of Populated Printed Wiring Boards Between ECAD and MCAD Systems

Robb McCord
Cad/Cam Engineer
Northrop Grumman

GLOBAL PRODUCT DATA INTEROPERABILITY
SUMMIT
2014

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Overview

- Organization overview
- Designs of Printed Wiring Boards (PWB's) proceeds in parallel on separate Ecad and Mcad systems – Expedition and NX 7.5
- Geometry Checking is on–going during the design:
  - Board outline
  - Component pin 1 location
  - Through and blind holes
  - Keepouts, other outlines and cutouts
  - Dxf or iges based using overlays
- Vendor supplied IDF software (Epak) for Ecad <> Mcad transfers creates "dumb extrusions" (not exact)

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ES Engineering Environment Development and Support

- **Provide engineering tools, support and infrastructure across the sector to facilitate the "Design Anywhere" concept and associated return on investment.**
- **Develop, Maintain and Optimize the engineering tools and related infrastructure across the sector. Resulting in increased engineering mobility, efficiency, productivity and lower overall tool costs.**
- **Key Activities:**
  - **Maximize tool license utilization and ensure license compliance**
  - **Provide technical tool support to maximize efficiency, leverage reuse and increase proficiency**
  - **Technology Insertion to address program needs**
  - **Address application interoperability, version compatibility & data conversion**

- **Greg Hodges Director EEDS**

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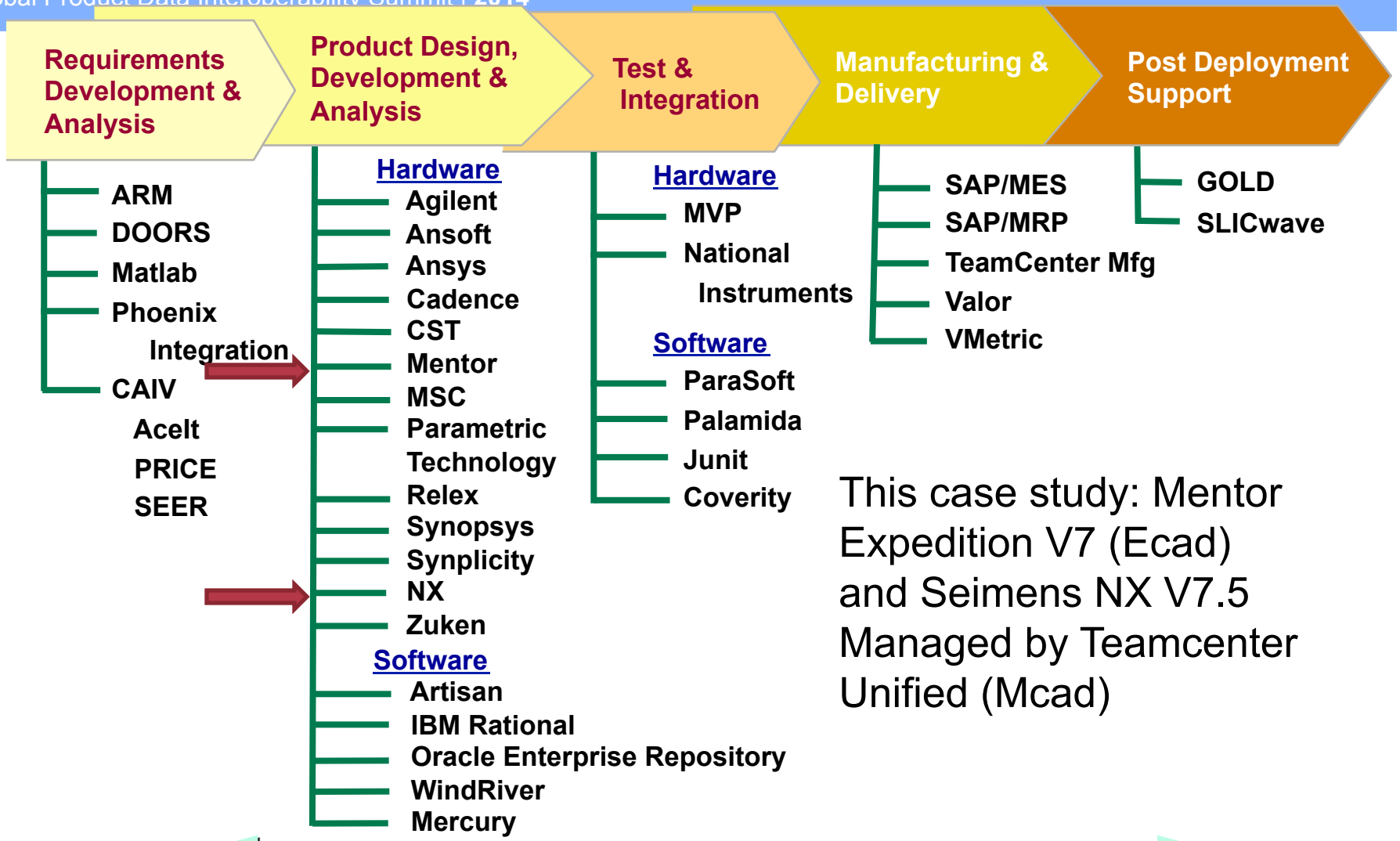
ES Sector Primary Common Tools



This case study: Mentor Expedition V7 (Ecad) and Seimens NX V7.5 Managed by Teamcenter Unified (Mcad)

- **ES Sector Wide Tools - Fully Supported Engineering Tools - (Tier 1)**
  - **NX, TcU, Mentor Expedition, …**
- **Multi-Campus Tools - Partially Supported Engineering Tools - (Tier 2) Legacy data/software, previous/interim standards**
  - **Inventor, Cadence Allegro, …**
- **Specialty Tools- Site or Department Engineering Tools - (Tier 3) engineering tools that are specialty or niche (not EEDS supported)**

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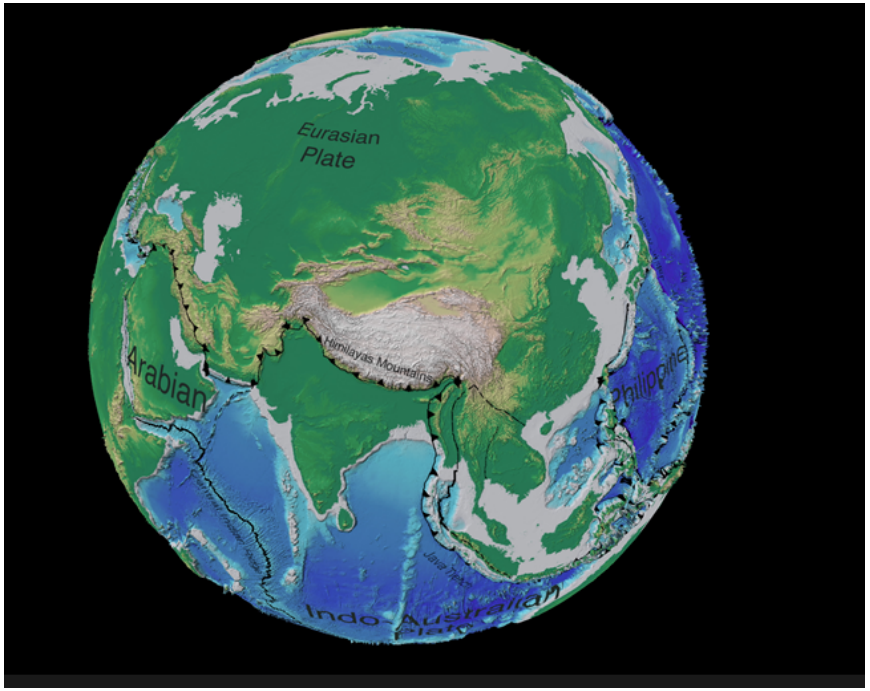
Historic Ecad <> Mcad Disconnect

Ecad World View



Mcad World View

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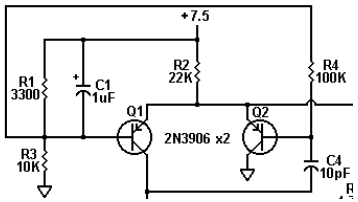
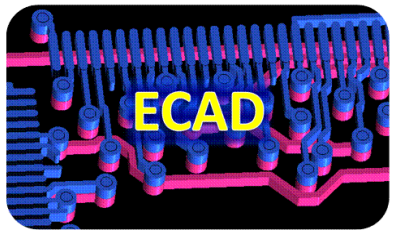
Former Process for Mcad <> Ecad Interoperation



DX Designer

Forward Annotation



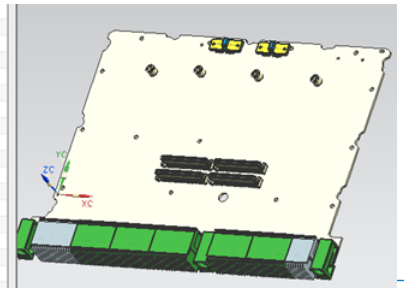
Mentor Expedition

Competed Mcad/Ecad Board Model

Ad-hoc dxf or idf checking

Schematic , component selection, geometry development

Ad-hoc dxf or idf checking



MCAD NX

Board design areas:
Antenna
RF
Power supply
Digital

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Definitions

- ***Reference Designators***: **alphanumeric designation for board components that need to be preserved through out any transfers**
- ***Critically placed connectors***: **interface with other parts of the mechanical design.**
- ***Intermediate Data Format (IDF):*** **early standard attempting to bridge the Ecad/Mcad chasm**
- ***"Epak":*** **bidirectional IDF translator from LTX Software – add on to NX**
- ***Mentor Expedition Cell***: **Library storage unit – multiple cells per p/n based on different board outlines**

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Former Process for Mcad <> Ecad Interoperation

- **In parallel**
  - **Ecad selects connectors to package and assigns reference designators for each component**
  - **Mcad creates board and other outlines with board origin with 1 unplated hole for 0,0**
- **A series of "ad-hoc" transfers of IDF and DXF are used to manually check the geometry as the design proceeds.**
- **Basically overlays of wireframe**
- **Corrections manually communicated**

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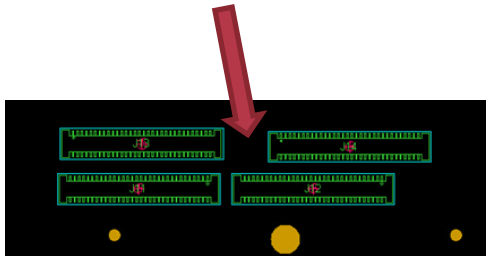
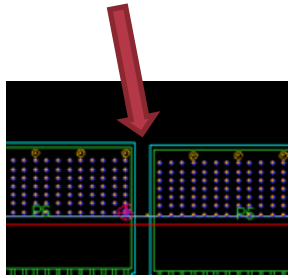
Problems with Former Process

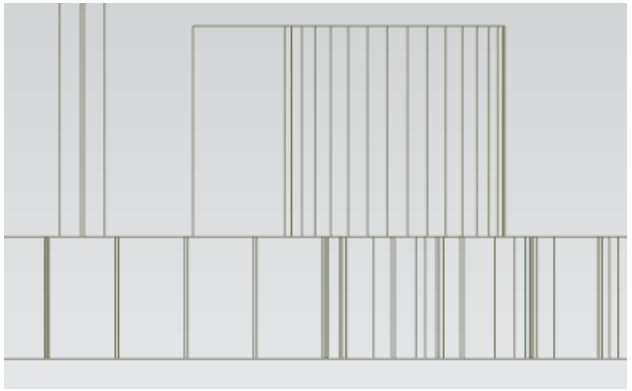
- **Human errors associated with manual processes**
- **Tough to spot differences in the size range of the thickness of a line on the screen**
- **Reference designators were not preserved in dxf and these are required for any type of associatively between Ecad and Mcad systems.**



Easy



Hard



Impossible

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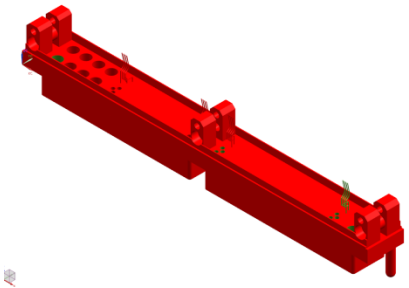
One to Many Problem

- **One 3D NX model for each critically placed library part (mostly connectors), example Amphenol p/n 10_507820**
- **One Mentor Expedition library part for each *orientation* of that part, i.e., board top, bottom, side or x-y orientation**



Mcad library part

10_507820_topy

10_507820_edge

10_507820_topx

Expedition library parts

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The problem with IDF

- **Reference designators are preserved (unlike dxf) – good.**
- **Out of the box Epak behavior is of 2 flavors:**
  - **Basic: builds 2d geometry on Mcad import and then extrudes the components in “dumb” solids based on the Z axis height of the Expedition library part. Ref Desk's are preserved. Round tripping is possible**
  - **Advanced: Will substitute in “real” library connectors on Mcad import but remember “one to many” - Which One? And What Orientation?**

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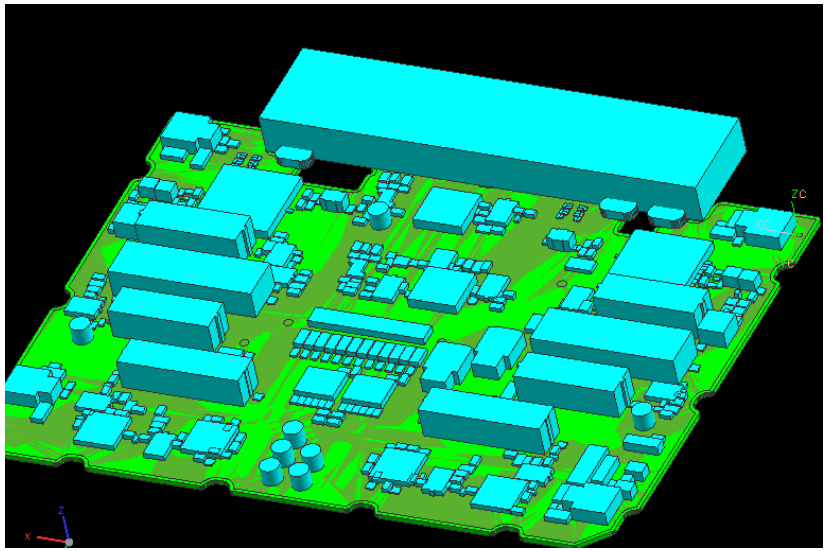
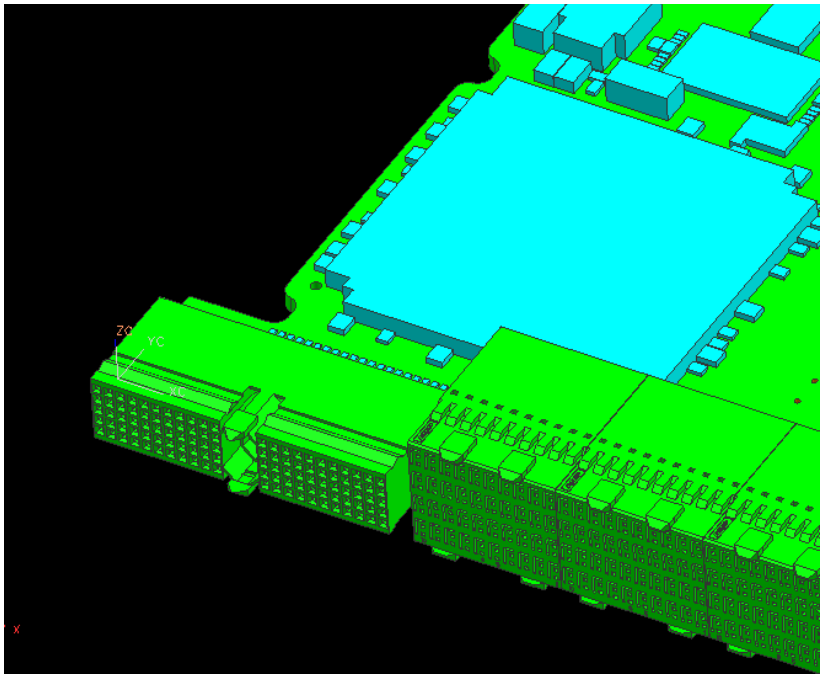
The problem with IDF



Basic: Dumb Extruded Mcad Model based on Ecad library heights – inexact and dangerous



Advanced: Real Mcad assembly model with actual connector library parts – the Holy Grail

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Genesis of a Solution

- **NX Reference Set: Designates what geometry is to be displayed in a component at a higher assembly level.**
- **NX Work Coordinate System (WCS): stored information on orientation and location**
- **Eurekea Discovery: NX has an undocumented ability to store a WCS in a Reference Set**
- **What if….**

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...What If?

- **Every Mcad connector library part had a *reference set* that contained geometry and a saved WCS that matched it to every occurrence of that connector in the Ecad library?**
- **The Epak software could map everything thus maintaining associativity in cell names and reference designators in bidirectional IDF transfers?**
- **As a preview, full credit for what follows goes to Keith Anderson and LTX Software for working with us and implementing all the required changes.**

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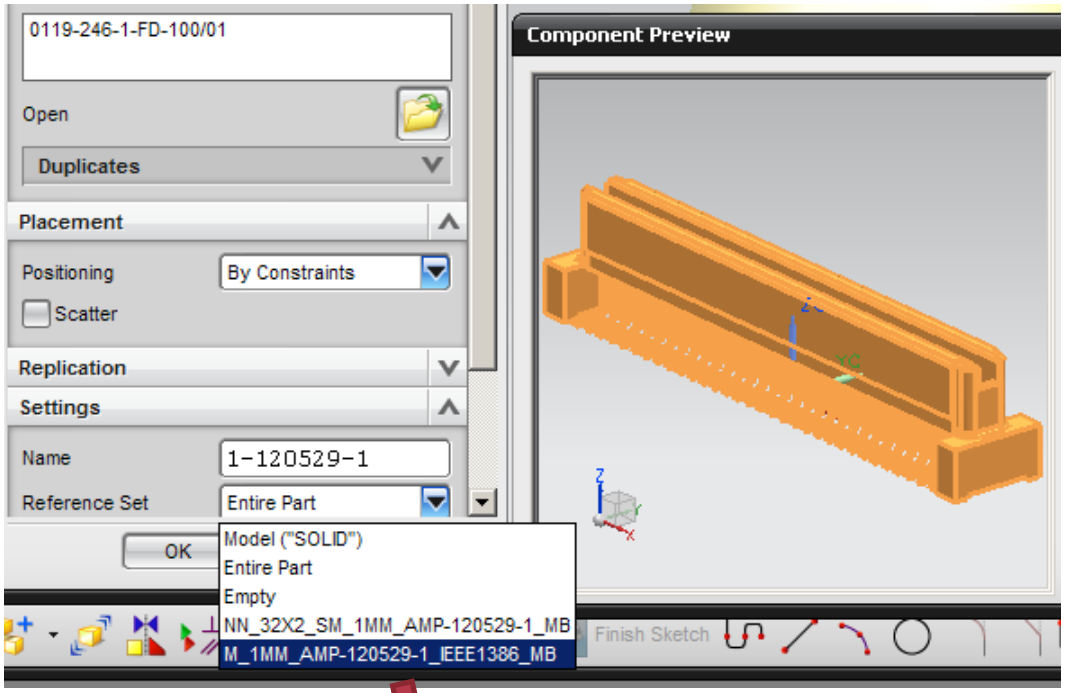
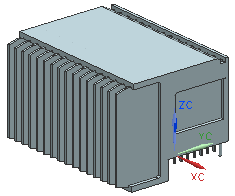
Solution Essentials – Part 1 – Mcad Library Modification



Add Reference Sets



Solid

+

Saved WCS

Mcad reference set names match Ecad cell names – one to one.

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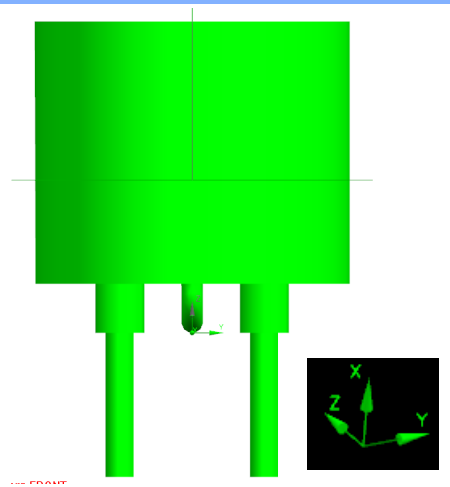
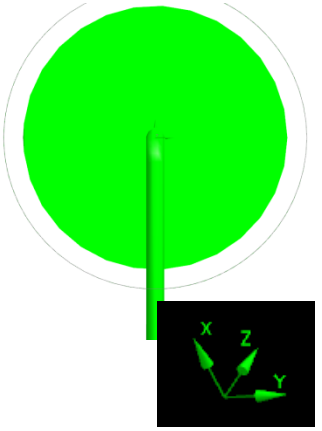
Solution Essentials – Part 1 – Mcad Library Modification

MCAD		ECAD
Solids plus saved coordinates system		**2D board footprint outline**
NX p/n 1-120529-1 **Ref Set** **nn_32x3_1-1205290-1**	**=**	**Expedition cell** **nn_32x3_1-1205290-1**
NX p/n 1-120529-1 **Ref Set** **m_1mm_1-1205290-1**	**=**	**Expedition cell** **m_1mm_1-1205290-1**





Geometry plus orientation … equals a one to one mapping between Mcad and Ecad

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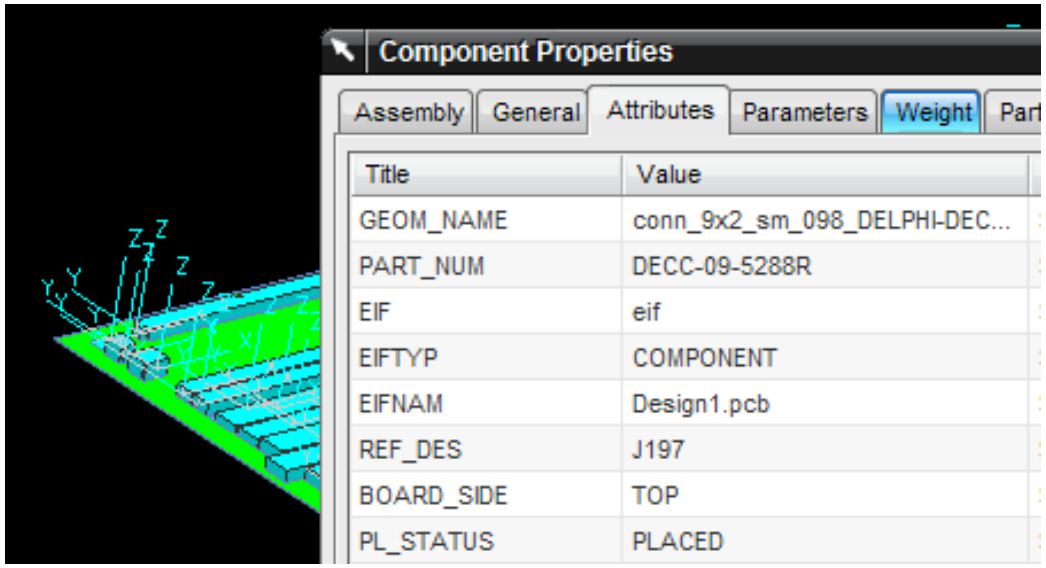
Solution Essentials – Part 2 Component Properties Created During IDF Import



- NX attributes created in NX board assembly file on first IDF import (initialization).
  - Mentor cell name, P/N, reference designator, board side etc.
- Preserved in future round trips to Expedition and back

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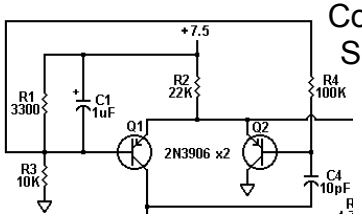
Solution Overview

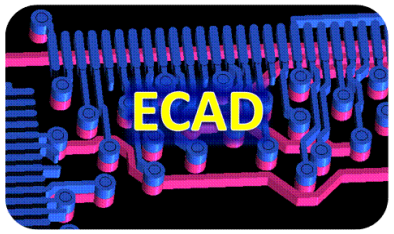


DX Designer

Component Selection

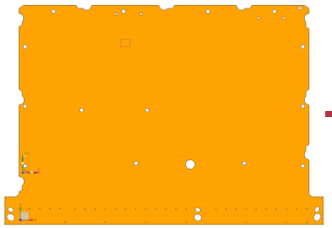
Initialization

Process



Expedition

Collaboration Process



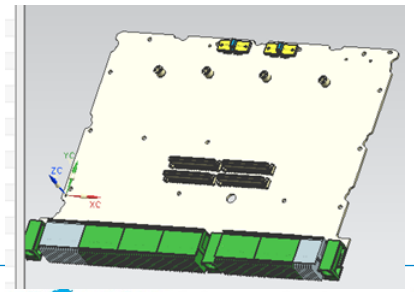
Mcad NX

Board shape, Component Selection and location

NXpedition

idf 3.0 processing No via's

Mcad NX



NXpedition

idf 3.0 processing

Changes in connectors and board outline convey

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Custom IDF Processing - NXpedition

- **In house developed visual basic to post-process IDF files from Mentor Expedition and Siemens NX**
- **Expedition to NX**
  - **Rename IDF and library files from emn and emp to brd and lib**
  - **Remove routing via's (not required on Mcad and makes files too large to process sometimes)**
  - **Syntax validation and geometry checking.**
- **NX to Expedition**
  - **Rename IDF and library files from brd and lib to emn and emp**
  - **Remove spaces in layers, syntax validation and geometry checking.**
- **Future customizations**

NXpedition
(ECAD/MCAD)

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Solution Details

- **Uses Epak IDF in component substitution mode**
- **Saved NX reference sets represent each Expedition cell to solve the one to many problem**
- **After initialization, data can be round tripped as many times as necessary with preservation of : p/n's, board geometry, reference designators, cell names, origins and orientations.**
- **Incoming IDF automatically syncs geometry on the receiving system**
- **Eliminates most of the tedious human checking looking for changes**

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Usage Scenario: Initialization process builds Mcad assembly with library components based on incoming IDF

Assembly Navigator

Number	Revisi...	Name	Description	ref_des
Sections				
IDF_TEST_SEK	01	idf_test_sek	IDF_TEST_SEK	
1410187-3	01	CONNECTOR, PLUG, RT ANGLE, 7 ROW X...	MultiGig RT2 daughter 3-row 16-column	P5
1410187-3	01	CONNECTOR, PLUG, RT ANGLE, 7 ROW X...	MultiGig RT2 daughter 3-row 16-column	P4
1410187-3	01	CONNECTOR, PLUG, RT ANGLE, 7 ROW X...	MultiGig RT2 daughter 3-row 16-column	P3
1410187-3	01	CONNECTOR, PLUG, RT ANGLE, 7 ROW X...	MultiGig RT2 daughter 3-row 16-column	P2
1410187-3	01	CONNECTOR, PLUG, RT ANGLE, 7 ROW X...	MultiGig RT2 daughter 3-row 16-column	P1
1410189-3	01	1410189-3	1410189-3	P0
0119-246-1-FD-100	01	CONNECTOR, GPO, FULL DETENT, MALE ...	I:\ug1\a\templates\connectors\smountgpo...	J20
0119-246-1-FD-100	01	CONNECTOR, GPO, FULL DETENT, MALE ...	I:\ug1\a\templates\connectors\smountgpo...	J21
0119-246-1-FD-100	01	CONNECTOR, GPO, FULL DETENT, MALE ...	I:\ug1\a\templates\connectors\smountgpo...	J22
0119-246-1-FD-100	01	CONNECTOR, GPO, FULL DETENT, MALE ...	I:\ug1\a\templates\connectors\smountgpo...	J23
1-1469492-9	01	CONNECTOR ACCESSORY, GUIDE, MODU...	1-1469492-9	J3
1-1469492-9	01	CONNECTOR ACCESSORY, GUIDE, MODU...	1-1469492-9	J2
1-1469492-9	01	CONNECTOR ACCESSORY, GUIDE, MODU...	1-1469492-9	J1
A17860-001	01	CONNECTOR, 10 PIN, MALE, HORIZONTAL...	Connector,10 pin w/mtg latch	J101
A17860-001	01	CONNECTOR, 10 PIN, MALE, HORIZONTAL...	Connector,10 pin w/mtg latch	J102
1410190-3	01	1410190-3	1410190-3	P6
1-120529-1	01	CONNECTOR, RECEPTACLE, BOARD STA...	120529_1	J13
1-120529-1	01	CONNECTOR, RECEPTACLE, BOARD STA...	120529_1	J11
1-120529-1	01	CONNECTOR, RECEPTACLE, BOARD STA...	120529_1	J14
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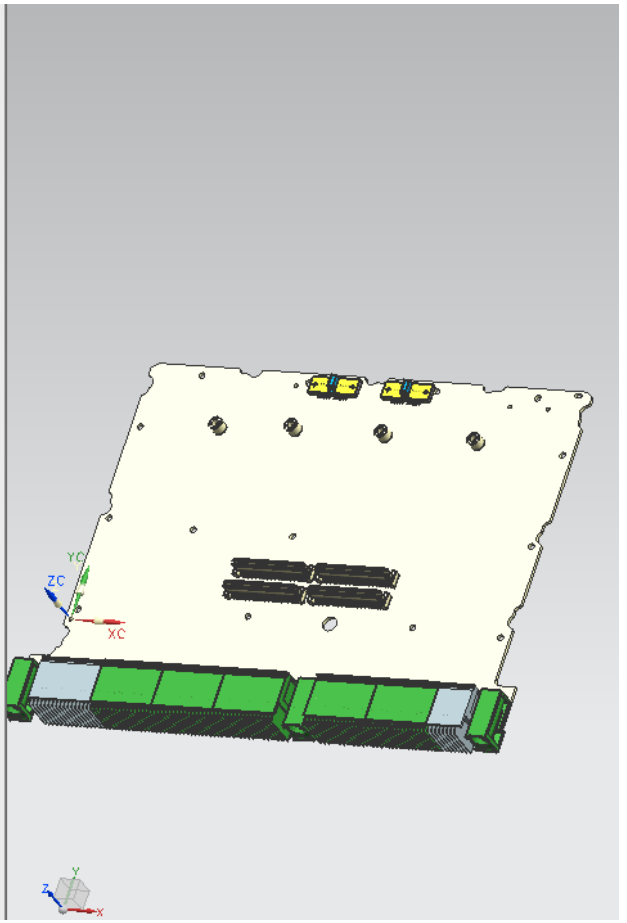

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Descriptive Part Name	Reference Set
Sections	
idf_test_sek-01	
1410187-3-01	X7_1.8X1.35MM_TYCO-1410190-3_A
1410187-3-01	X7_1.8X1.35MM_TYCO-1410190-3_A
1410187-3-01	X7_1.8X1.35MM_TYCO-1410190-3_A
1410187-3-01	X7_1.8X1.35MM_TYCO-1410190-3_A
1410187-3-01	X7_1.8X1.35MM_TYCO-1410190-3_A
1410189-3-01	X7_1.8X1.35MM_TYCO-1410189-3_A
0119-246-1-fd-100-01	CONN_GPO_GILBERT-0119-246-1_A
0119-246-1-fd-100-01	CONN_GPO_GILBERT-0119-246-1_A
0119-246-1-fd-100-01	CONN_GPO_GILBERT-0119-246-1_A
0119-246-1-fd-100-01	CONN_GPO_GILBERT-0119-246-1_A
1-1469492-9-01	CONN_2_SM_TYCO-1-1469492-X_A
1-1469492-9-01	CONN_2_SM_TYCO-1-1469492-X_A
1-1469492-9-01	CONN_2_SM_TYCO-1-1469492-X_A
a17860-001-01	0_SM_50_OMNETICS-A17860-001_MB
a17860-001-01	0_SM_50_OMNETICS-A17860-001_MB
1410190-3-01	X7_1.8X1.35MM_TYCO-1410190-3_A
1-120529-1-01	NN_32X2_SM_1MM_AMP-120529-1_MB
1-120529-1-01	M_1MM_AMP-120529-1_IEEE1386_MB
1-120529-1-01	NN_32X2_SM_1MM_AMP-120529-1_MB
1-120529-1-01	M_1MM_AMP-120529-1_IEEE1386_MB

Single P/N with 2 reference sets (ie there are 2 ECAD cells for this p/n.

NX Reference Set Name = Expedition Cell Name

P/N's common to ECAD and MCAD

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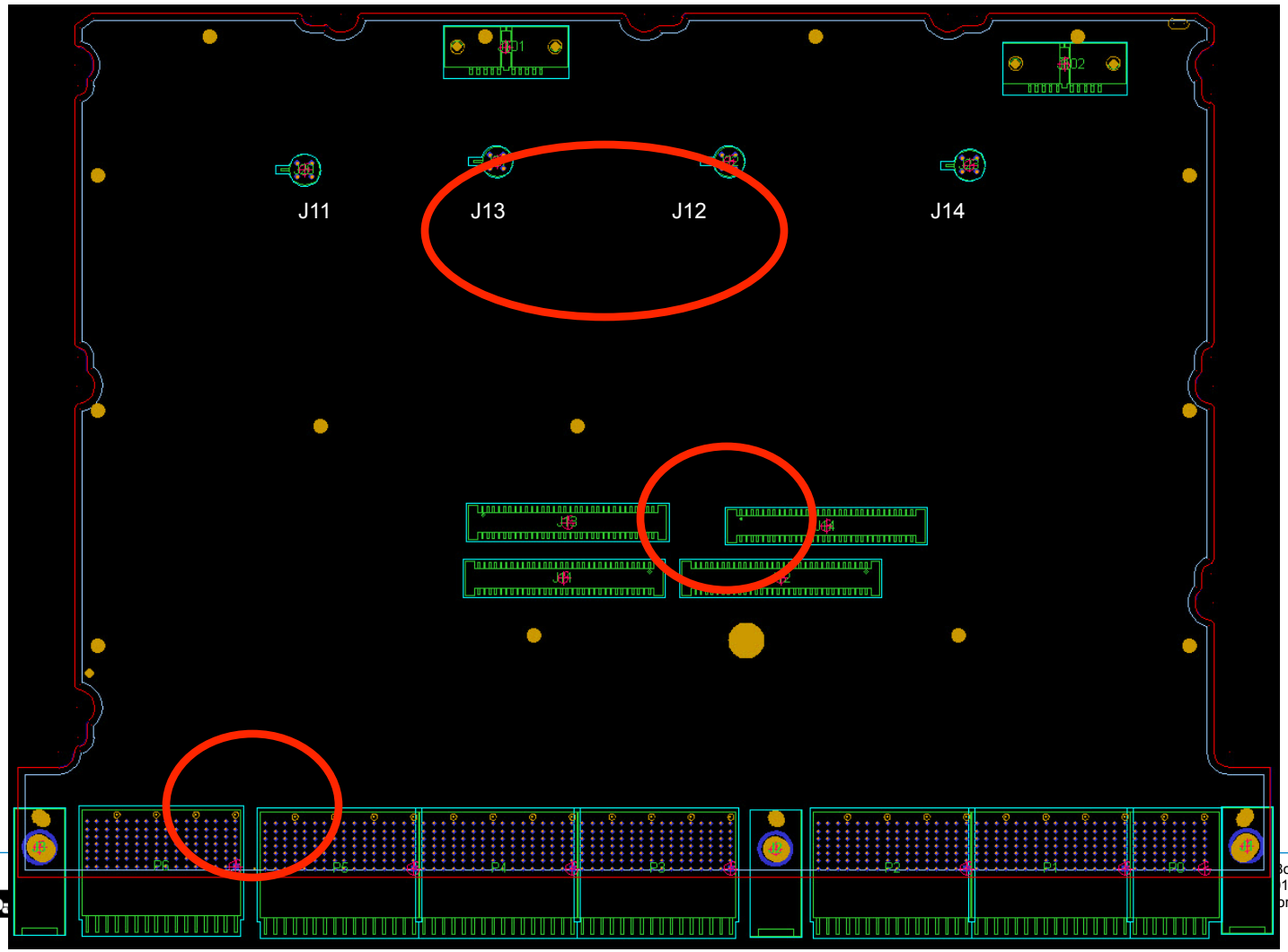
Usage Scenario: But some components are misplaced and Reference Designators incorrect



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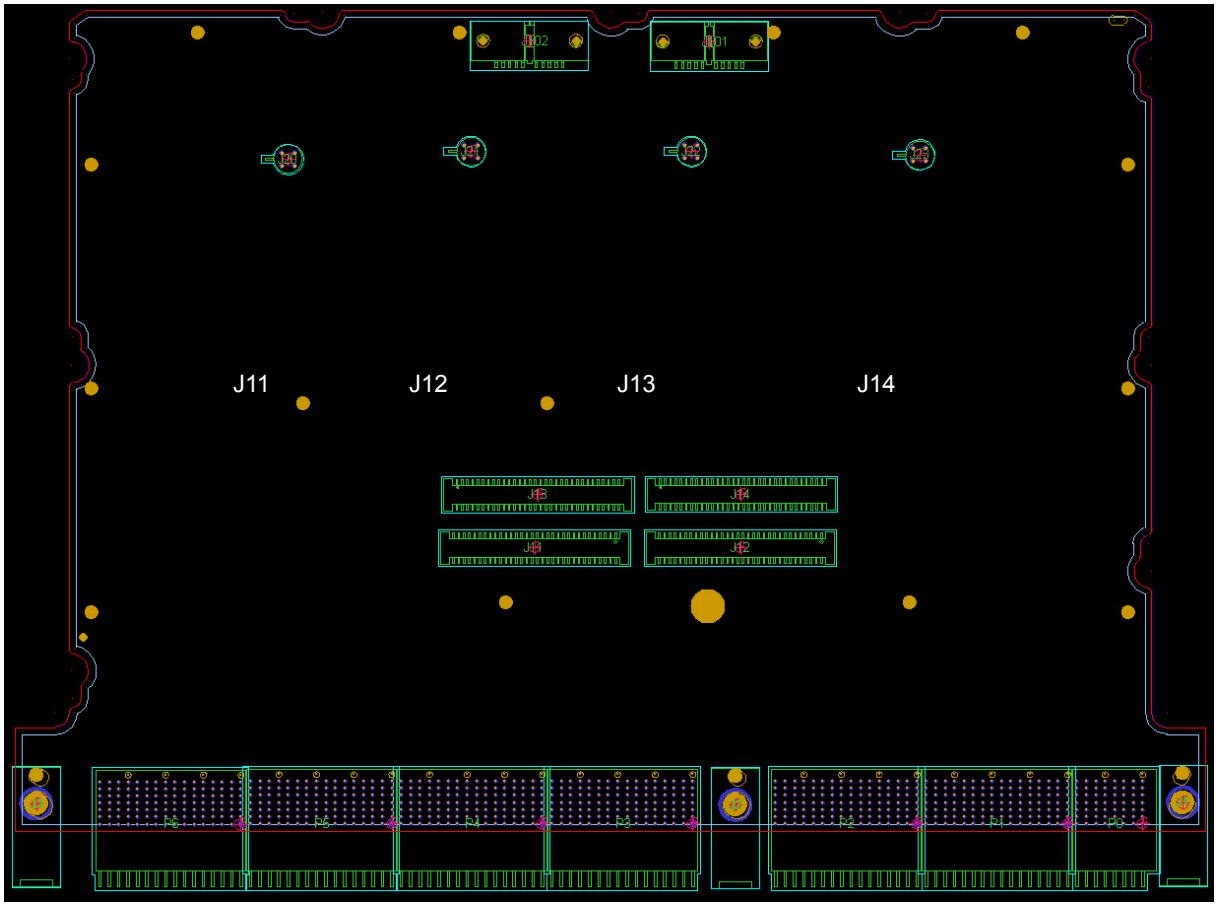
Usage scenario: Mcad corrects model and roundtrips IDF back to Expedition where changes automatically made



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Issues

- **Some types of holes get double geometry sometimes**
- **Developing a list of connectors that will be used moving forward (i.e. not everyone ever used)**
- **“special” geometry only used at NGES**
- **NX7.5 – 30 character limit in reference set name**
- **Convincing Ecad that they won’t fall off the edge of their world! (i.e. cultural resistance to process change)**
- **Undocumented WCS reference set capability in NX may go away**
- **Part families**

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Future

- **Work with LTX to develop “no move” option for when design is complete and no “auto move” is desired**
- **Develop capabilities for other types of components such as chips, caps and resistors.**
- **Cleanup of legacy names in Mcad and Ecad libraries so there is a strict “one to one” correlation**
- **Complete modifying NX library connectors with Expedition library info.**
- **Complete Rollout in NX 8.5 – 3rd quarter 2014**

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Conclusion

- **Solution developed that solves the basic “one to many” disconnect and allows full Mcad / Ecad interoperation**
- **Automatic geometry error checking – locations and shape are locked in synch between the two systems.**
- **Anybody using NX and the current version of LTX Epak IDF software can utilize**
  - **IDF to Mcad – matching p/n and reference set**
  - **IDF to Ecad – matching p/n and cell name**
- **Greatly reduces errors and costly rework .**

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Thank You

Questions?

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