

# OneBoard:

*A New ECAD/MCAD  
Data Exchange  
Process*

**Kelli Hosier, presenting  
Robb McCord  
Doug Renwick, presenting  
Mike Rindos**

## GLOBAL PRODUCT DATA INTEROPERABILITY **S U M M I T** 2017



# Biographies – Northrop Grumman OneBoard Team

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- Kelli Hosier (EEDS) has been supporting Mentor Graphics tools for over 20 years. Her duties include writing automation to improve tool usage and feeds to external processes as well as providing training and support to users. She is also responsible for integrating the Mentor Graphics Expedition tools to the corporate PLM system.
- Robb McCord (EEDS) is a product data exchange specialist focusing on supply chain and customer interoperability. He has had leadership roles in industry initiatives like AFEI, PDES Inc. and PLM World and is currently exploring means for conveying Product Manufacturing Information annotated models to the supply chain.
- Doug Renwick (EEDS) has been a software developer for 22 years. He currently develops and supports custom software applications and plug-ins for mechanical design tools. On a regular basis he also coordinates technical seminars for mechanical engineers and designers.
- Mike Rindos (EDS) has been a production engineer for 2 years. Mike primarily collaborates with mechanical engineers to introduce new engineering designs to the production floor while providing a level of configuration. His other focuses are program risk identification and risk management.

# Agenda

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- Overview of the OneBoard project
- Background
- Documentation of current process
- Solution Overview
- Status
- Future Plans
  - Siemens acquisition of Mentor factors

# Overview

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- Board data files are exchanged between MCAD (NX) and ECAD (Expedition) for many reasons
  - Synchronizing MCAD and ECAD representations of board: origins, mounting holes, outlines, keepout areas, etc.
  - Board checking: interface with surrounding structure, chassis, heatsinks, mounting hardware
  - Placement checking: interference between different parts, between parts and mechanical hardware, and between component/connector locations
  - Routing checking: interference between copper routes on outer layers and mechanical hardware, surface traces, shorting, thermal interfaces and RF/digital ground planes.



# Problem and Proposed Solution

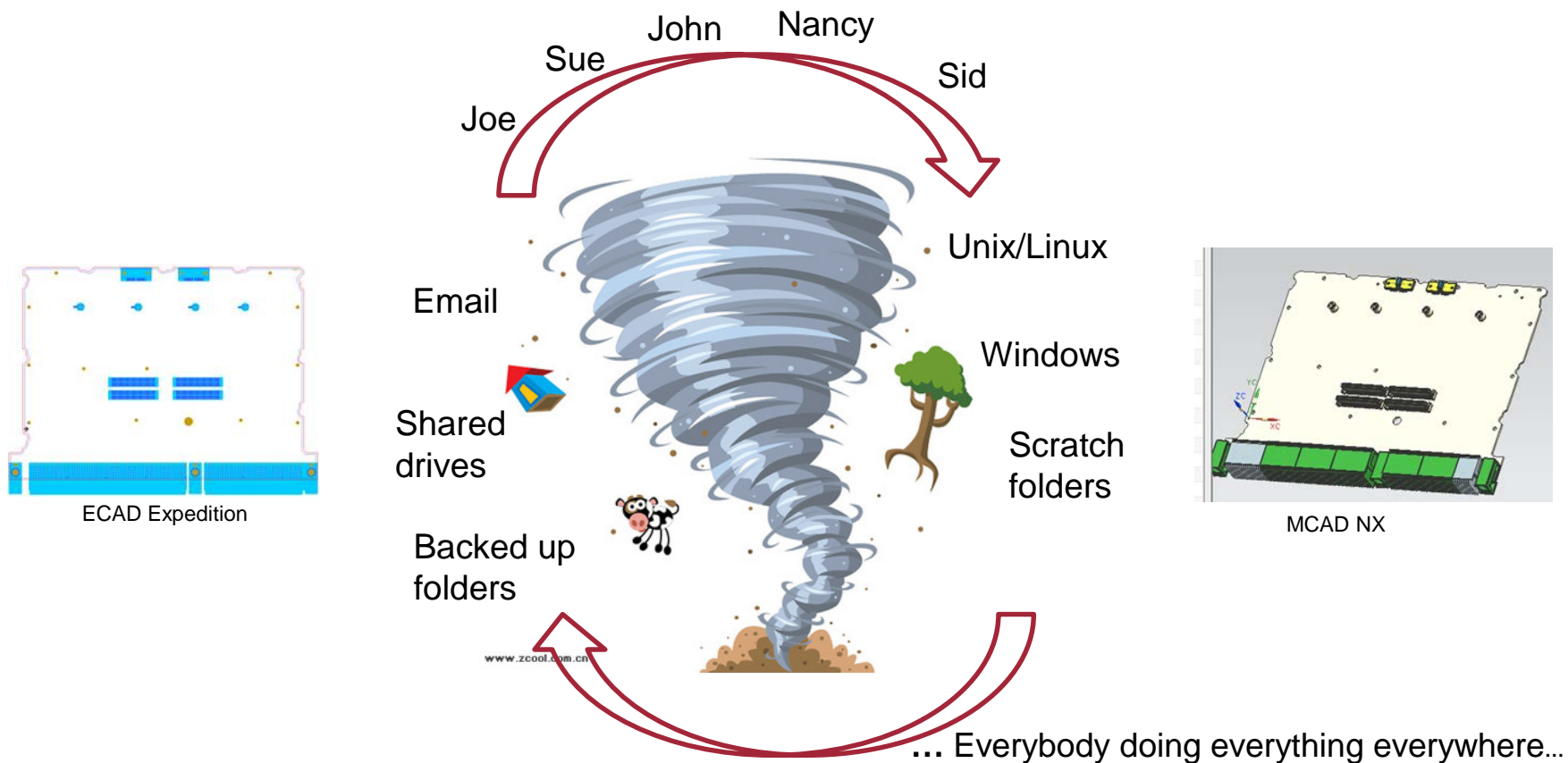
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- This exchange has had problems
  - Files are exchanged through email
  - Files are manually renamed between the MCAD and ECAD systems
  - Multiple copies of files exist
  - Hard to tell if you have the latest version of the file
  - IDF generated by the Expedition and NX systems has issues which cause the receiving system problems
- The OneBoard team was formed to address these issues
  - Explore and map the current processes and look for automation possibilities focused on:
    - Eliminating manual interaction with files
    - Storing files in a central repository
    - Maintaining configuration control on the files

# Past Process

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- No configuration control; files not Teamcenter or Sharepoint controlled.
- Highly dependent on users keeping track of exchanges



# Board Data Files Comparison

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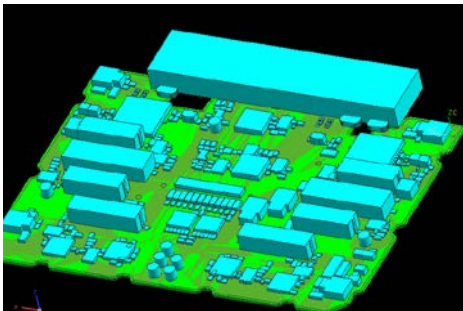
- **IDF Files**

- Intermediate Data Format – can be 3D
- Specification for exchanging data between Electrical and Mechanical CAD tools
- Objects contain intelligence that can be interpreted by the CAD tool
- Contains board and part information, but no copper information
- Optimal use when MCAD and ECAD libraries are synchronized

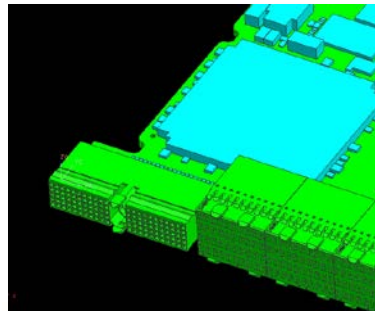
- **DXF Files**

- Autocad Drawing Exchange Format - 2D in our usage
- Objects are graphical with no associated intelligence
- Contains information about all board objects, including copper objects

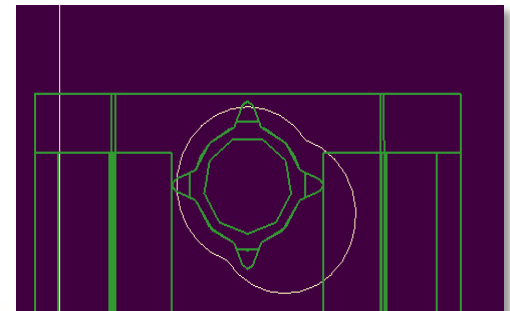
Basic IDF



Smart IDF



DXF



# IDF Interoperation Considerations – NXpedition

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- Layer names with spaces and MiXed case cause Expedition problems
- Internal routing vias cause huge files which cause NX problems
- The 2 systems use different file extensions for the IDF board and the library files and refuse to recognize any other extensions
- Others: duplicate board outlines, wrong IDF version, ...
- Solution: custom developed software “NXpedition” created to post-process IDF into a format to better import into the receiving system

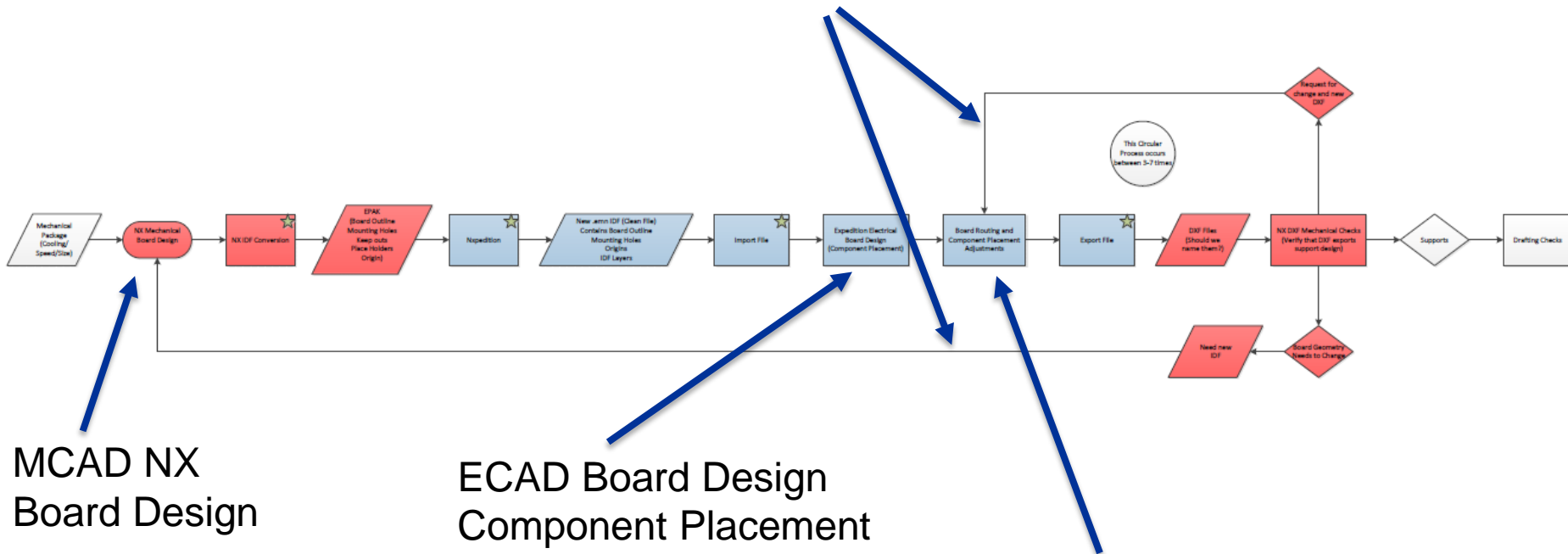




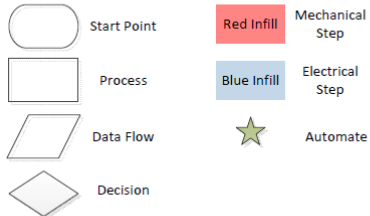
# Design Process Interfacing Model

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## Iterative File Generation Loops



### Board Exchange Process Key



... Seems simple enough... Not... building consensus for this chart may have been the hardest step

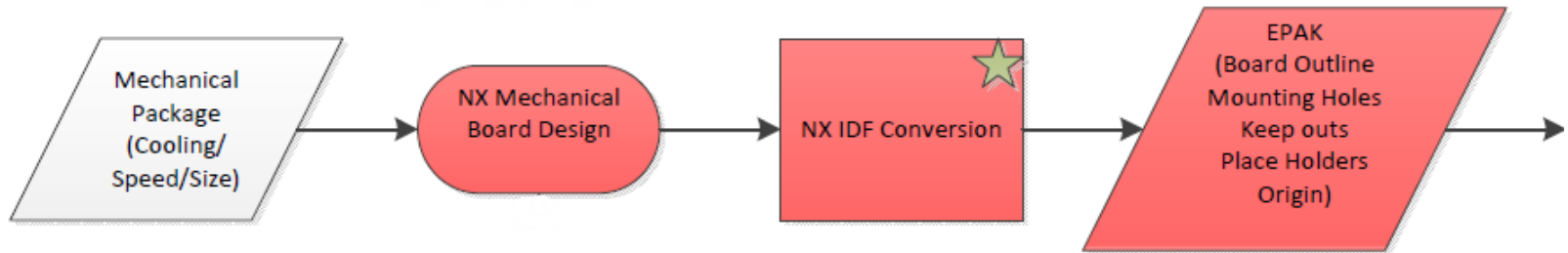
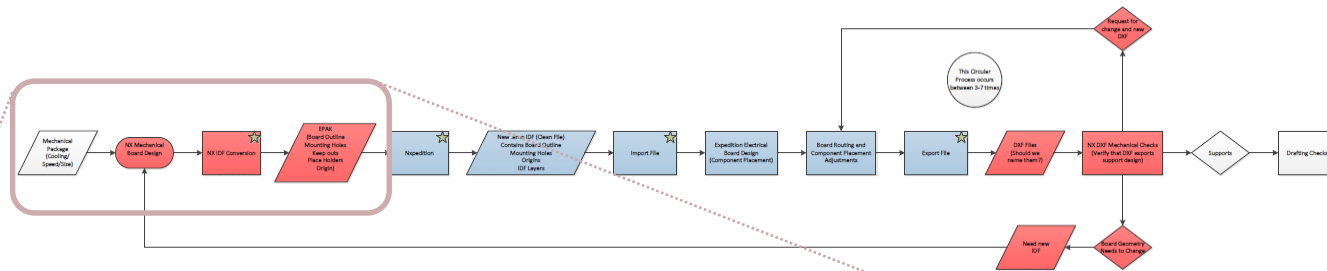
# Current Interoperations Details

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- The next 4 slides show the details of the current manual interfacing between Expedition and NX
- Gold Stars highlight the areas for automation identified by the OneBoard team

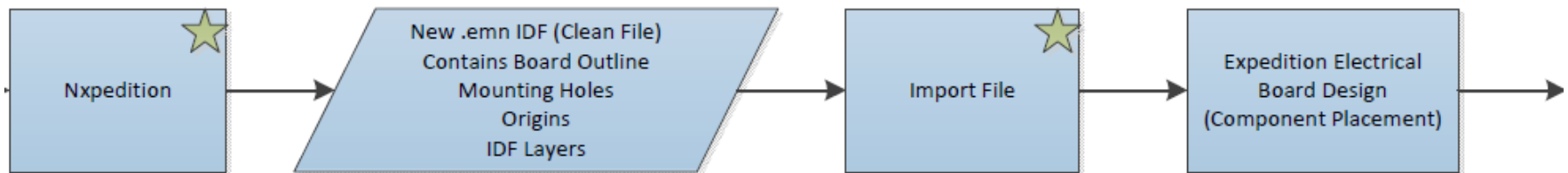
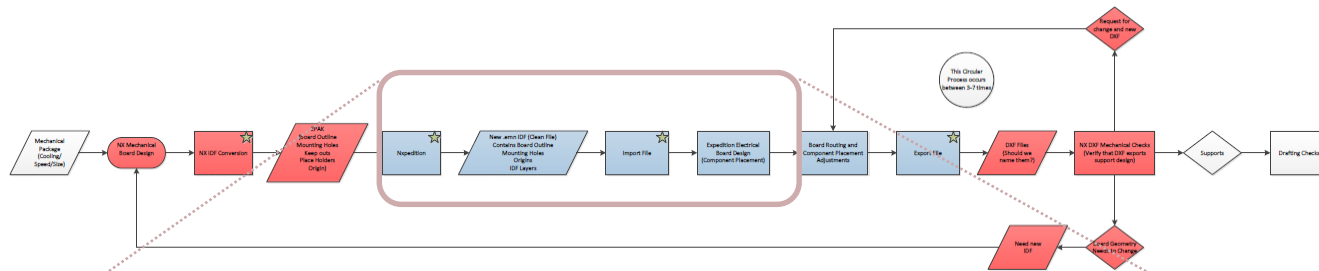
# OneBoard Process – IDF Export

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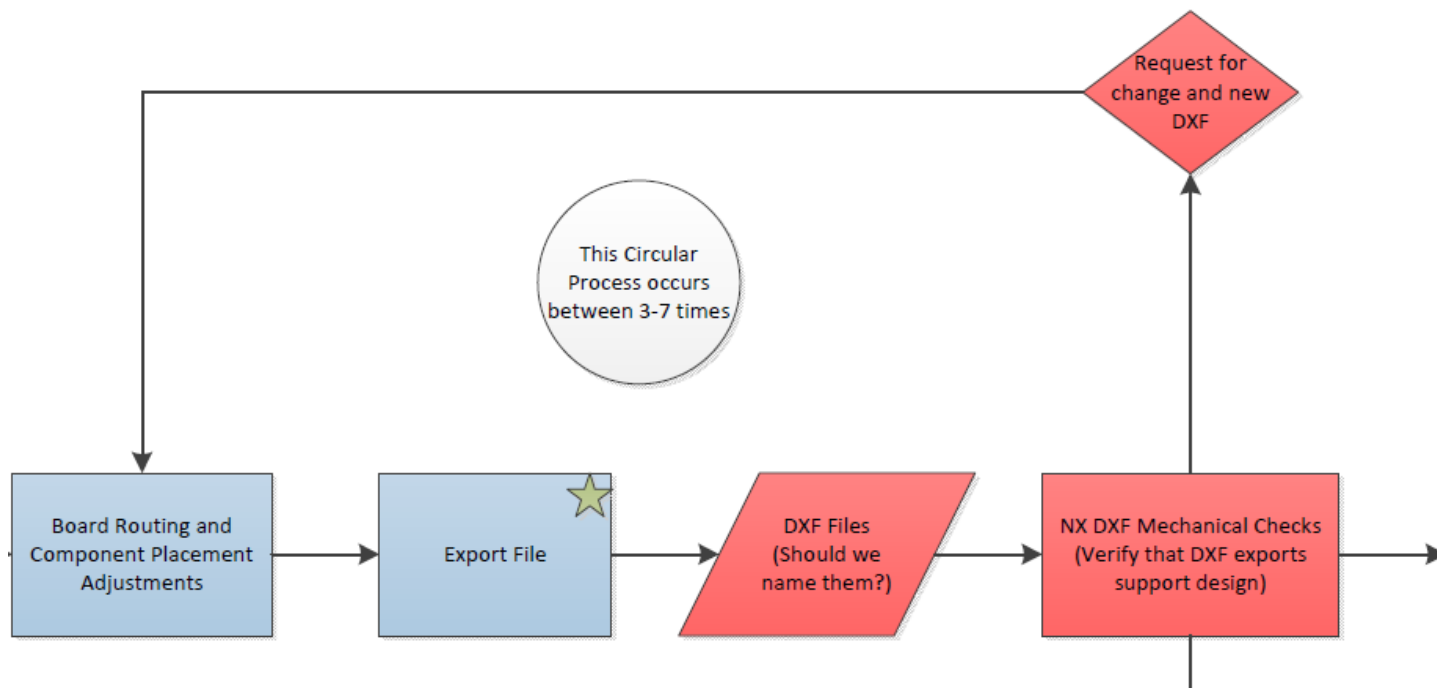
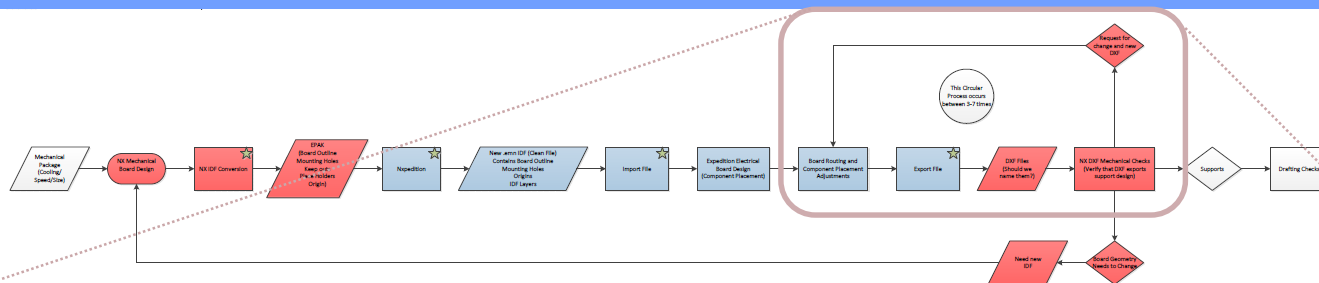
# OneBoard Process – IDF Import

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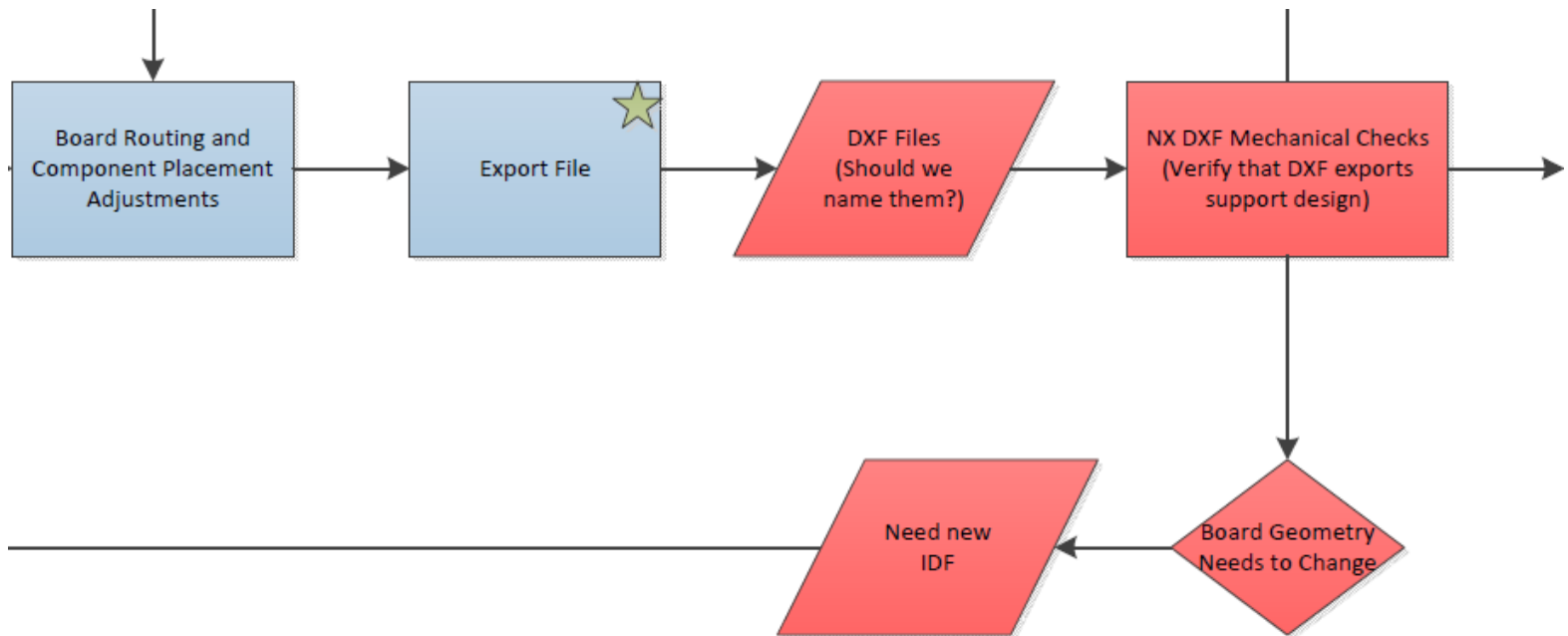
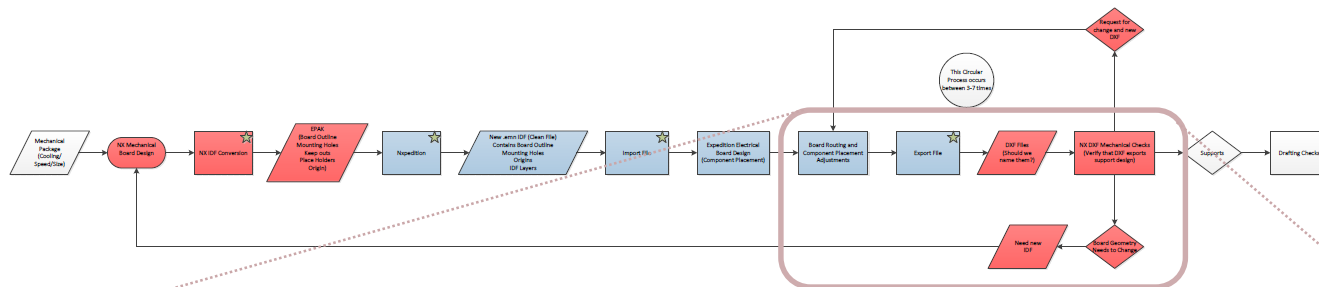
# OneBoard Process – DXF Export/Import

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# OneBoard Process – DXF Export/Import

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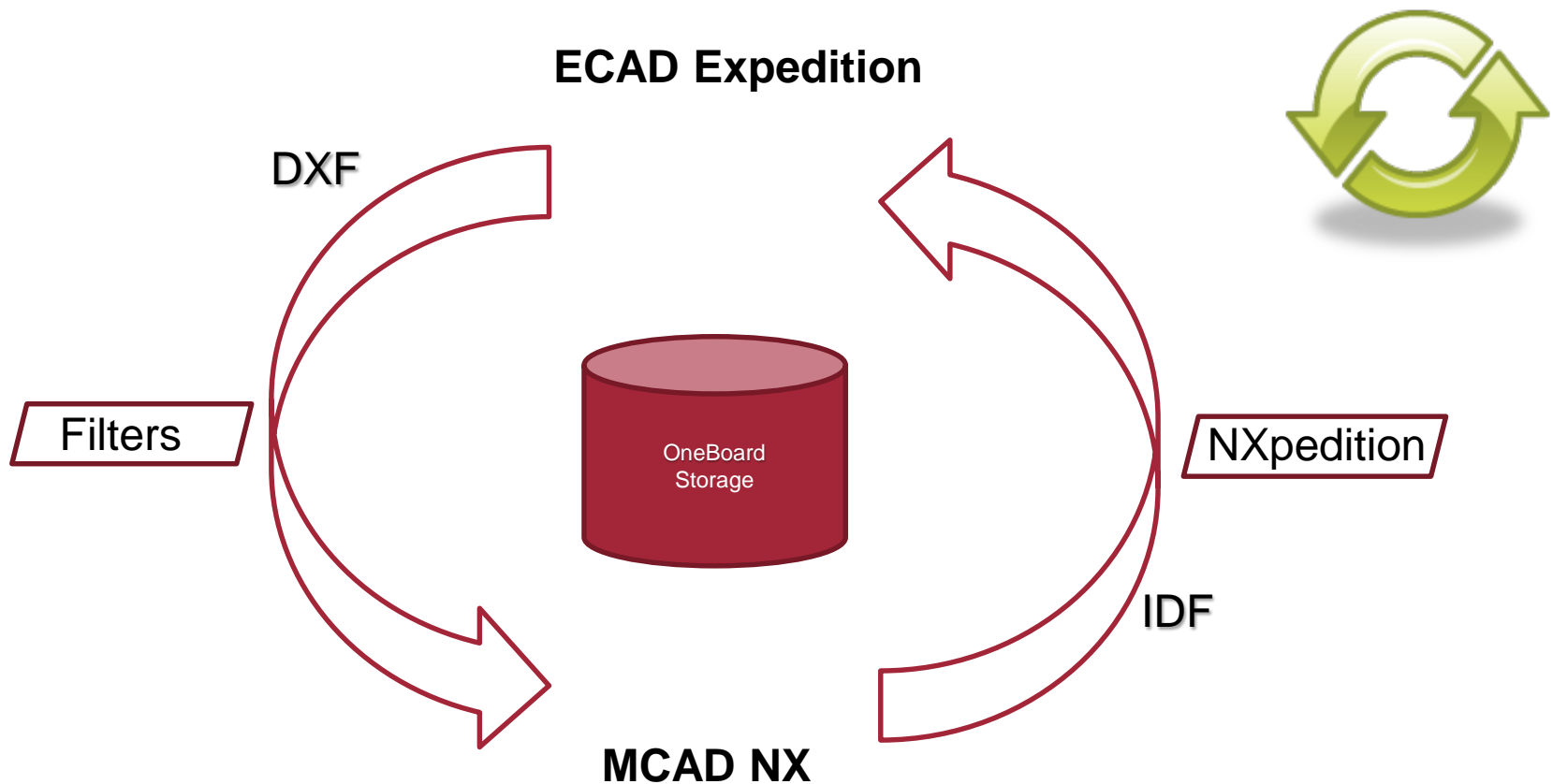
# OneBoard Solution Overview

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- Programs created to run within the ECAD and MCAD tools to automate the import/export functions during design interoperations
- IDF selected for NX to Expedition initialization and subsequent transfers
- DXF selected for Expedition to NX
- New menu picks with predictive behavior – with most common selections already populated or derived from the Expedition or NX model
- Many levels of menu selections of the prior process eliminated
- Configuration controlled file storage – permanent record of who, what and when

# OneBoard Solution Overview

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...Improved MCAD/ECAD Collaboration



# OneBoard File Repository

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- ECAD/MCAD Collaboration site:
  - Upload or download via automations or manually
  - Access via Windows Explorer, Browser, drive mapping, UNC path
  - Automatic naming and versioning by the custom programs
  - Teamcenter Community based Sharepoint

SharePoint Newsfeed OneDrive Sites Mccord, Robb [US] (MS)

BROWSE TEAMCENTER FILES LIBRARY SHARE FOLLOW SYNC

**ECAD-MCAD** EDIT LINKS Search this site

OneBoard\_ECAD-MCAD\_FileExchange

Home new document or drag files here

Documents **All Documents** Find a file

Recent

	✓		Name	Name	Modified	Modified By	Checked Out To	Version
OneBoard Issues								
<b>OneBoard_ECAD-MCAD_FileExchange</b>			1456	1456	April 27	Mccord, Robb [US] (MS)		1.0
ECAD-MCAD-Sandbox			132H01	132H01	May 1	Mccord, Robb [US] (MS)		1.0
StandardSiteLinks			K200	K200	May 15	Hosier, Kelli [US] (MS)		1.0
Links			091H01	091H01	April 18	Mccord, Robb [US] (MS)		1.0
Site Contents			091H01REF	K091H01REF	May 1	Mccord, Robb [US] (MS)		1.0
			070G01REF	070G01REF	April 18	Mccord, Robb [US] (MS)		1.0
			K681	K681	May 23	Chad A [US] (MS)		1.0
			K646	K646	May 15	Hosier, Kelli [US] (MS)		1.0
			766REF	K766REF	May 24	Stephen [US] (MS)		1.0
			710H01_COS_DXF160711	710H01_COS_DXF160711	April 18	Mccord, Robb [US] (MS)		1.0
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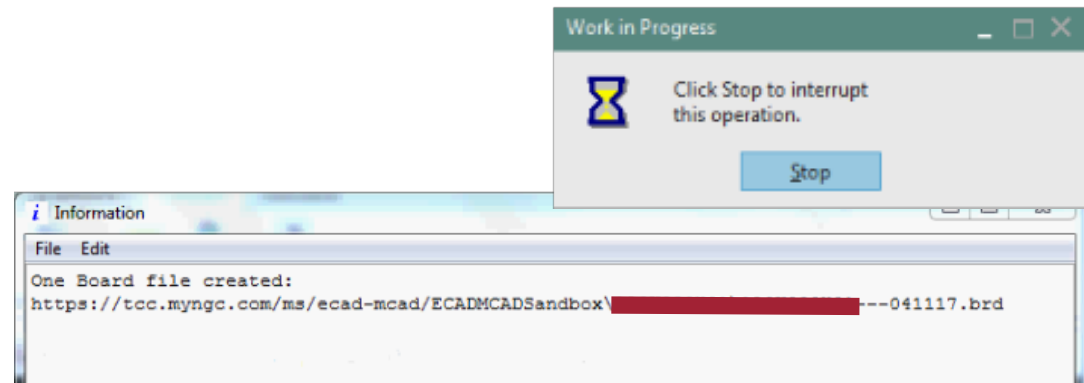
EDIT LINKS

# Customized IDF Export From NX

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- Translators tab > Export IDF
  - Detects board solid and keepout sheet solids
  - Derives board coordinates from current WCS
  - Assigns DA ownership and file name from NX part name
  - Generates IDF file of assembly
  - Writes the file to OneBoard Storage



# IDF Data Exported

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- Board Outline
- Cutouts
- Keepouts
- Other Outlines
  - Generic shapes put on user-defined layer IDF\_<layer\_name>
  - Can be converted to intelligent objects (keepouts) in Expedition
- Drilled Holes
  - Board mounting holes
  - Component placement guide holes



# Customized NX Export Function

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ExportIDF.dll

Gathers basic data from NX.  
Removes previous attributes.  
Assigns new attributes to NX model.  
Displays user interface to modify other outline names.  
Call epak.dll to create the IDF.  
Upload IDF to OneBoard Storage.

Epak.dll

Reads attributes from NX model.  
Generates IDF file.

IDF file temporary storage

OneBoard Storage

## NX UI for Export

Export IDF

Keepouts

Select Other Outline (0)

List of Other Outline Names:

PLACE\_KEEPOUT  
PLACE\_KEEPOUT  
PLACE\_KEEPOUT  
PLACE\_KEEPOUT

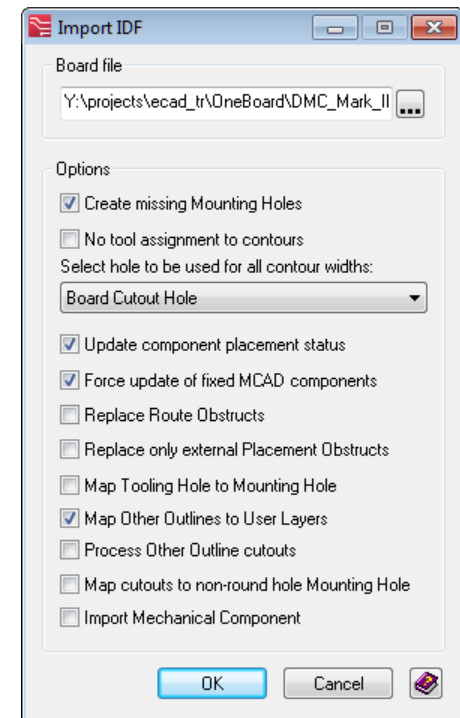
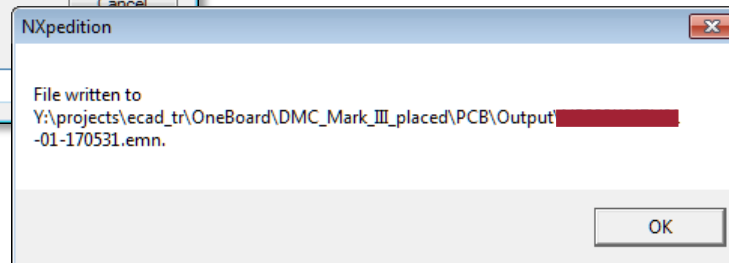
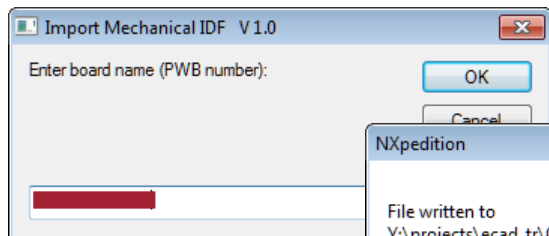
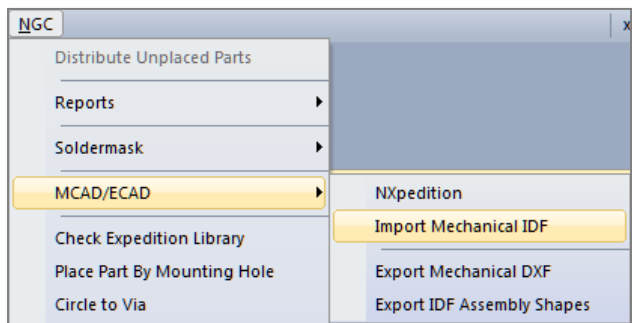
New name for Other Outline:

OK Apply Cancel

# IDF Import to Expedition

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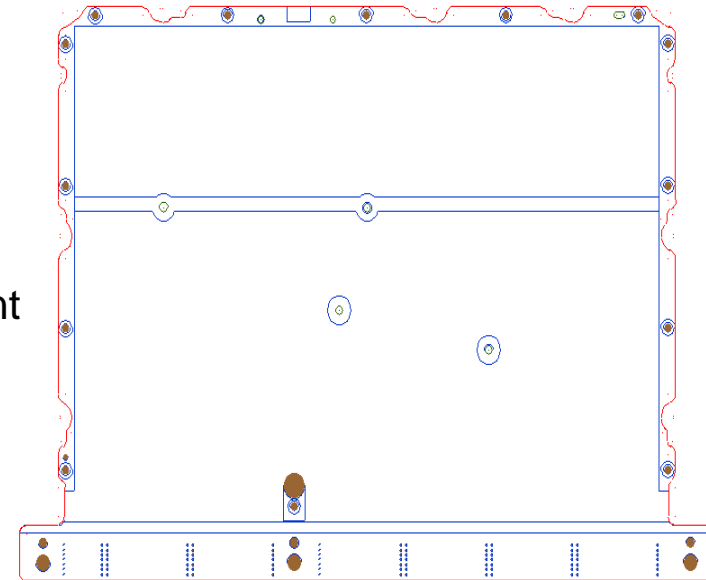
- NGC > MCAD/ECAD > Import Mechanical IDF
  - Pulls the IDF file from OneBoard Storage
  - Runs NXpedition in the background to preprocess the file
  - Invokes the Import IDF command with default options set



# IDF Issues

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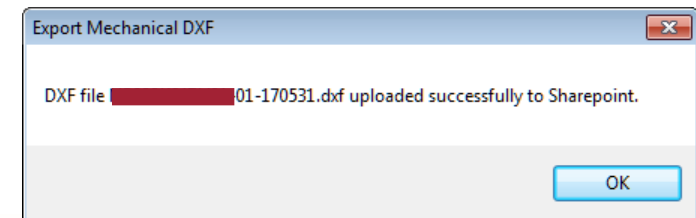
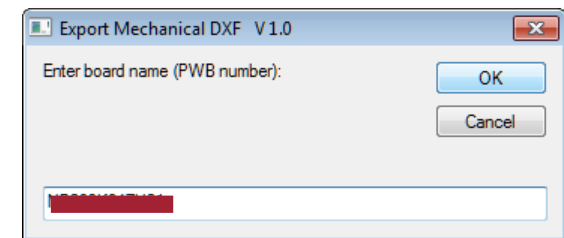
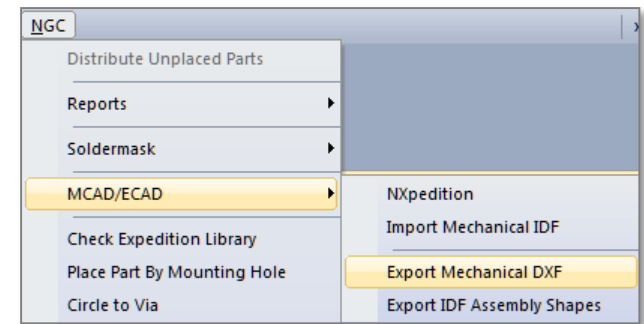
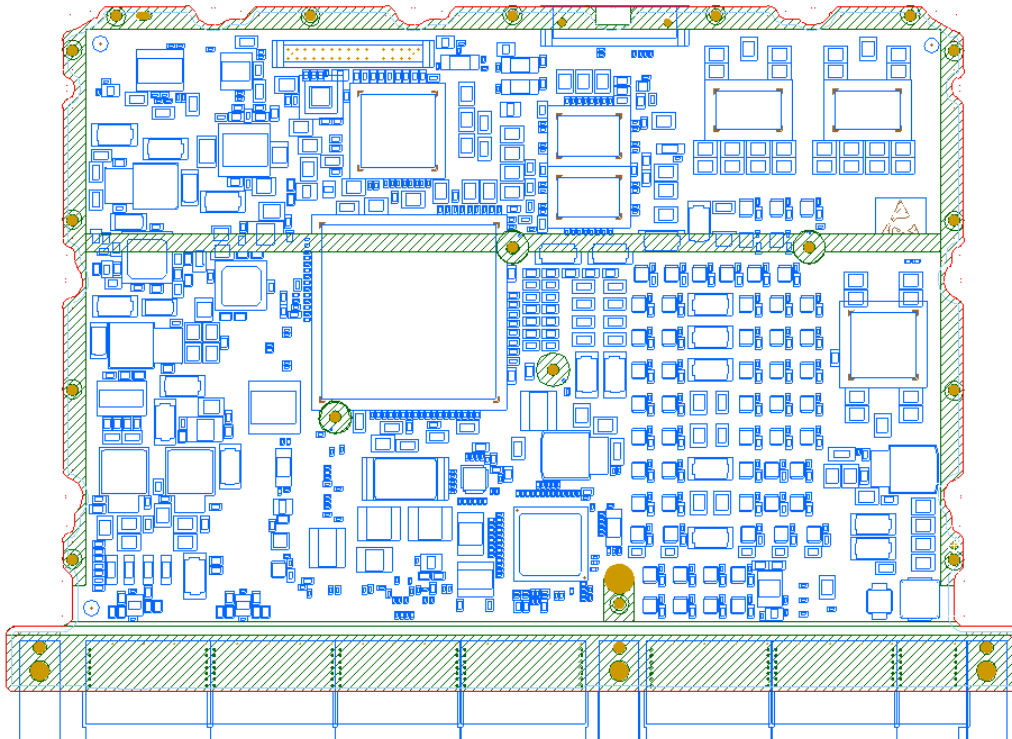
- Origin needs to be on an object, not a point in space
  - Different coordinate systems between NX and Expedition
  - Lower left corner of the board outline may be different location between the tools
  - Center of a mounting hole is good choice for origin
- Only one Board Outline can exist in the file
  - Slots/Cutouts should be defined as contours in NX
- Layers assigned to Other Outline shapes cannot have spaces in the name
  - Spaces will be converted to underscores by NXpedition



# DXF Export from Expedition

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- NGC > MCAD/ECAD > Export Mechanical DXF
  - Generates a DXF file containing all part and copper objects on top and bottom layers of board
  - Writes the file to Sharepoint



# DXF Data Exported

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- Board outline, origin, contours (cutouts), cavities
- Assembly outlines, reference designators
- Part pads, pin (plated) holes, and fiducials
- Mounting holes
- Routed traces, conductive shapes , planes, via pads, and via holes on top and bottom layers only
- IDF other outline layers from previously imported IDF files



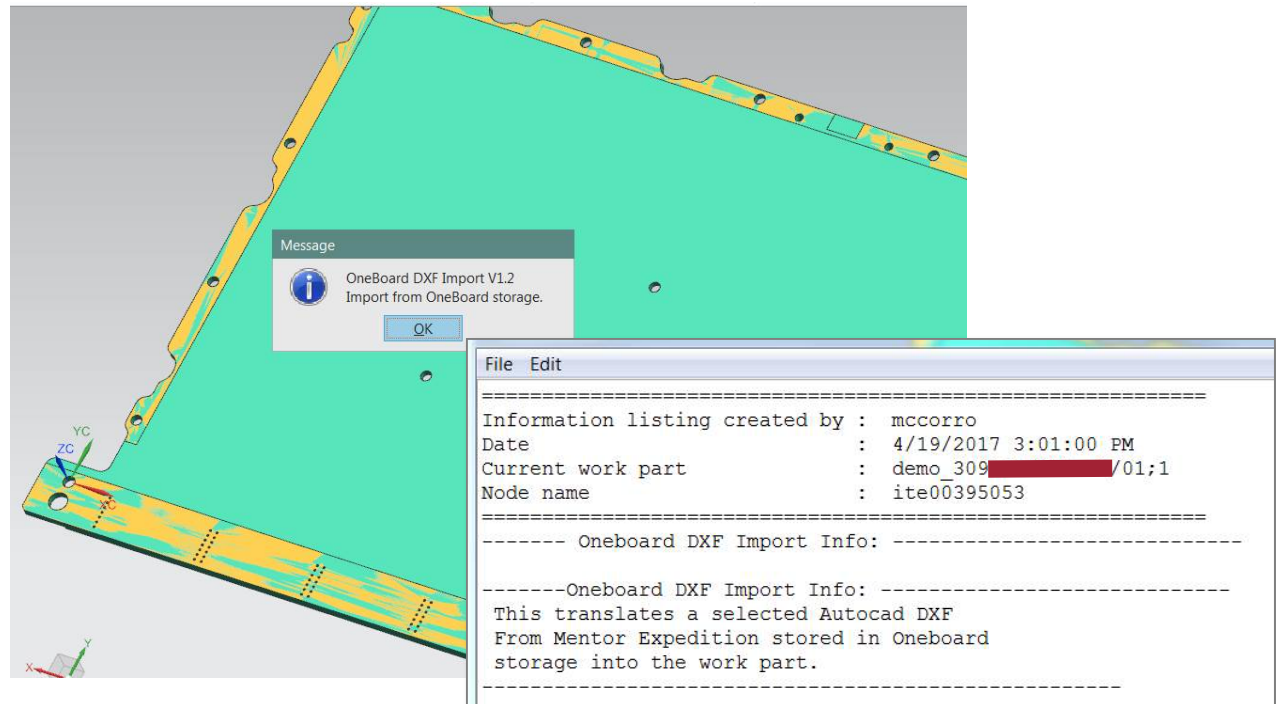


# DXF Import To NX

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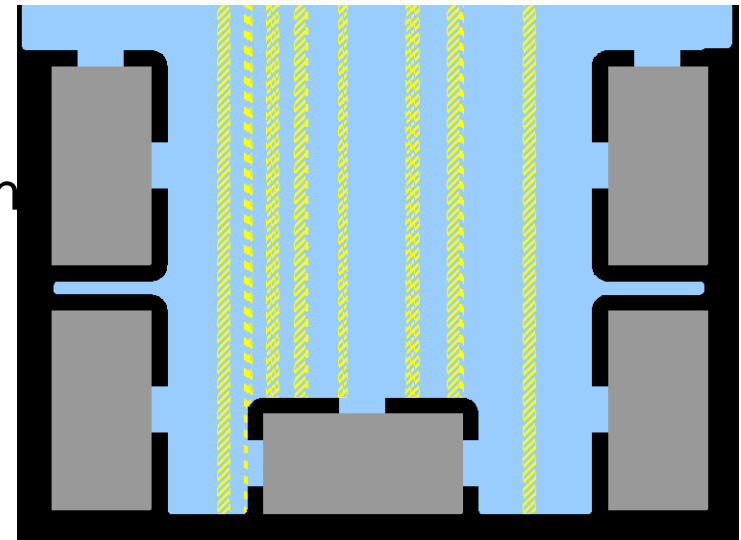
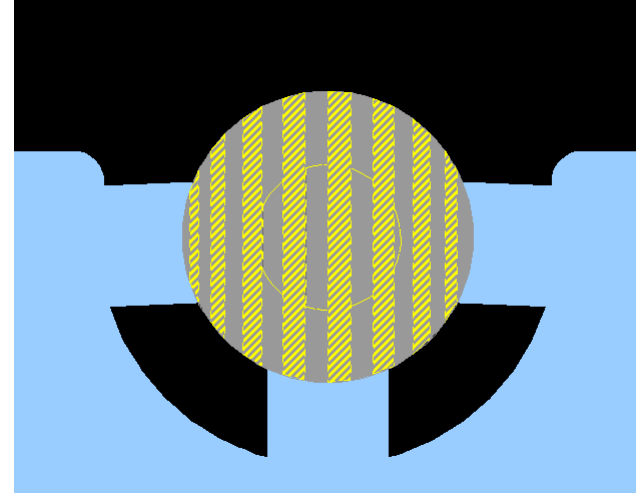
- Translators tab > Import DXF
  - Pulls the file from OneBoard Storage
  - Imports the DXF file into the work part



# DXF Issues

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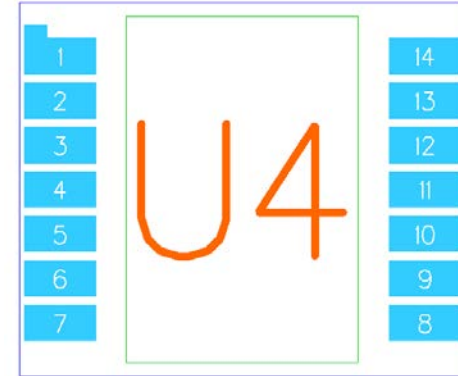
- DXF data is not intelligent
  - Dumb graphics only
- DXF data can be very large
  - Data is not contourized
  - Pads and planes not drawn as polygons
  - Filled planes converted to “many” lines
  - Expedition data stored on many layers
- Incompatibilities in how ECAD and MCAD write and interpret DXF object types (Hatch Fill, etc)
  - Process refinement in process
    - Automatically filter/exclude unneeded problem object types and layers.
    - Reduce file size and translation time



# DXF vs IDF Export From Expedition

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- Mechanicals prefer DXF to IDF for board placement data
- IDF files
  - Use placement outlines to represent parts
  - Placement outlines in Expedition library are large – 5 mils past the ends of the pads
  - Few NX models exist for electrical parts
  - Part height information included – parts with no NX models are shown in NX as blocks the size of the part outline, extruded the height of the part
  - Large placement outlines mean part blocks overlap each other in NX
  - No copper data included in IDF file
- DXF files
  - Use assembly outlines to represent parts
  - Assembly outlines in Expedition library represent true size of parts
  - No part height information included – all parts are shown in NX as flat polygons
  - DXF file includes copper features on the board



# Why Not Use Teamcenter?

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- Teamcenter license cost (no longer an issue due to new contract)
- Electricals have no Teamcenter experience
  - Need to install Rich Client (or use web client)
  - Need training on Teamcenter client
  - Need retraining on Teamcenter client every time new board starts
    - Electricals only work on design tools a few months each year
    - Spend remaining time simulating and testing designs
- Teamcenter automation not as streamlined
  - Sharepoint process 1 step
  - Teamcenter process many steps
- Teamcenter permissions
  - Electricals and Mechanicals need to be in same group to write to board item

# IDF Electrical Process – Sharepoint vs Teamcenter

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- Sharepoint process

1. Open design in Expedition
2. NGC > MCAD/ECAD > Import IDF
3. Enter board number
4. Click OK in Import IDF dialog box

- Teamcenter process

1. Open Teamcenter client
2. Search for item
3. Expand item and select IDF file
4. Actions > Download File
5. Select download location and download file
6. Open design in Expedition
7. File > Import > Import IDF
8. Find and select IDF file
9. Click OK in Import IDF dialog box

# DXF Electrical Process – Sharepoint vs Teamcenter

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- Sharepoint process

1. Open design in Expedition
2. NGC > MCAD/ECAD > Export DXF
3. Enter board number

- Teamcenter process

1. Open design in Expedition
2. File > Export > Export DXF
3. Select board layers to export
4. Click OK in Export DXF dialog box
5. Open Teamcenter client
6. Search for item
7. Create dataset under item
8. Check-Out dataset
9. Upload DXF file to dataset
10. Check-In dataset

# OneBoard CompleteTeam

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- Mike Rindos, Lead
- Kelli Hosier, EEDS Tool Support
- Steve Krug, MCAD superuser
- Chad Lee, ECAD superuser
- Robb McCord, EEDS Tool Support
- Doug Renwick, EEDS Tool Support
- Helen Park, Management Sponsor
- Karen McConnell, Management Sponsor



# Implementation

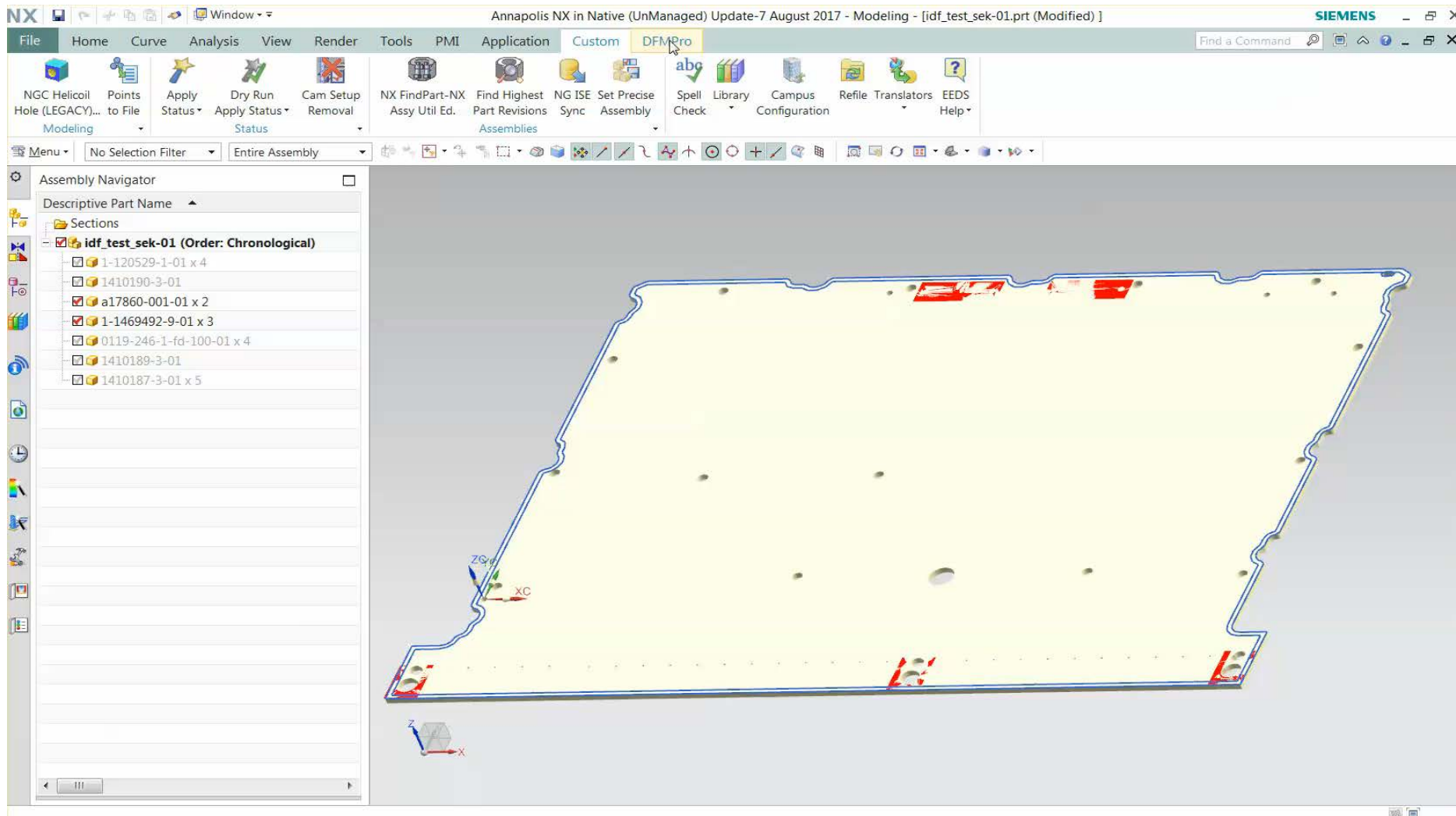
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- 3 months development in the Expedition, NX and Sharepoint environments
- 3 “shakeout” pilot project implementations
- Application rolled out to 800 NX users and 500 Expedition users
- Automations created through the use of NX Open and Grip plus Mentor Application Programming Interface (API)
- Allows our mechanical and electrical engineers to focus on design rather than the mechanics of generating, transferring and controlling IDF and DXF files, thus trimming valuable time from the printed wiring board design process



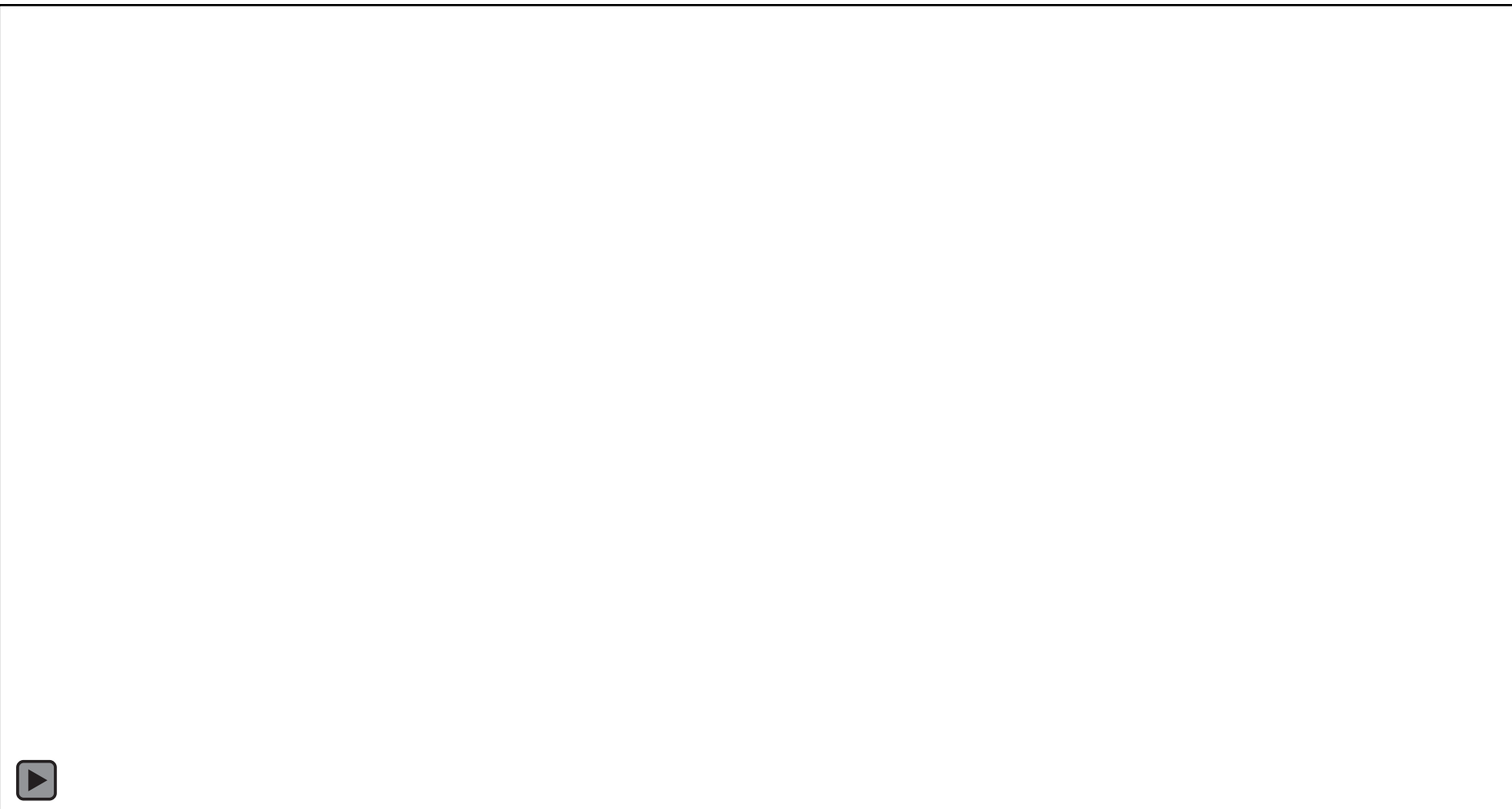
# Video Demo – Export IDF from NX

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# Video demo – Import IDF to Expedition

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# Video Demo – Export DXF from Expedition

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# Video Demo – Import DXF to NX

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SharePoint

Newsfeed OneDrive Sites

Mccord, Robb [US] (MS)

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ECAD-MCAD EDIT LINKS

OneBoard\_ECAD-MCAD\_FileExchange - 123R456

+ new document or drag files here

All Documents Find a file

Name	Modified	Modified By	Checked Out To	Version	File Size
123R456-01-170814.brd	Yesterday at 6:46 PM	Hosier, Kelli [US] (MS)		1.0	72 KB
123R456-01-170814.dxf	Yesterday at 7:06 PM	Hosier, Kelli [US] (MS)		1.0	599 KB

OneBoard Issues

OneBoard\_ECAD-MCAD\_FileExchange

ECAD-MCAD-Sandbox

StandardSiteLinks

Links

Site Contents

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# Conclusion and Future Plans

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- Reduced cycle time for file exchanges between ECAD and MCAD
- “One Button” imports and exports greatly reduce human errors such as output files having wrong version, file extension or units or import files bringing in unnecessary layers and objects.
- Eliminates manual version tracking and location of files
- Future Plans:
  - Continuous Improvement through better filtering of DXF to NX (file size)
  - Better predictive behavior of outlines in NX to IDF (top vs bottom)
  - Investigate migration into Teamcenter after implementation of the A&D module
- Siemens acquisition of Mentor – probably little or no impact in the immediate future

# Questions

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# Thank you