

An Introduction to GenCAM/GenX





Agenda

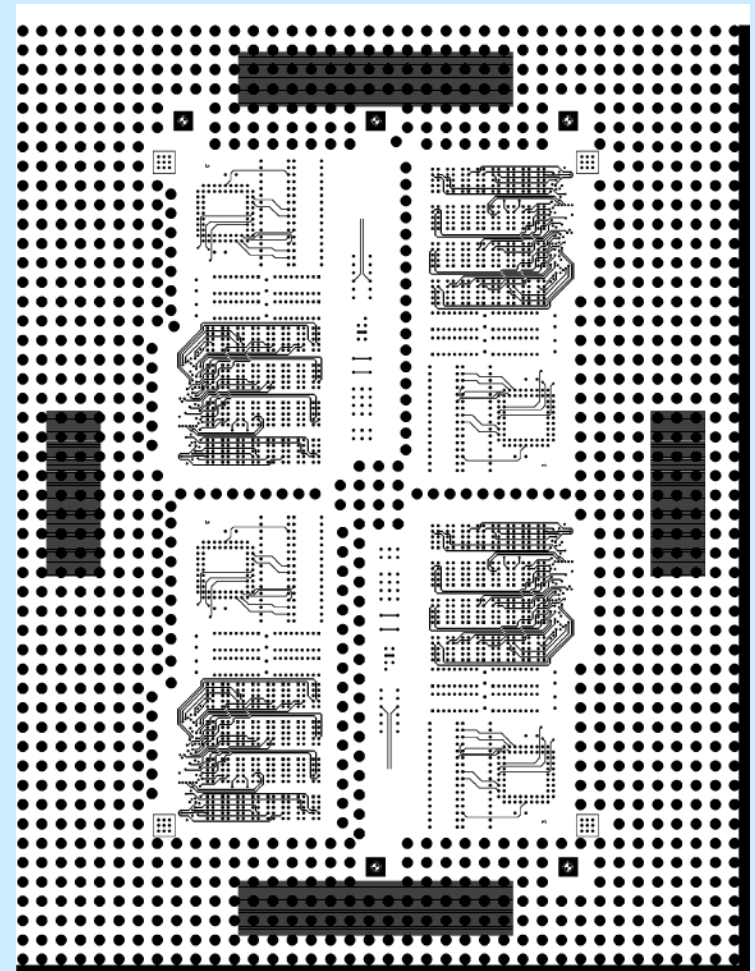
- ✓ Introduction GenCAM
- ✓ XML Background
- ✓ Introduction to GenX
- ✓ GenX Examples
- ✓ Current Status
- ✓ Roadmap



What is GenCAM?

- ◆ Replacement for Gerber

```
G04 GSI RS-274x
photoplot definition
file *
%FSLAX24Y24*%
%MOIN*%
%IPPOS*%
%ADD10C,0.01000*%
%ADD11C,0.20000*%
%ADD12C,0.01200*%
%ADD14C,0.02000*%
%ADD15C,0.02500*%
```





What is GenCAM?

- ◆ Complete manufacturable description PLUS:
 - Human readable
 - Test instructions
 - Administrative (contact) information
- ◆ Similar in many respects to STEP files, but new concept for industry
- ◆ Conformance testing important part of roll-out



Example of GenCAM

```
$BOARD
```

```
BOARD: "11354-66540";
```

```
OUTLINE: "All";
```

```
LINE: (0, 0), (12000, 20000);
```

```
CIRCARC: (12000, 20000), (12000, 30000), (11800,  
25000);
```

```
LINE: (12000, 30000), (10000, 30000);
```

```
LINE: (10000, 30000), (0, 0);
```

```
CUTOUT: "TransformerHole", "AllLayers";
```

```
CIRCLE: "RoundCut", (80000, 140000);
```

```
HOLE: "Thole1", "PlatedTooling1875", , (11550,  
29550);
```

```
HOLE: "Thole2", "PlatedTooling1875", , (550, 550);
```

```
ATTRIBUTE: "MegaTool", "board mill tool", "255";
```

```
$ENDBOARD
```

What About XML?

- ◆ Map GenCAM into XML
- ◆ XML, a subset of SGML, offers:
 - Easy parsing
 - Enforcement of document structure through GenX DTD (Built in conformance!)
 - Transmission of structured data over the web



XML Background

- ◆ eXtensible Markup Language
- ◆ A text-based, data description *meta* language
 - Design your own markup language
- ◆ A streamlined subset of SGML
- ◆ Designed for use on the Internet
- ◆ A W3C Technical Recommendation (February 10, 1998)

XML Benefits

- ◆ Supported by all major vendors, including Microsoft, IBM, Netscape, Sun
- ◆ Easy Client-side manipulation
 - Designed to be easy to parse
 - 26K of Java code (Aelfred)
 - 5K of JavaScript
- ◆ Free XML parsers available, even for commercial use



What is an XML Document?

- ◆ A Valid XML document is made up of two parts:
 - Document Type Definition (DTD)
 - Tags and Content
- ◆ NOTE: The DTD can be referenced by a URL
 - Saves about 52K per document in GenX DTD (Release 0.1h, 1/20/99)

What is a DTD?

- ◆ A formal definition that:
 - Defines a specific set of tags and their relationships to one another
 - Specifies attributes and default values within tags
 - Specifies tag structure
- ◆ Controls the manipulation of data
 - Requires everyone to use the same set of tags the same way



XML Mapping of GenCAM

- ◆ XML is used to create markup *language* (*GenX*)
- ◆ The defined language describes content and structure of a document
- ◆ Three DTDs are needed:
 - Initial Assembly File
 - Change File
 - Complete File

GenX Benefits

- ◆ Central maintenance of the DTD
 - <http://www.gencam.org>
- ◆ Syntax checking effortlessly
 - No new code needed to check a new data structure or set of tags
 - Important in a dynamic industry
- ◆ Semantic checking can be coded against XML API
 - SAX or DOM



Georgia Tech GenX Team

- ◆ Work initiated by the Engineering Information Systems Lab in July 1998
- ◆ Further developed with NIST funding as part of the Internet Commerce in Manufacturing Project
- ◆ Currently headed by Andy Dugenske

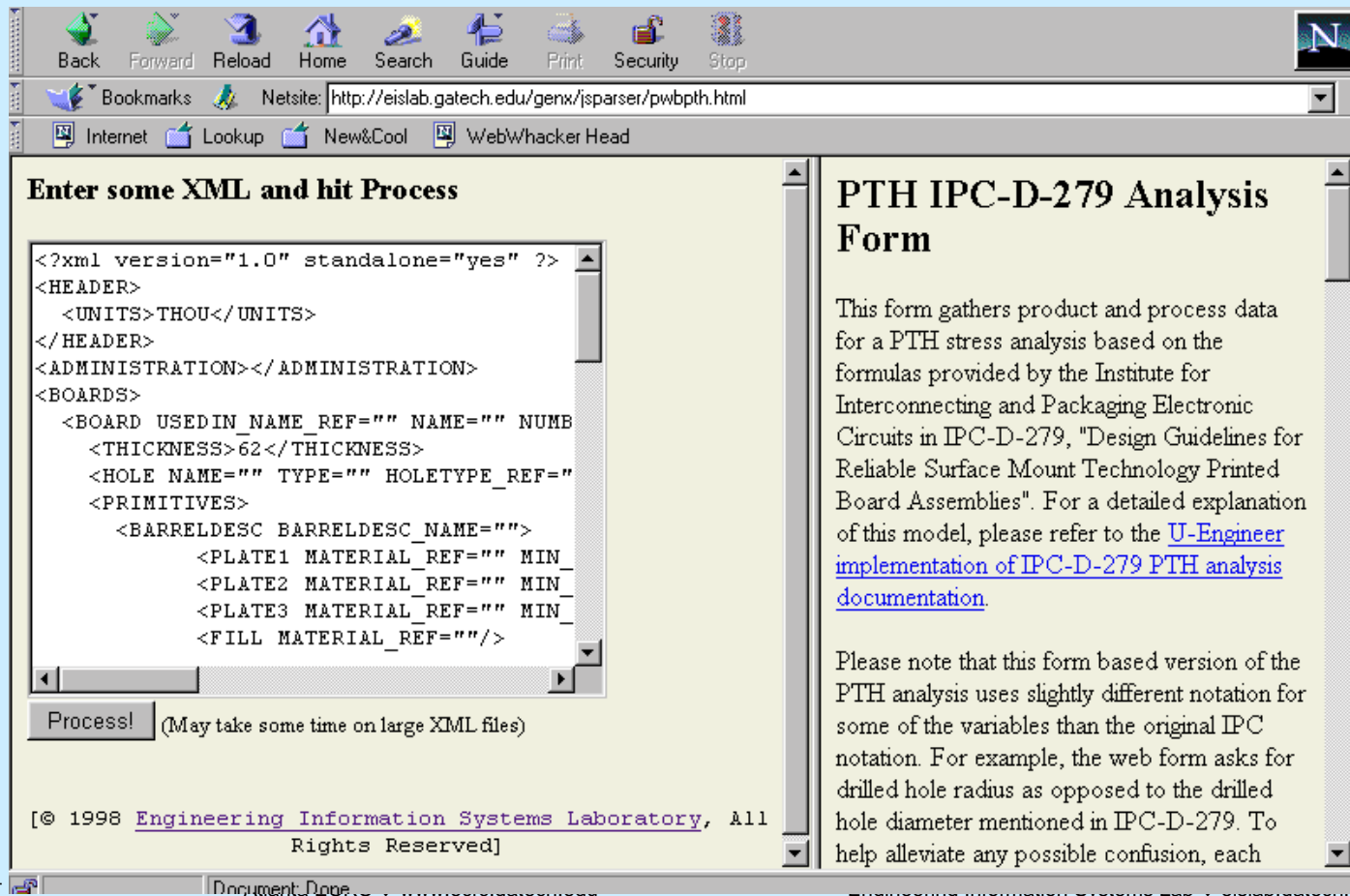


EIS Lab and GenX

- ◆ Distributed product data over the web- rather than centralized data repository
- ◆ Upload *only* idealizations-
 - Natural data compression (Factor of ~100)
 - Greater intellectual property security - Difficult to reverse engineer (materialization)

GenX ESB Example

◆ GenX Driven IPC-D-279 PTH Analysis



Back Forward Reload Home Search Guide Print Security Stop

Bookmarks Netsite: http://eislabs.gatech.edu/genx/jsparser/pwbpth.html

Internet Lookup New&Cool WebWhacker Head

Enter some XML and hit Process

```
<?xml version="1.0" standalone="yes" ?>
<HEADER>
  <UNITS>THOU</UNITS>
</HEADER>
<ADMINISTRATION></ADMINISTRATION>
<BOARDS>
  <BOARD USEDIN_NAME_REF="" NAME="" NUMB
    <THICKNESS>62</THICKNESS>
    <HOLE NAME="" TYPE="" HOLETYPE_REF=""
  <PRIMITIVES>
    <BARRELDISC BARRELDISC_NAME=""
      <PLATE1 MATERIAL_REF="" MIN
      <PLATE2 MATERIAL_REF="" MIN
      <PLATE3 MATERIAL_REF="" MIN
    <FILL MATERIAL_REF=""/>
```

Process! (May take some time on large XML files)

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PTH IPC-D-279 Analysis Form

This form gathers product and process data for a PTH stress analysis based on the formulas provided by the Institute for Interconnecting and Packaging Electronic Circuits in IPC-D-279, "Design Guidelines for Reliable Surface Mount Technology Printed Board Assemblies". For a detailed explanation of this model, please refer to the [U-Engineer implementation of IPC-D-279 PTH analysis documentation](#).

Please note that this form based version of the PTH analysis uses slightly different notation for some of the variables than the original IPC notation. For example, the web form asks for drilled hole radius as opposed to the drilled hole diameter mentioned in IPC-D-279. To help alleviate any possible confusion, each

GenX Benefits

- ◆ Collaborative engineering- DTD allows legal “patches”
- ◆ Searching is potentially much more customizable and accurate
- ◆ High Degree of readability
 - Essentially, name tags for all parameters
 - Supported in browsers natively (IE5-demo)
 - Customizable views (reports) possible using XSL

GenX Benefits

- ◆ Synergy with other XML standards/emerging activities
 - EDI/e-commerce (BizTalk)
 - NEMI
 - ECIX/Pinnacles Component Information Standard
 - RosettaNet/OASIS/xml.org
- ◆ Jumping on the XML Hype train!



GenX Costs

- ◆ File size will increase
 - Hopefully hold to a minimum with good design choices
- ◆ Some additional qualifiers have to be added to GenCAM keywords
 - For example, adding `_NAMED` to `CIRCLE` keyword when referencing the named form of the `CIRCLE` primitive
- ◆ Not all syntactic restrictions enforced



GenX DTD- Example Section

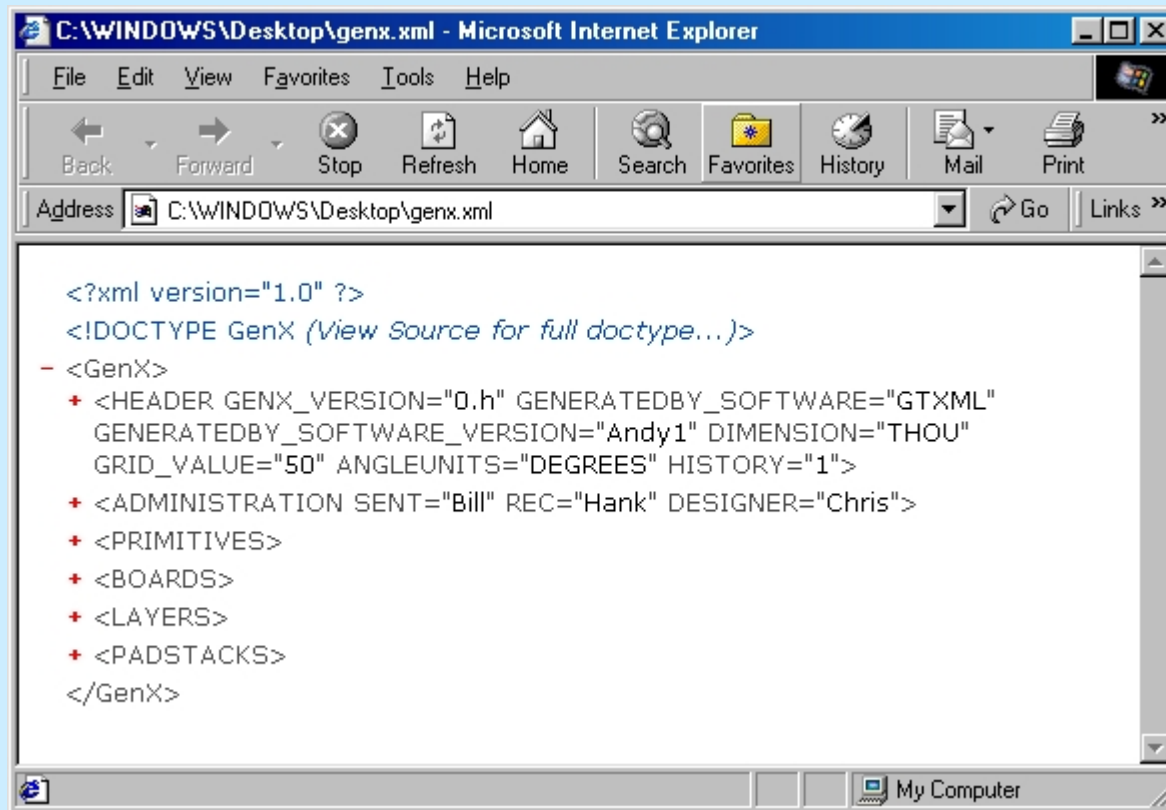
```
<!ELEMENT HEADER (ASSEMBLY_DEF+,BOARD_DEF+
<!ATTLIST HEADER
  GENX_VERSION CDATA #REQUIRED
  CHARACTERSET CDATA #IMPLIED
  GENERATEDBY_SOFTWARE CDATA #IMPLIED
  GENERATEDBY_SOFTWARE_VERSION CDATA
  DIMENSION (MM|UM|MM100|USERCM|USERMM|USE
  GRID_VALUE CDATA #IMPLIED
  ANGLEUNITS (RADIANS|DEGREES) #REQUIRED
  HISTORY CDATA #REQUIRED>
```



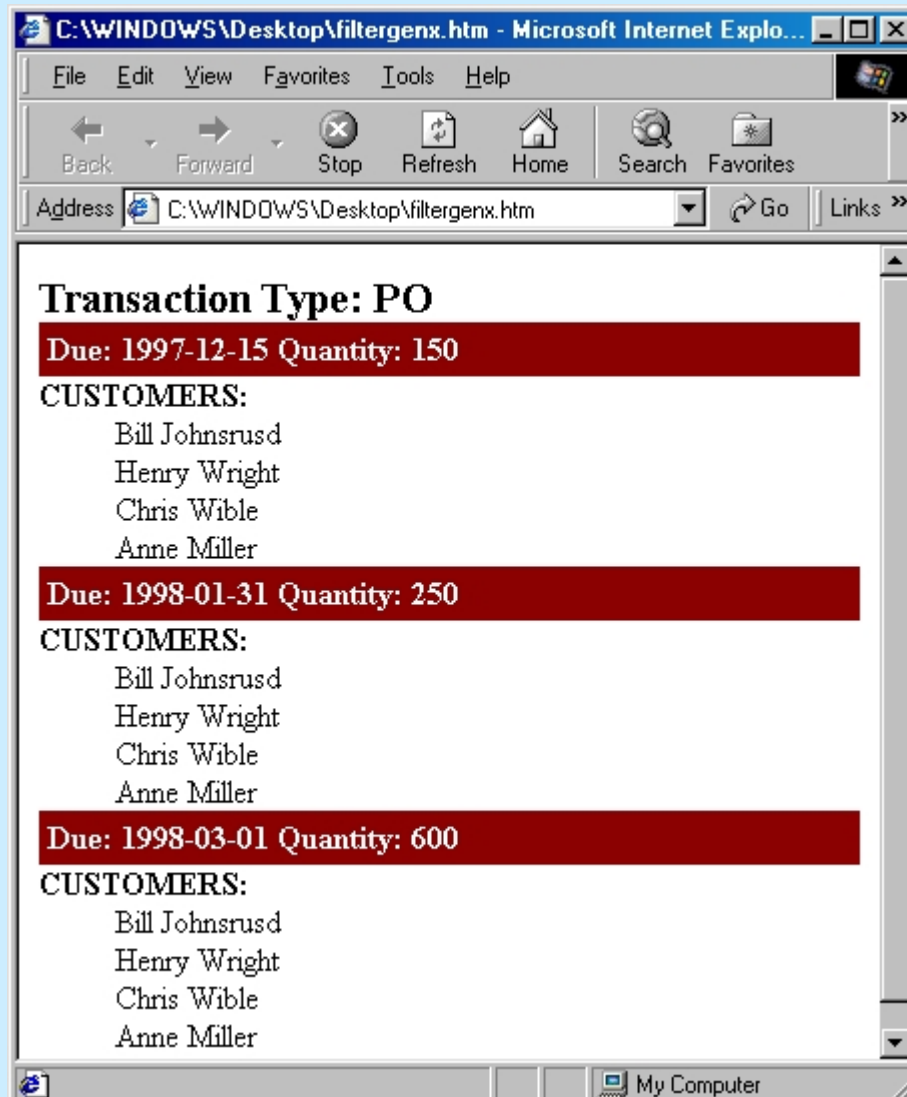
GenX Document- Example

```
<HEADER  
  GENX_VERSION="0.1.h"  
  GENERATEDBY_SOFTWARE="GTXML"  
  GENERATEDBY_SOFTWARE_VERSION="AJS"  
  DIMENSION="THOU" GRID_VALUE="50"  
  ANGLEUNITS="DEGREES" HISTORY="1" >  
  <ASSEMBLY_DEF  
    USEDIN_NAME="C100"  
    NAME="Modem C100 mrboard"  
    NUMBER="11149-14811"  
    REVISION="Rev 566g 20" />
```

Viewing GenX in A Browser



Viewing GenX with XSL



C:\WINDOWS\Desktop\filtergenx.htm - Microsoft Internet Explo...

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites

Address C:\WINDOWS\Desktop\filtergenx.htm Go Links

Transaction Type: PO

Due: 1997-12-15 Quantity: 150

CUSTOMERS:

- Bill Johnsrud
- Henry Wright
- Chris Wible
- Anne Miller

Due: 1998-01-31 Quantity: 250

CUSTOMERS:

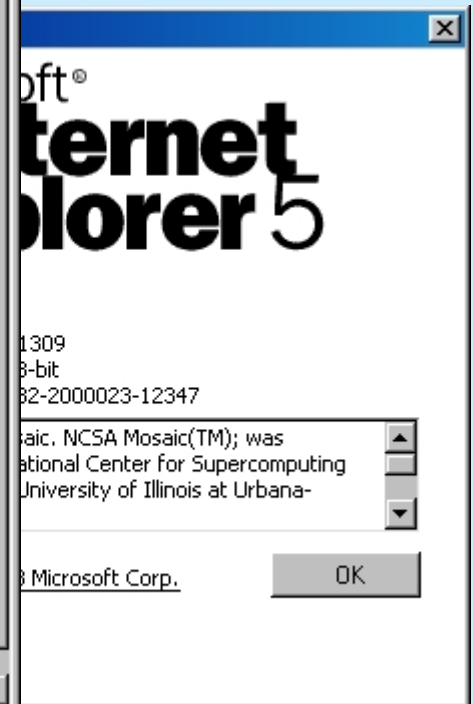
- Bill Johnsrud
- Henry Wright
- Chris Wible
- Anne Miller

Due: 1998-03-01 Quantity: 600

CUSTOMERS:

- Bill Johnsrud
- Henry Wright
- Chris Wible
- Anne Miller

My Computer



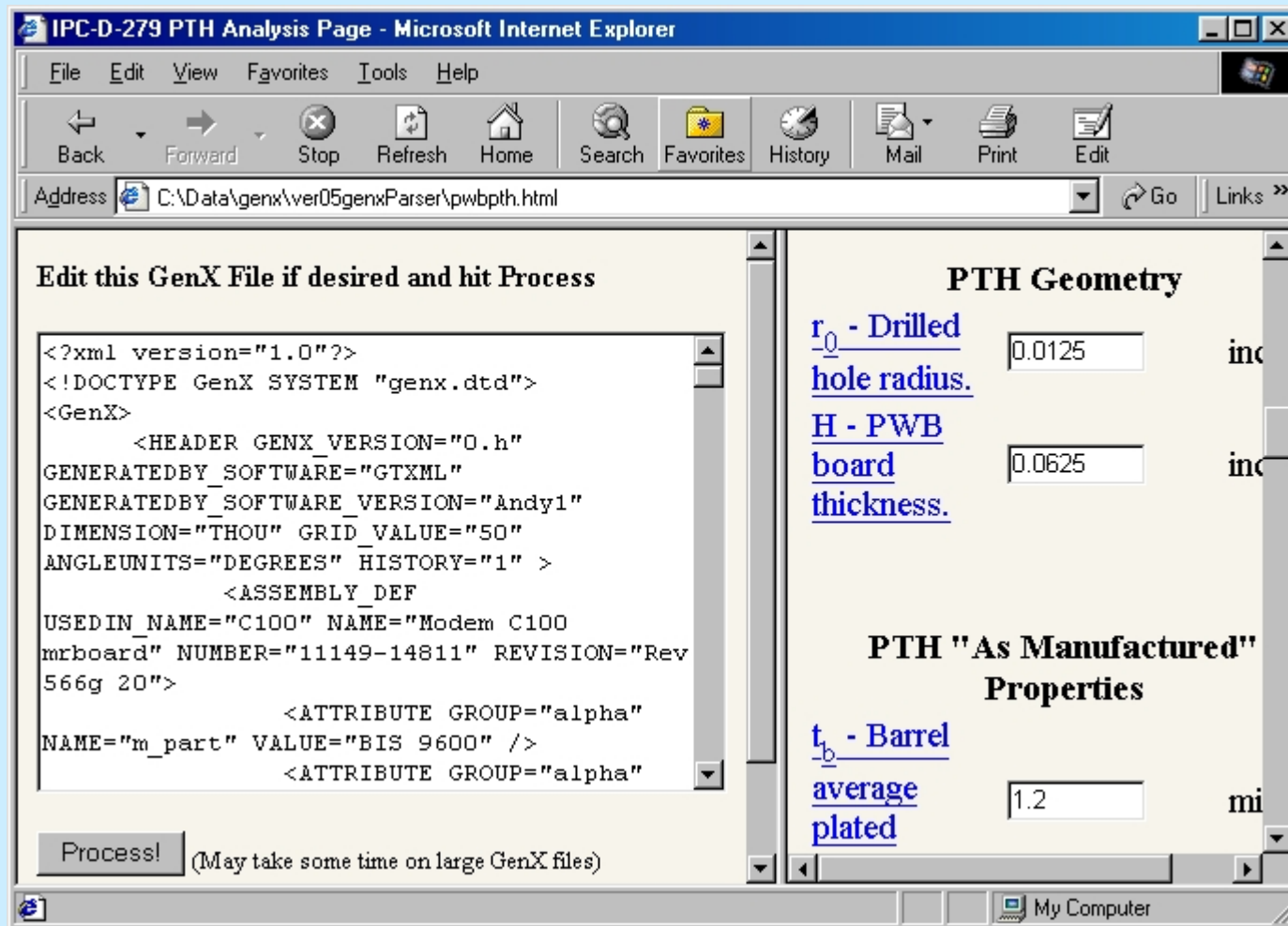
Microsoft
Internet Explorer 5

1309
8-bit
82-2000023-12347

...aic, NCSA Mosaic(TM); was
...ational Center for Supercomputing
...University of Illinois at Urbana-

Microsoft Corp. OK

GenX and Analysis



IPC-D-279 PTH Analysis Page - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail Print Edit

Address Go Links >>

Edit this GenX File if desired and hit Process

```

<?xml version="1.0"?>
<!DOCTYPE GenX SYSTEM "genx.dtd">
<GenX>
  <HEADER GENX_VERSION="0.h"
GENERATEDBY_SOFTWARE="GTXML"
GENERATEDBY_SOFTWARE_VERSION="Andy1"
DIMENSION="THOU" GRID_VALUE="50"
ANGLEUNITS="DEGREES" HISTORY="1" >
  <ASSEMBLY_DEF
USEDIN_NAME="C100" NAME="Modem C100
mrboard" NUMBER="11149-14811" REVISION="Rev
566g 20">
    <ATTRIBUTE GROUP="alpha"
NAME="m_part" VALUE="BIS 9600" />
    <ATTRIBUTE GROUP="alpha"

```

PTH Geometry

r₀ - Drilled hole radius. inc

H - PWB board thickness. inc

PTH "As Manufactured" Properties

t_b - Barrel average plated mi

(May take some time on large GenX files)

My Computer



Current Status- GenCAM

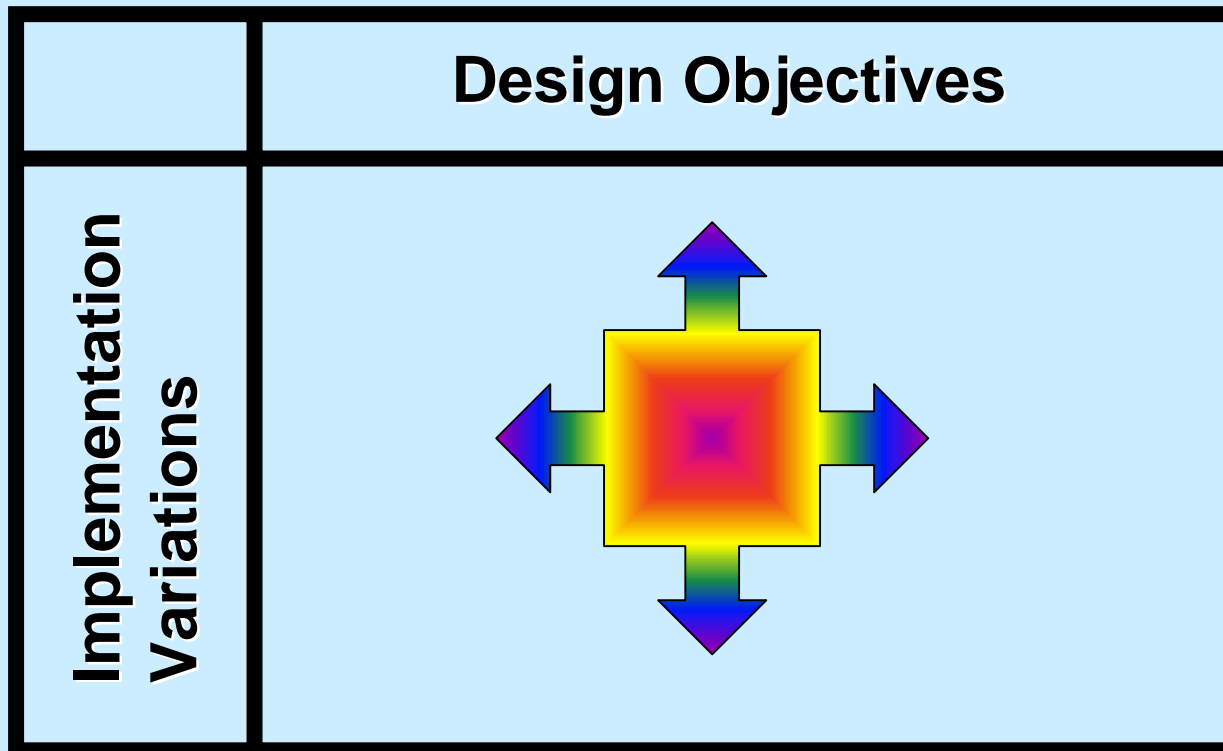
- ◆ GenCAM (ASCII) IPC 2511 is IPC/ANSI Standard
- ◆ IPC 2511 Revision A is currently being distributed to IPC Members for voting
 - “As implemented” ASCII version
- ◆ 8 Vendors producing products



Current Status- GenX

- ◆ Research Topic
- ◆ IPC will use XML for GenCAM Version 2.0
- ◆ Proposal pending with PMTEC
 - GT, NIST, RSI, IPC

Future Steps- R&D



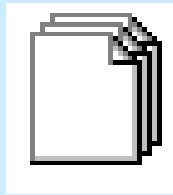


Future Steps

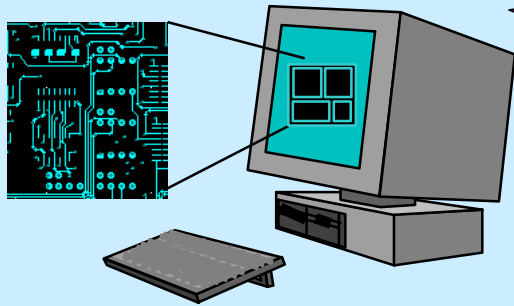
- ◆ Integration with other standards
- ◆ CAMX
- ◆ SRFF
- ◆ Uniform API into XML and ASCII versions

End of Presentation on GenCAM/GenX

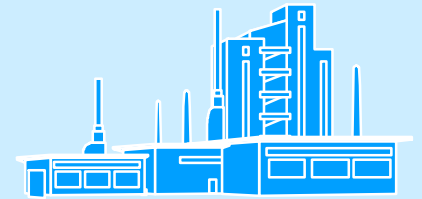
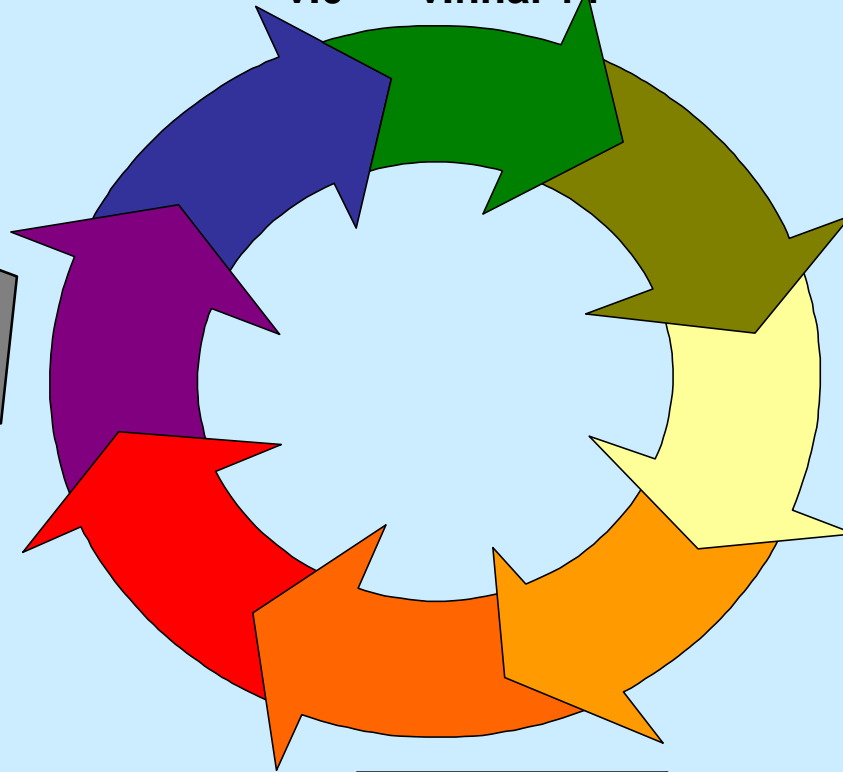




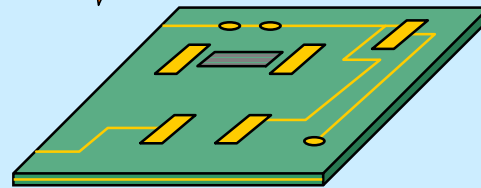
GenCAM File,
v.0 == v.final ??



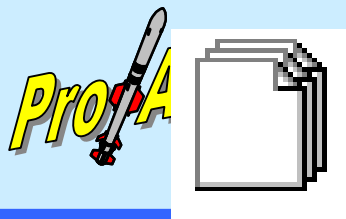
Design
Facility



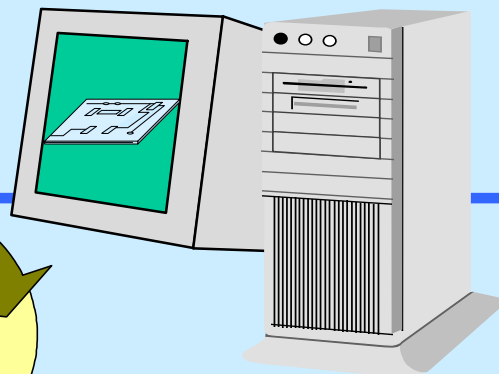
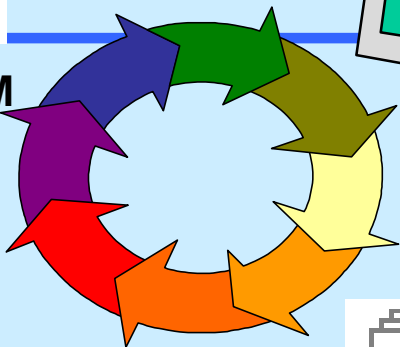
Manufacturing
Facility



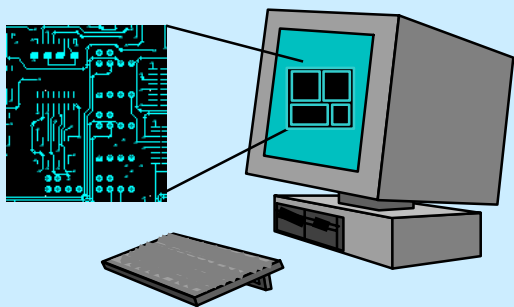
Printed Circuit
Board



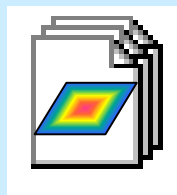
GenCAM
File,
v.0 ...
v.final



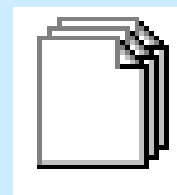
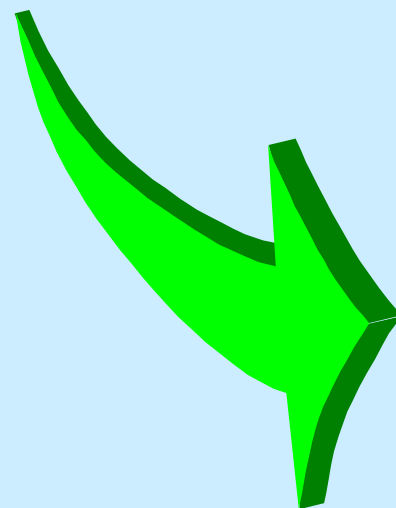
Engineering Service
Bureau



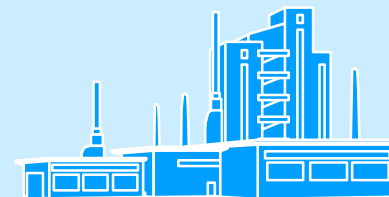
Design
Facility



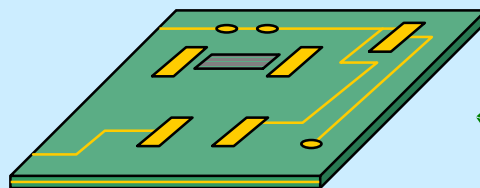
Analysis
Results



GenCAM
File,
v.final



Manufacturing
Facility



Printed Circuit
Board

