

# Software Interoperability: Enabling New Technologies

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NIST

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# Presentation Agenda:

- Why Interoperability?
- Overview of NIST
- Visions of the Past and the Future
- What is Interoperability?
- Supply Chains – Interoperability Showcase
- Current Software Technologies Enabling Interoperability

# Why Interoperability?



## Great Baltimore Fire of 1904

- Fire departments responded from as far a way as Washington DC, Philadelphia, and New York to combat the blaze
- Firefighters could not share their fire hoses due to different hose threads
- The fire destroyed 1500 buildings over an area of 80 city blocks
- NFPA 1963, Standard for Fire Hose Connections allowed future interoperability

# We Live in a Heterogeneous World

- Distributed technologies and outsourcing are becoming part of everyday life
  - Ever-Increasing Demand for Many Levels of Information
    - World Wide Web, on-line databases
  - Extended Enterprise Integration
    - Virtual enterprises are made up of disaggregated, specialized elements. These elements need to be seamlessly connected to support consistent business processes.
  - Explosive Growth of Autonomous Electronic Products
    - PDAs, smart phones, game consoles
    - Factory equipment, consumer electronics, etc.
  - Ever-Increasing Number of Standards
    - IPC standards, RosettaNet, IEC, etc.
    - Interoperability required between standards

# Future is Ubiquitous Electronics

## **IC makers gear up for new tire pressure monitor rule**

Posted: Dec 02 2003

The U.S. National Highway Traffic Safety Administration could be on the verge of issuing a regulation that would put a microprocessor in every new tire, paving the way for semiconductor makers to provide automakers with 80 million chips a year.

The agency, still reeling after a U.S. Court of Appeals in New York threw out its earlier tire pressure mandate this summer, is said to be putting the finishing touches on the new ruling, which would bar automakers from using cheaper techniques to "infer" tire pressure. Industry sources said the NHTSA, which has been tight-lipped about its plans, will publish the new regulation before year's end.

"We have indications that NHTSA will move fast - possibly in the next couple of weeks, but definitely before Christmas," said one industry executive. "They have to, because the carmakers need to plan this into their production schedules."



# Where do these standards come from?

- Individual companies
- Industry consortia
- Standards bodies (informal and formal)
- Governmental agencies

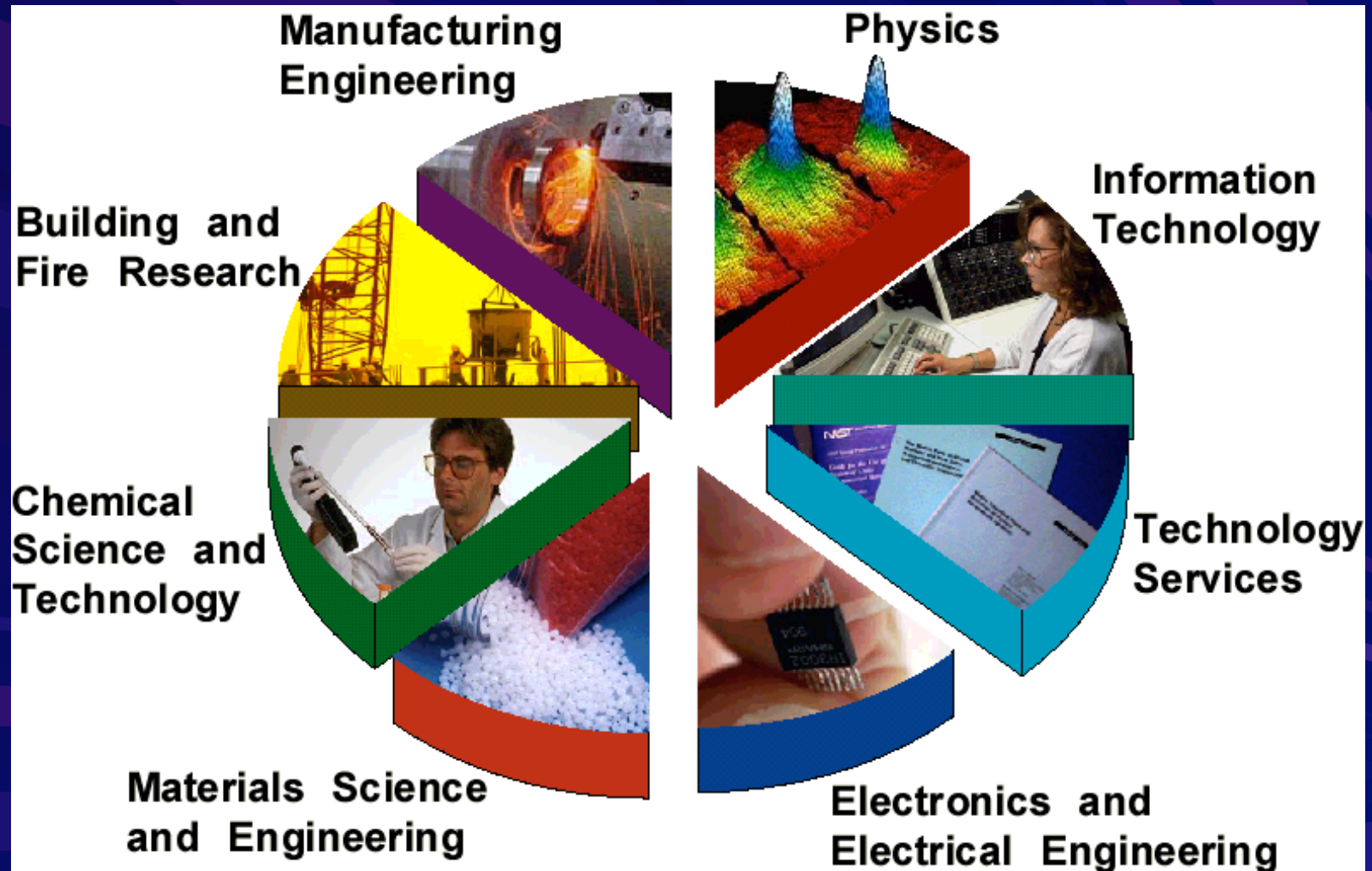
# National Institute of Standards and Technology

*NIST's mission is to develop and promote measurements, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life.*

- 3,000 employees
- \$760 million annual budget
- \$570 million current R&D
- partnerships with industry
- 900 industrial partners
- 2,000 field agents
- 1,600 guest researchers
- NIST Laboratories -- National measurement standards
- Baldrige National Quality Award



# NIST's Measurement and Standards Laboratories





# Infrastructure For Integrated Electronic Design and Manufacturing (IIEDM)

## Customer Needs:

- Reduce time to market for new electronics
- Reduce the risk of adoption of new technologies

## Project Goals:

- Assist in the development of neutral product data exchange specifications
- Help develop manufacturing specifications
- Create needed infrastructure for the exchange of component information

# Standards Organizations

- IPC
- ISO/IEC TC93 – Design Automation
- Object Management Group (OMG)
- Standard for the Exchange of Product Data (STEP)
- Organization for the Advancement of Structured Information Standards (OASIS)
- Semiconductor Equipment Materials International (SEMI)

# Consortium & Trade Organizations

- IPC
- National Electronics Manufacturing Initiative (NEMI)
- RosettaNet
- Consortium for Advanced Manufacturing (CAMI)
- ECALS/ Japan Electronic and Information Technology Industries Association (JEITA)
- International SEMATECH (ISMT)

# What is Software Interoperability?

*“The ability of a system or a product to work with other systems or products without special effort on the part of the customer”* - Department of Education, Tasmania

*“The ability of software and hardware on multiple machines from multiple vendors to communicate.”* - JMR Electronics

*“... letting different kinds of applications and systems do what they do best, while agreeing on a common “contract” for how disparate systems can communicate to exchange data with one another.”* - Bill Gates




# Approaches to Software Interoperability

- Current methods build on standards
  - Shared data format
    - e.g., MPEG, JPEG, MP3
    - Becomes more useful as it is more widely adopted
    - A truly monolithic standard would have to encompass all possible domain information
  - Translation between different data formats
    - e.g., Gerber to IPC2581
    - Mappings can be difficult and can result in loss of data
  - Shared APIs, protocols, and information models

# Benefits from Software Interoperability

## Enables Best of Breed Solutions

- Allows a Plug-and-Play environment, which enables adoption of new technologies
- Standards can level the playing field and facilitate innovation
  -  e.g, USB, PCMCIA, PCI, IDE

## Supports Distributed Work Environments

## Increased Supply Chain Productivity

- Reduces errors
- Reduces time to market for new products

# Supply Chains: Interoperability Showcase

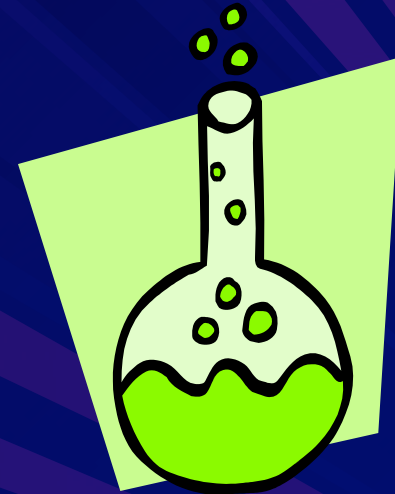
*“A **supply chain** is a network of facilities and distribution options that performs the functions of procurement of materials; transformation of these materials into intermediate and finished products; and distribution of these finished products to customers.”*

(Source: Ganeshan & Harrison - Introduction to Supply Chain Management)

- Software interoperability plays an important role in every part of the supply chain
- Successful introduction of any new technology will require integration with existing software and standards

# Supply of Raw Materials

- New Technology  
example: new materials or chemicals (e.g. lead-free alternatives )
- New attributes need to be definable, storable, and searchable for new customers



Chemical X



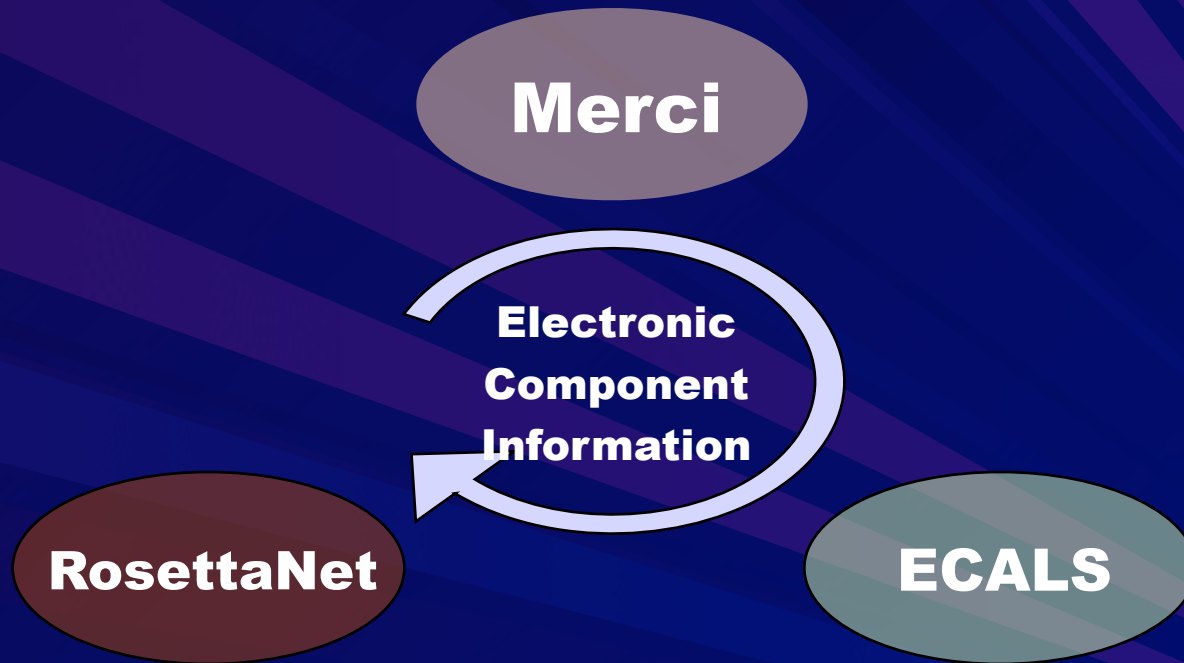
# Supply of Raw Materials

- To integrate a new material could require:
  - Interoperability with multiple international dictionaries and parts catalogues:
    - e.g., IEC 6130, ECCMA, ECALS, RosettaNet Technical Dictionary
  - Interoperability with multiple search standards and product data sheet formats:
    - e.g., PDF Datasheets, RosettaNet PIP2A9/10, PDX
  - Interoperability with declaration standards
    - e.g., NEMI/IPC 1571/1572

# NIST's Data Dictionary Work

- Assisted in the development of Si2 & RosettaNet's data dictionary format (became the RNTD)
- Assisted in the development of RosettaNet PIP 2A9 "Query Electronic Component Technical Information"
- Developed dictionary software and translators
  - Query builder
  - 2CIDS – converts IEC dictionary to RosettaNet format
- Convened the IEC TC93 WG6 dictionary harmonization effort
  - IEC 61908 "The Technology Roadmap for Industry Data Dictionary Structure, Utilization and Implementation" report

# Dictionary Harmonization Effort



## Problems Mapping Different Dictionaries:

- Different dictionary class structures
- Dictionaries that are focusing on different domains
- Naming convention problems
- Different ways of measure attributes

# Manufacturing of Finished Goods

- New Technology  
example: New  
Manufacturing Data  
File Formats (e.g. IPC  
2581 Standard)
- Data exchange  
continues to be a  
difficult task, with  
different data formats  
being used by  
different suppliers.



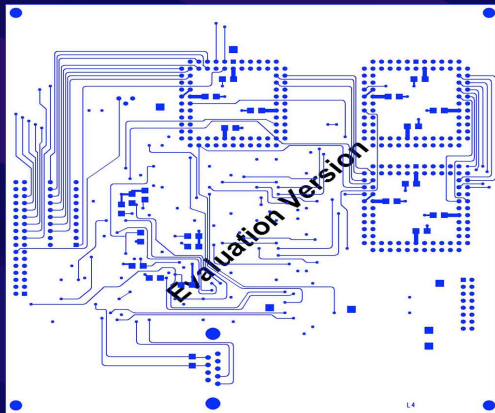
**Board Manufacturer**



# Manufacturing of Finished Goods

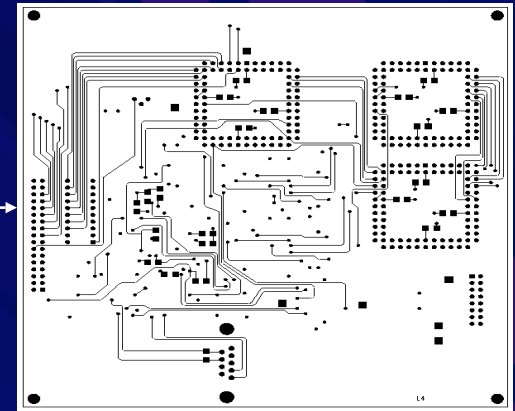
- The current supply chain involves many different companies, each contributing to various facets of the manufacturing process.
- The various attempts to standardize IT technologies and data exchange formats are making progress, but have not yet reached the point at which they become so cost effective that widespread adoption is inevitable.
- Any new data format would require translation tools to allow communication with existing supply chains (e.g., Gerber to IPC 2581 translator).

# Gerber to IPC 2581 Translator



Gerber File

NIST  
Translator

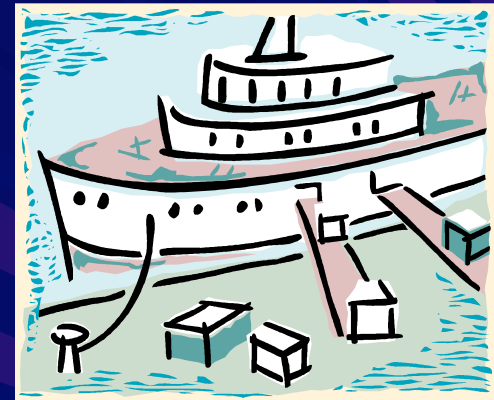


IPC 2581 File

- NIST developed a platform-independent software translator from Gerber to IPC-2581
- One of the issues discovered is an inherent problem with preserving design intent across formats

# Distribution of Products

- Driving force: new legislation (e.g. Restriction of Hazardous Substances directive)
- These directives are forcing new distribution technologies
- A common material declaration standard would support global interoperability



Customs

# Material Declarations

- Growing awareness of manufacturing's impact on the environment
- New regulations are being drafted that seek to limit or ban materials deemed harmful for the environment
- Export and importing new products will require that manufacturers declare the presence of these materials
- No adequate declaration standard exists



# Developing IPC 175X Standards

- Working with iNEMI and IPC to develop the IPC 175x series of standards
- Using software development tools to manage the complex design of a material declaration data exchange format
- Creating a standard that has a simple implementation for small businesses (.pdf) with a B2B-capable implementation (using XML)
- This standard will allow material declaration information from different players in the manufacturing chain to be shared.

# Current Software Trends Supporting Interoperability

- Support interoperability between entities that were not specifically designed to interoperate
  - Common Data Formats (e.g., XML, SGML, JPEG, MPEG)
  - Information Modeling Tools (UML)
  - Extended Networks for Supply Chains
  - Security and Authentication

# What Comes Next?

- When developing new technologies, developers should focus on “Interoperability by Design”
  - Modify existing standards
  - Develop new standards as needed
- Standards based software solutions are the key to supporting plug and play environments
  - Reduces risk of adoption of new technologies
- Information models are the best way to insure interoperability between any two entities