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IPC-2571

Generic Requirements for Electronics Manufacturing Supply Chain Communication – Product Data eXchange (PDX)

IPC-2571

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A standard developed by IPC

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PDX

– GENERIC

Generic Requirements for Electronics Manu- facturing Supply Chain Communication - Product Data eXchange (PDX)

A standard developed by the Product Data Exchange Task Group (2-15a) of the Supply Chain Communication Subcommittee (2-15) of IPC.

The IPC-2571 standard defines an XML encoding schema that enables a total product definition to be described at a level appropriate to facilitate supply chain interactions.



Users of this standard are encouraged to participate in the development of future revisions.

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Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the Product Data Exchange Task Group (2-15a) of the Supply Chain Communication Subcommittee (2-15) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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Generic Requirements for Electronics Manufacturing Supply Chain Communication - Product Data eXchange (PDX)

Introduction

Today, manufacturing is accomplished through the collaboration of a dynamic, global network of original equipment manufacturers, manufacturing service providers, and parts suppliers. To capture market opportunities, this network of partners is required to function even more efficiently than would a single company which kept control of all production processes in house.

Virtual manufacturing networks, such as these, are highly dependent on accurate and immediate product content information. Yet today's manufacturing networks are often forced to rely on inadequate paper-based communications like faxes and emails, or on web pages that are not dynamically linked to the source of the product content.

The dilemma is especially acute among organizations trying to bring electronic products to market. It is becoming increasingly rare for companies that design products, which have substantial electronics content, to manufacture their own products. It is more typical for the bulk of the manufacturing to be subcontracted to an Electronics Manufacturing Services (EMS) provider. The Original Equipment Manufacturer (OEM) who designs the product will typically only perform the final assembly and packaging but in some cases, even this is sub-contracted. The EMS provider may ship the finished product directly to customers. The EMS provider in turn will purchase the bulk of the components either directly from the component manufacturers or from distributors.

Increasingly, even the product design process is a collaborative effort. Often the Electronics Manufacturing Services provider or component supplier will suggest changes to a product design based on component price or availability information that is not available to the Original Equipment Manufacturer. The pressure to both reduce costs and improve products translates directly into a much higher frequency of product changes throughout a product's lifecycle. Effective and timely communication of these product changes across the supply chain is essential in order to avoid potentially costly rework or dead inventory problems.

PDX is the Product Data eXchange standard for the e-supply chain. Product Data eXchange is a multi-part standard, represented by the IPC 2570 series of specifications. The Product Data eXchange standardization effort is focused on the problem of communicating product content information between Original Equipment Manufacturers, Electronics Manufacturing Services providers and component suppliers. The standard is based on XML because this provides a simple yet powerful and flexible way to encode structured data into a format that is both human and machine-readable. The Product Data eXchange standard provides a way to describe product content (Bill of Materials (BOM), Approved Manufacturer Lists (AML), Drawings, etc.), Engineering Change Requests (ECR), Engineering Change Orders (ECO) and Deviations in an eXtensible Markup Language (XML) format. This standard will enable dramatic efficiency improvements throughout the supply chain since partners will have a way to exchange product content and changes in a common language.

The OEM companies at the top of the supply chain (SC), originate the product structure and feed it to the down stream SC partners. Various design for assembly, fabrication, test feedback (DF*) and material status, WIP and Quality information will flow back up the SC to the OEM (i.e. 257* standards). In some cases OEMs will be feeding data to both internal EMSs and multiple external EMSs and they need methods to make sense of this varying feedback. It is assumed that most SC partners will have several internal applications that they use to vault and control the product information (PDMs, ERPs, CAMs, CADs, etc).

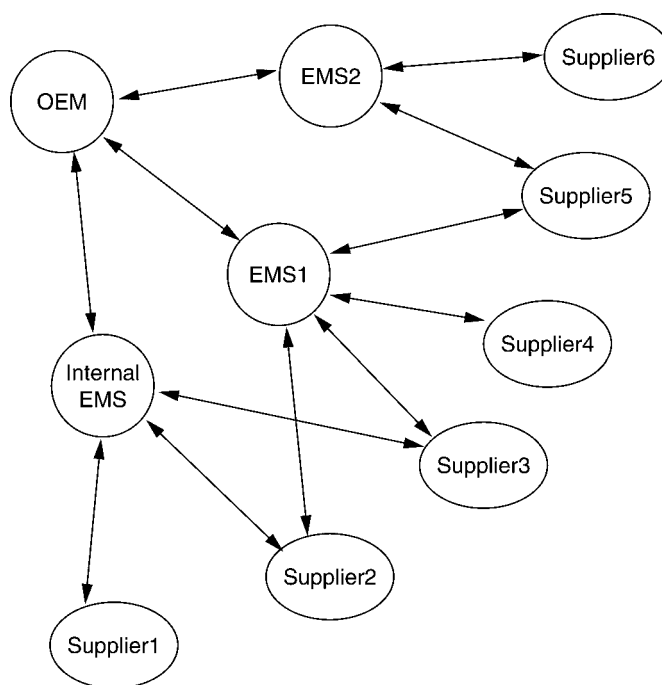


Figure 1 Supply Chain Information Exchange

As the product structure moves through the supply chain, various subsets of the product information will be made available to the suppliers and EMSs. Non Disclosure Agreements and security mechanisms are needed that allow this data to be shared in a secure and protected way. For example EMSs usually strip the PCB (Printed Circuit Board) information out of the full product data package before sending it on to the PCB fabricators. They also partition the BOM when they send quote packages to suppliers as part of the component procurement process. OEMs typically decide to partition the complete product structure and have different assemblies manufactured by several EMS companies.

To satisfy this mode of SC information exchange, IPC 257X allows all or portions of the product structure to be defined and transmitted. In some cases what appears as a “component” to one SC partner, may in fact be a complex assembly to another. The applications generating and processing this standard must be able to subset and merge the partial definitions into their company’s internal information models.

Relationships to Other Standards Initiatives

IPC 2510 – GenCAM

The GenCAM standard (IPC 2510) describes printed boards and printed board assemblies. GenCAM describes a printed board in enough detail to be able to manufacture and assemble a board. The Product Data eXchange standard, on the other hand, is intended for high-level supply chain communication of product definition data. Product Data eXchange allows a company to describe a complete system or sub-system including hardware and other higher-level assemblies that would not normally be described by GenCAM documents. Product Data eXchange does not however define a standard for describing parts and assemblies in enough detail to be able to manufacture them. This is achieved only by including other documents in a Product Data eXchange package. These other documents may include GenCAM documents. There is some overlap in scope between the bill of materials section of Product Data eXchange and the parts list section of GenCAM, however there are also significant differences. In a GenCAM file, the electrical characteristics of each device are described, as is the placement on the board of each instance of that device. A Product Data eXchange bill of material for a printed board assembly can be characterised as

a summary of a GenCAM parts list in the sense that it does not contain electrical characteristics or placement information. It may however also contain some information such as find numbers or information about mechanical fasteners, which is typically omitted from a GenCAM file. In general it should be possible for software to generate most of a Product Data eXchange bill of material from a GenCAM parts list but the reverse will not in general be possible. There are also some differences in the relative importance of some of the optional data that may be included both in a GenCAM parts list and a Product Data eXchange bill of material. Notably, both GenCAM and Product Data eXchange allow manufacturer part numbers to be recorded. This information may in some cases be omitted from a GenCAM parts list because the choice of which of the many possible manufacturer parts to use may not have been made at the time that the GenCAM file was generated. In a Product Data eXchange document this information will normally be required. Engineering Notes, examples, and other engineering related information that is used in a GenCAM file through the reference of attachments and utilizing workflow can be transmitted via the IPC2571 & IPC2578 series.

RosettaNet

RosettaNet is dedicated to the development and deployment of standard electronic business interfaces to align the processes between supply chain partners on a global basis. In order to efficiently conduct eBusiness, companies require a robust technical dictionary and data structures, a framework for passing messages, and conventions for business transactions. RosettaNet addresses these needs by building a master dictionary to define properties for products, partners, and business transactions. This master dictionary, coupled with an established implementation framework (exchange protocols), is used to support the eBusiness dialog known as the Partner Interface Process or PIP.

RosettaNet has well-defined Partner Interface Processes for the exchange of data about complete products and data about electronic components, and is embarking on developing a mechanism for exchanging manufacturing information. Product Data eXchange provides exactly this missing capability. It is anticipated that the data descriptions in Product Data eXchange will be leveraged into RosettaNet Partner Interface Processes to provide an end-to-end solution for the entire electronics supply chain.

Open Applications Group, Incorporated (OAGI)

The Open Applications Group, Incorporated has defined standard interfaces between enterprise software applications. The scope of the Open Applications Group, Incorporated Interchange Specification (OAGIS) overlaps to a small extent with the Product Data eXchange standard, and it is anticipated there will be opportunities for consolidation in the future.

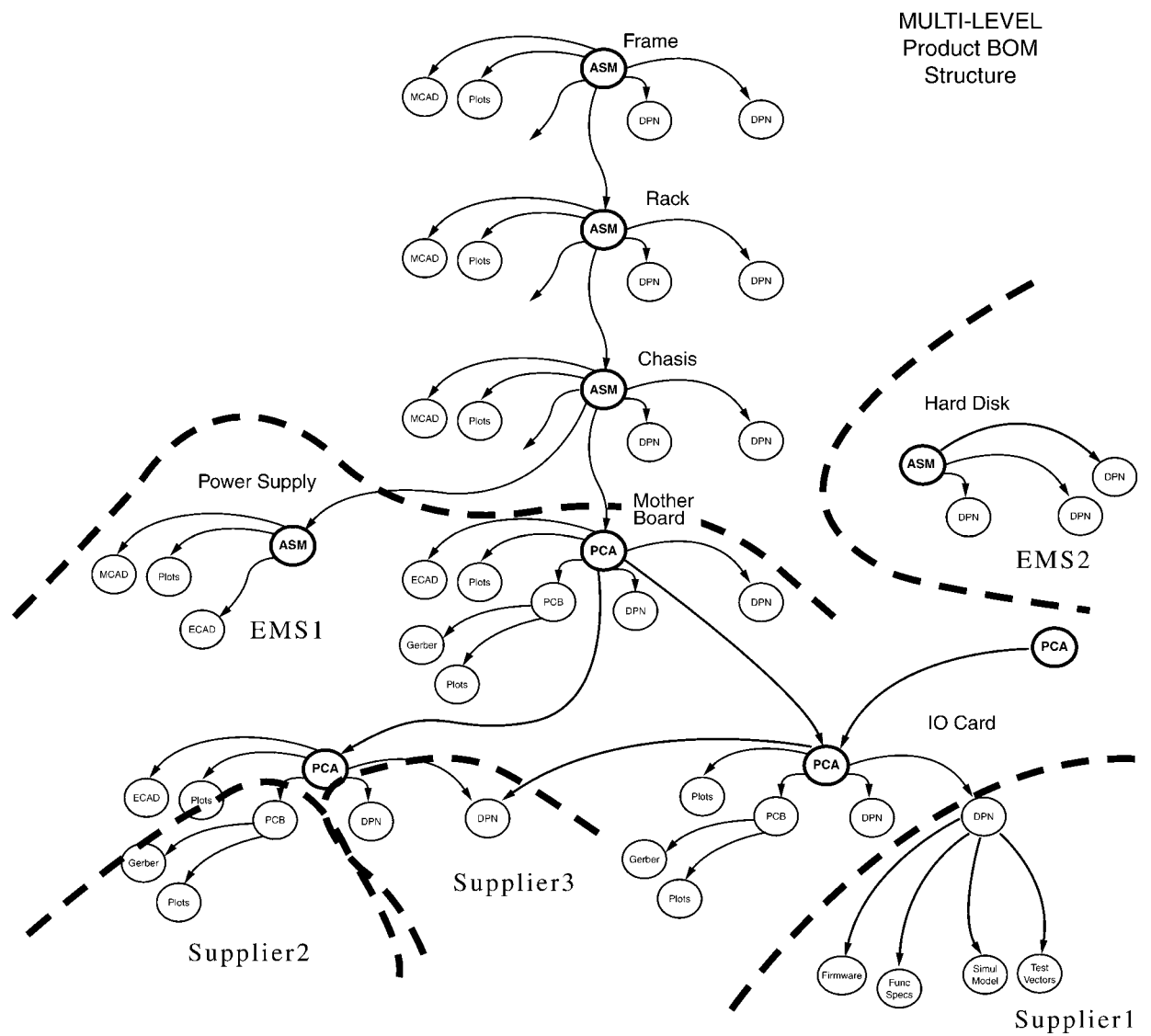


Figure 2 Multi-level Product BOM Structure

1 Scope

The Product Data eXchange 1.0 standard defines an XML encoding scheme that enables a total product definition to be described at a level appropriate to facilitate supply chain interactions. The scheme is defined for bill of materials (BOM), approved manufacturer list (AML), changes (Engineering, Manufacturing, Product) and references to documents describing geometric and other definition characteristics.

IPC 2571 is the umbrella specification for other IPC 2570-series specifications. It describes the Package element that is required for every Product Data eXchange implementation, as well as other common elements shared across the 2570 series. The sectional standards provide application exchange capability. IPC 2576, for instance, transfers as-built product configuration data, and IPC 2578 defines specific product definition elements such as items, changes, bills of material (BOMs), and approved manufacturing lists (AMLs).

The IPC 2570-series of standards transfer the data required to support the following business processes:

- Quote request
- Manufacturing
- Engineering change management (including signoff)
- Work in Process (not started)
- Report on Quality (in development)
- Report on as-built product configuration

2 Applicable Documents

The following documents are related to the Product Data eXchange efforts.

2.1 IPC Documents

The following documents contain provisions, which, through reference in this text, constitute provisions of this standard. All documents are subject to revision. Parties who make agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

IPC-T-50	Terms and Definitions for Interconnecting and Packaging Electronic Circuits.
IPC 2510	Generic Computer Aided Manufacturing Descriptions for Printed Boards and Printed Board Assembly.
IPC 2576	Product Data eXchange – Sectional Requirements for Electronics Manufacturing Supply Chain Communication of As-Built Product Data
IPC 2577	Product Data eXchange – Sectional Requirements for Supply Chain Communication of Manufacturing Quality Assessment
IPC 2578	Product Data eXchange – Sectional Requirements for Supply Chain Communication of Bill of Material and Product Design Configuration Data

2.2 RosettaNet Documents

The following are RosettaNet Partner Interface Process documents that relate to this standard, and reflect an effort made by both organizations towards harmonization.

RosettaNet PIPs	2C1-10 (IPC2578)	Product Design Information
	Segment 7A	Design Transfer
	Segment 7C	Distribute Manufacturing Information

2.3 OAG Documents

OAGIS Open Applications Group Interchange Specifications will be used to harmonize with this standard and will be incorporated in later revisions of this standard.

2.4 RFC Documents

RFC 1950	ZLIB Compressed Data format Specification 3.0
RFC 1951	DEFLATE Compressed Data Format Specification Version 1.3
RFC 1952	GZIP file format specification 4.3

3 Product Data eXchange Package

This standard uses a single XML file in the format described by this specification to represent a Product Data eXchange (PDX) package. The Product Data eXchange package can reference external attachments (see attachments section below). The XML file will be named "pdx.xml". The pdx.xml file must contain a single ProductDataeXchangePackage element and optionally the other elements described in this specification. The pdx.xml file may also contain elements from the other IPC 257x PDX standards.

Since a Product Data eXchange package can be one XML file and an unlimited number of external attachments, one way to communicate the Product Data eXchange package as a single package is to compress the files as described in Internet RFC's 1950 through 1952.. This not only brings all the files together in one file for ease of delivery, but also compresses the files to reduce their size. Compression is particularly useful for XML files since they tend to be very large with large amounts of repeated data and thus compress significantly. This compressed file consisting of the pdx.xml file and any external attachments can be named a Product Data eXchange file with a ".pdx" extension and the MIME type can be application/x-pdx. The compression of the Product Data eXchange package contents is optional and is not required by this specification. The sending and receiving partners must define this as part of the transport layer they use for communicating Product Data eXchange packages.

The Product Data eXchange package requires internal Document Type Definition (DTD) file inclusion so the entire content of the DTD file is included in the pdx.xml file. The DTD is included at the end of this document. In addition to the mandatory XML process instruction of <?xml version = "1.0"?>, or <?xml version = "1.0" encoding="UTF-8"?>, the pdx.xml file also includes two other process instructions: <?pdx_version = "1.0"?>, which states in which version of Product Data eXchange standard the package is formed, and <?generated_by SoftwareVendor/SoftwareName/Version/BuildNumber?>, which states which version of what software was used to create the package.

3.1 Modeling Diagram Occurrence Indicator Meanings

Occurrence indicators are used within element content models to specify how many times an element may appear at a given location. The indicators available to schema developers are listed below:

Occurrence Indicator	Meaning
<i>none</i>	The element must appear once and only once.
?	The element (or group of elements) may appear zero or one times. The element is optional, but is only allowed to appear once.
+	The element (or group of elements) must appear one or more times. The element is required to appear at least once, but multiple consecutive occurrences may be present.
*	The element (or group of elements) may appear zero or more times. The element can appear as many times consecutively as needed, or even zero times.

Note that graphics and a table of attribute descriptions are provided as an aid to understanding the elements in the PDX standard suite. In any instance where the XML DTD conflicts with an image or description, the DTD should be considered normative.

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