LOTAR
LONG TERM ARCHIVING AND RETRIEVAL

LOTAR Project Overview

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Lockheed Martin Aeronautics Company
The LOTAR International Project is a working group supported by the AIA and PDES, Inc. in the Americas, and ASD-STAN and the ProSTEP iViP Association in Europe to form a four party consortium.

- The project goal is to develop, publish and maintain standards designed to provide the capability to archive and retrieve digital product and technical information, including 3D CAD and PDM data, in a standard neutral form that can be read and reused throughout the product lifecycle, independent of changes in the IT application environment originally used for creation.

- The standards are published as EN/NAS(*) 9300 series and cover both the information content as well as the processes required to ingest, store, administer, manage and access the information.

(*): EN – European Standard (Norm); NAS – National Aerospace Standard
Objectives & Benefits of LOTAR

- Objectives include:
  - Developing a standard for preserving, managing and retrieving product data throughout its lifecycle.
  - Providing methods, process modules and data model(s), to enable long term archiving of CAD, PDM and additional technical data.
  - Developing recommendations for practical introduction of long term archiving of product data, such as 3D CAD and PDM data, in the industry.

- Benefits include:
  - Process security achieved through implementation of archival systems compliant to international accepted standards.
  - Aerospace and Defense authorities accept workflow due to intense collaboration during standards creation.
  - Applicable archiving workflow supported by STEP interfaces & functionalities.
  - By solving the challenges of long term data retention, issues of data exchange are addressed.
Information Lifecycle Planning
Driving Questions

What data should we archive?
Why are we archiving the data?
What is the current data format?
What is the retention period of the data?
How frequent do we access the data?
What is the final format the data is to be archived in?

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LOTAR Timeline

Late 1990s:

2000
- Start of the PDES, Inc. LTDR Project (US) coord w/AIA LTDR

2002
- Start of the ASD Stan – ProSTEP iViP LOTAR Project (Europe)
- IAQG* approved charter for AIA/ASD Stan Joint Project
- AIA LTDR Published ARP9034

2003
- First joint team meeting of the international AIA - ASD-Stan LOTAR effort under the mgt of the IAQG* (MoU: AIA/ASD-Stan)

2004
- Launch of the 3D CAD and PDM Workgroups

2005
- First Publication of LOTAR Basic Parts

2006
- First Publication of LOTAR Common Process Parts

2009
- Creation of the joint LOTAR International consortium (AIA / ASD-Stan / PDES, Inc. / ProSTEP iViP)
- Launch of the Composites WG

2012
- First Publication of LOTAR Domain Specific Parts (3D CAD)
- Launch of the Workgroups for Electric Harness, Meta Data for Archive Packages, and 3D Visualization

2014
- Kicked off LOTAR Eng Analysis & Sim Workgroup Sept 2014

* IAQG: International Aerospace Quality Group
Motivation for LOTAR

- Meeting the legal and business requirements of the aerospace and defense industry:

- EN/NAS 9300 considers requirements coming from:
  - Legal and certification rules
  - Regulations on long term archiving of technical documentation
  - Reuse
  - Support in operation

- Additional to legal demands, there are industry established standards, company specific rules and recommendations.

- The standard defines architecture, processes and data formats to fulfill these requirements.
The life cycle of applications and storage technologies has to be considered by setting up a long term archiving and retrieval standard:

- Continuous development of technical product documentation leads to a change of methods and tools, which are used for design, manufacturing, customer support and archiving.
  - New releases of CAD / CAM / CAE / PDM / … systems offering new functionalities
  - After each migration, the data shall be checked for consistency and completeness.
  - A conversion of the native product data into a more stable format is essential.
Organizational Structure

Process Steering Council

Hosting Organization
AIA
AIA-EMC
G. Mills
R. Rentsch

Hosting Organization
PDES Inc.
J. Harris
M. Jahadi

Hosting Organization
ASD-Stan
ASD-SSG
G. Lessmann
Yves Baudier

Hosting Organization
ProSTEP ivip.
R. Pohl
S. Vettermann

Americas Sector

Leadership Team

Americas Sector
Chair
Rick Zuray

Americas Sector
Project Coord.
Jeff Holmlund

Europe Sector
Chair
JY Delaunay

Europe Sector
Project Coord.
Jochen Boy

PDES Inc
Board Champion
Mike Jahadi

CAx-IF
Chair
Phil Rosche

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“Open Archive Information System” (OAIS) Reference Model is basis for LOTAR processes

- Developed by Aerospace and Defense Industry
- Extended to meet the specific requirements of LOTAR

As neutral data format for the archives, ISO 10303 (STEP) has been chosen since it is the most advanced open format.
A distinctive feature of the combined use of LOTAR and STEP is the use of Validation Properties.

Validation Properties are key characteristics of a model that help to ensure consistency of the data. They are computed by the exporting system and included as key-value pairs in the STEP file. Any importing system will compare its import results with these properties and thus determine success of the data transfer.
Standards (5) year vision

- Process & Use Cases
  - CAD Mechanical 3D Geometry with PMI & Assy
  - Product Management Data
  - Composite Design & Manufacturing
  - Electrical Harness
  - Systems Engineering (Not Started)
  - Engineering Analysis & Simulation
  - Electronics (Not Started)

- ISO Information Models
  - AP242 E1&2
  - AP239
  - AP242 E1&2
  - AP203
  - AP242 E2 Target
  - AP233 Target
  - AP209 E2 Target
  - AP210 E2 Target
Governance:
LOTAR Document Structure

Basic Parts 001 – 009
Overview, Reqs, Methods...

Common Process Parts 010 – 099
Common Processes, Data Prep, Ingest, Archive Storage, Retrieval...

Domain Specific Parts
100 – series
200 – series
300 – series etc.

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LOTAR Involvement in the development of ISO 10303-242

PDM
General management information
Activity and work management
Effectivity, Specification, Breakdown and Configuration

Process Plans
Requirements
Design Rules

Electrical Wire Harness

AP242 Domain Support

Presentation

3D MACHINING
Form Features

3D PMI
(Product & Manufacturing Information)

3D Assembly
Constraints

3D Kinematics

3D Composite Design

2D Draughting

3D Shape
Data Quality

3D Shape (Explicit and Parametric)

3D Exact/Explicit Geometry
3D Tessellated Geometry
3D Parametric & contr. history

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LOTAR Member Companies 2015

(Americas)
- BAE Systems
- Boeing
- Embraer
- General Dynamics
- General Electric
- Goodrich
- Honeywell
- Lockheed Martin
- Rockwell Collins
- Sandia National Labs

(Europe)
- Airbus Commercial
- Airbus Defense & Space
- AFNET
- IAI (Israel Aerospace Industries)
- SAFRAN
- Airbus Helicopter TBC
## Status of use of NAS/EN 9300 by LOTAR members

<table>
<thead>
<tr>
<th>A&amp;D company</th>
<th>Area of application</th>
<th>Scope</th>
<th>CAD 3D exact geometry</th>
<th>CAD 3D tessellated geometry</th>
<th>CAD 3D PMI</th>
<th>CAD Assembly structure</th>
<th>ISO formats</th>
<th>Project status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airbus</td>
<td>A350</td>
<td>3D electrical harness installation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 214 ed3 (*) + AP 242 ed1</td>
<td>PROD</td>
</tr>
<tr>
<td>EADS</td>
<td>&quot;Full 3D&quot; model based</td>
<td>&quot;Full 3D&quot; model based</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 242 ed1</td>
<td>PROD</td>
</tr>
<tr>
<td>Dassault-Aviation</td>
<td>Falcon 7X</td>
<td>complete definition of the aircraft (airframe, brackets, pipes, harness)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 214 ed3 (*)</td>
<td>PROD</td>
</tr>
<tr>
<td>Sncema</td>
<td>New parts of engines</td>
<td>3D definition with PMI of new mechanical part</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>AP 214 ed3 (*)</td>
<td>PROD</td>
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<tr>
<td>Boeing</td>
<td>787</td>
<td>3D definition with PMI with assemblies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 203 ed2 (*) + U3D PDF</td>
<td>DEV</td>
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<tr>
<td>Gulfstream</td>
<td>G650</td>
<td>3D mBD mechanical, electrical and composite</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 203 ed2 (*)</td>
<td>PROD</td>
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<tr>
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<td>F35</td>
<td>3D mBD mechanical, electrical and composite</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 203 ed2 + AP242 ed1</td>
<td>DEV</td>
</tr>
<tr>
<td>EMBRAER</td>
<td>Legacy 450 &amp; Legacy 500</td>
<td>complete definition of the aircraft</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AP 242 ed1</td>
<td>PROD</td>
</tr>
</tbody>
</table>

### Notes:
- **PLANNED**: project planned
- **DEV**: project in development
- **PROD**: project on production

(*) Plan to migrate to STEP AP 242 ed1 when possible
LOTAR International

- 7 Technical Working Groups
  - 3D Mechanical / PMI
  - PDM / PLM
  - Adv. Mfg & Composite
  - Electrical
  - 3D Visualization
  - Meta data for archive packages
  - Engineering Analysis & Simulation

Description of a LOTAR WG web page:
- Goals and Objectives
- Associated LOTAR use cases
- LOTAR Family of Standards
- Associated ISO 10303 Information Models
- Meetings & teleconferences
- Accomplishments
- Related standardization projects
LOTAR WG: 3D Mechanical CAD with PMI (EN/NAS 9300-1xx)

- **Scope:**
  - Exchange and archiving of 3D Geometry via STEP
  - Provision of Validation Properties and User Defined Attributes
  - Transfer of PMI (Product & Manufacturing Information) as:
    - Representation (machine-consumable, reusable)
    - Graphic Presentation (human-readable)

- **Deliverables\(^*\):**

- **Parts:**
  - 100 (Common Concepts)
  - 110 (Explicit 3D Geometry),
  - 115 (CAD Assembly Structure),
  - 120 (PMI Graphic Presentation),
  - 121 (PMI Semantic Representation),
  - 122 (Machining Features),
  - 125 (Assembly PMI Graphic Pres.)

- Comprehensive suite of test models
- Numerous pilot projects in cooperation with the CAx-IF
- Support of STEP AP242 development and associated Recommended Practices

\(^*\): Accomplished or in work; more planned
Scope:

- Archive and retrieve Product Data Management information in a standard neutral form that can be read and reused throughout the product lifecycle.
- Preservation of digital PDM information along the product lifecycle: in development, as designed, as planned, as delivered and as maintained.

Deliverables(*):

- Parts 200 (Common Concepts), 210 (PDM “as designed”), 220 (PDM “as built”), 230 (PDM “as maintained”).
- Recommendations for the Validation of Product Structures.
- Preparation of a STEP AP239 / PLCS DEX.
- Facilitation of pilot projects.

(*): Accomplished or in work; more planned.
Scope:
- Preservation of New information required in STEP data model for Additive manufacturing:
- **Organic Shapes and Surface Models**
  - Design Tools –
  - Representation Formats
  - Preservation of CAD 3D tessellated solids
  - 3D composite structures information such as Sequences, Plies, Cores, Material properties, Rosette, Orientation…
  - Preservation of CAD 3D tessellated solids
- **Deliverables** (*):
  - Parts 300 (Common Concepts), 310 Ed.1 (“exact implicit” – Ply Definition), 310 Ed.2 (“approximate explicit” – 3D Tess. Solid)
  - Support of STEP AP242 Development and associated Recommended Practices
  - Prototype part developed to anticipate future structures in order to demonstrate concepts
  - Independent tests of CAD tools for the purpose of interoperability

*): Accomplished or in work; more planned
Scope:
- Preservation of digital electrical harness models for
  - Design
  - Certification
  - Manufacturing
  - Support

Deliverables(*):
- Parts 400 (Common Concepts), 410 (Physical harness definition for design & construction)
- Preparation of test cases for physical electrical harness definition
- Coordination with other standardization projects related to electrical harness (STEP AP 210, AP239, VDA VEC specification, ...)
- Preparation of business requirements and use cases for extension of STEP AP 242 ED2 to include Electrical Harness Data

(*): Accomplished or in work; more planned
LOTAR WG: Engineering Analysis and Simulation (EN/NAS 9300-6xx)

- **Scope:**
  - Preservation of Engineering Analysis and Simulation information
    - Simulation
      - Structural (p1)
      - CFD (p2)
    - Analysis Methods
      - Deterministic (p1)
      - Finite Element (p1)
    - Material Types
      - Composites (p1)
      - Metallic (p1)

- **Deliverables:(*)**
  - Parts 600 (Fund. & Concepts), 6xx (TBD)
  - Preparation of WG Scope and Use Cases
  - Coordination with other standardization projects related to EAS (AP209, AP242, MoSSEC, ProSTEP iViP)
  - Preparation of business requirements and use cases for extension of STEP AP 242 ED2 to include Simulation & Analysis Data

(*): Accomplished or in work; more planned
LOTAR WG: 3D Visualization  
(Technical Specification/Rec Practice)

Scope:
- To define common recommendations for LT Archiving and Retrieval of 3D Visualization information being consistent with LT Archiving and Retrieval of information concerning CAD models and related information, throughout the full product life cycle.

Deliverables (*):
- To define the characteristics of the Visualization information to be archived.
- To prepare recommended practices for implementing available 3D Visualization standards by the LOTAR community.
- To describe the recommended processes to ensure the consistency between the archived CAD 3D (authoring) data and the archived 3D Visualization (derived) data

(*) Accomplished or in work; more planned
LOTAR WG: Meta-Data for Archiving (Technical Specification/Rec Practice)

**Scope:**
- Define processes, UCs and standard information model to manage meta-data for:
  - Submission Information Package
  - Archival Information Package
  - Dissemination Information Package
- Define processes, UCs and standard information model to manage meta-data for:
  - Define the information model and the corresponding STEP AP 239 PLCS subset

**Deliverables(\(^{(*)}\):**
- Parts 021 (Meta-data for Archiving),
- Processes, use cases and test cases
- STEP AP 239 information model subset
- STEP AP 239 LOTAR DEX / Rec. Practices for meta data for AP
- Test round reports and prototypes of PLM vendors

(\(^{(*)}\): Accomplished or in work; more planned)
Why LOTAR?
• Mission, Objectives & Scope
• Legal & Business Motivation
• Technical & IT Background
• Goals & Benefits

LOTAR Organization
• External View
• Internal View
• Working Together
• Fundamentals & Processes
• Member Companies

LOTAR Workgroups
• 3D CAD with PMI
• PDM
• Composites
• Electrical Harness
• 3D Visualization
• Meta-Data for Archival
• Engineering Analysis & Simulation

Communication
• Public Presentation
• Progress Reports

LOTAR Standard
• Overview on Parts
• Industry Use

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2015-02-20
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more

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2015-03-11
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Any questions?

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