ProSTEP iViP/VDA
JT Application Benchmark

4th JT Benchmark

SHORT REPORT

ProSTEP iViP

Contents

1   Introduction

JT has become a widely used format for product visualization during the product development process. The ProSTEP iViP Association and the German Association of the Automotive Industry (VDA) have launched three JT-related projects in succession which are being coordinated with each other: the ProSTEP iViP/VDA JT Workflow Forum, the ProSTEP iViP/VDA JT Application Benchmark and the ProSTEP iViP/ VDA JT Implementor Forum.

As the latest in a row of four benchmarks, the JT Application Benchmark was carried out in 2013 to achieve an independent evaluation of the progress being made with regard to the development of JT translators. The object of the testing was ISO 14306:2012 (JT 9.5). Additionally, the interoperability between JT and the STEP AP242 XML schema (publication as ISO Standard planned for Q1/2014) was also part of the Benchmark. Thus, this 4th Benchmark covers results far beyond state-of-the-art technology.

The benchmark was managed by the JT Workflow Forum and JT Implementor Forum. Because the benchmark is an independent activity, it was financed directly by the two organizations, the ProSTEP iViP Association and the VDA, and not by the participating companies whose products were tested. It is a neutral comparison of trendsetting JT applications with regard to the selected test criteria. Therefore the results of the benchmark cannot only be used to evaluate the application of JT in PLM environments but also for improvement of the interoperability of the applications.

As such applications are undergoing a permanent development; the Benchmark can only give a snapshot of the functions and qualities of the applications.

2   Approach

Focal points of this 4th Benchmark are the quality of visualization, the handling of the applications as well as gathering first experiences with regard to the interaction of JT with STEP AP242 XML.

2.1 Four steps

Based on the Lessons Learned from the previous benchmarks, the JT Workflow and JT Implementor Forum agreed on the following 4-step approach:
 1. The JT Workflow Forum clarifies the target intent for the Benchmark and provides details on the expected outcomes (e.g. PMI visualization vs. semantics).
 2. The vendors make proposals for the JT file scope, configuration settings and evaluation approach which in their eyes will best fit the requirements.
 3. A proof of concept/test run for the Benchmark is conducted, using the agreed-on settings and test models, as a test round in the JT Implementor Forum.
 4. If the test run is successful, the actual Benchmark is conducted.

2.2 Building blocks

This benchmark is composed of two independent building blocks:
 • JT-Loop test: Translation from JT to CAD and CAD to JT, focus on XT-BREP, PMI and CAD-Attributes.
 • JT with AP242 XML test: Export from CAD to JT with STEP AP242 XML and import of JT with STEP AP242 XML files into CAD systems and viewers with focus on Product Structure and Attributes (Meta Data).

3 Criteria

The criteria were defined by the JT Workflow Forum. Details, especially the validation methods, were elaborated in collaboration with the JT Implementor Forum.

3.1 JT-Loop test

Reflecting the customers' IT environments, following CAD formats were chosen as destination formats for the JT to CAD translations and as source formats for the according CAD to JT translations:
- CATIA V5 R19
- NX 8.5
- Creo Parametric 2.0
- SolidWorks 2012

The translation results were checked with the validation tools provided by the JT-IF members, which are
- 3D_Evolution 2012 from CT CoreTechnologie,
- NX 8.5 and JT Utilities 8.3.2 from Siemens PLM,
- CADIQ 7.1.0.11 from ITI TranscenData
- Q-CompareV5JT 1.6.2, Q-Checker for JT 1.7.4 and Q-Spector 1.7.4 from Transcat PLM.

In case the findings of the different tools were differing, the vendors were contacted to discuss the results.

3.1.1 XT-BREP criteria
All geometry elements specified in ISO 14306's XT-BREP data container should be converted complete and correct. The defined tolerance is 0,01mm distance between geometric elements. Geometric elements could be faces, curves and points.

To check if the XT-BREP criteria were fulfilled, the geometry of the source and the target model is compared by the check tools.

3.1.2 PMI criteria
To check if a translator converts the PMI correctly, the following criteria were observed:
- Type should be kept: A PMI from type Note should be converted to a PMI from type Note.
- Content should be kept: The whole text content of a PMI should be converted completely and correctly.
- Layout should be kept: Color, style and size in the target model should be as in the source model. Additionally the position and the orientation of the PMI should be correct.

3.1.3 Attribute criteria
In the conducted Benchmark, it should be checked if user defined attributes with ud-marker and JT attributes were converted correctly.

3.2 JT with STEP AP242 XML

The import and export of product structures using STEP AP242 XML files and JT were tested.

The criteria are separated in the categories XML criteria, Attribute criteria and Product Structure criteria which are described in the following subchapters.

3.2.1 XML criteria
The written XML file should be conform to the STEP AP242 XML schema version 1.2. The criterion is fulfilled if the validation of the XML file against the schema succeeded. If the check tool reports a validation error, the criterion is not fulfilled.

3.2.2 Attribute (meta data) criteria

Attributes on assembly level in the source model should be converted completely and correctly in the target model. The Attribute criteria are fulfilled if:

- All attributes on assembly level are converted completely and correctly in the XML file.
- All attributes are visible in the target system.

The Attribute criteria are not fulfilled if:

- Assembly attributes are missing or incorrect in the XML file.
- Attributes are not visible in the target system.

3.2.3 Product structure criteria

The main focus of this benchmark is to validate if product structures can be written as STEP AP242 XML files. The test criteria are the following:

The product structure should not be changed. That means that multiple instances of parts should be handled correctly and the placement and orientation of parts should be as in the source model.

The product structure criteria are fulfilled if:

- The product structure is not changed.
- Multiple instances of parts are handled correctly.
- Placement and orientation of parts are not changed.

Product Structure criteria are not fulfilled:

- Product structure or instantiation of parts is wrong within the XML file or in the target system.

4   Testing

The benchmark tests were executed at PROSTEP to assure neutral testing and documentation. The vendors provided the software to be benchmarked and licenses for the runtime of the benchmark testing and evaluation.

4.1 Configuration and settings

For the translator tests, the vendors were asked to provide the configuration and settings that would fit best to the benchmark criteria. The vendors of the check tools were asked to provide settings that fit the test criteria with given tolerances.

4.2 JT-Loop test

4.2.1 Test model

For the JT-Loop test, the JT Workflow Forum decided to use a productive JT test model that is created in a user configuration (cf. Figure 1). The reason is that they wanted to benchmark the translators with models as they are available in the daily work. The XT-BREP container of test model for the JT-Loop test contains faces, curves and points. The test model contains 6 PMI, all from type Note. In the test model several attributes are saved.
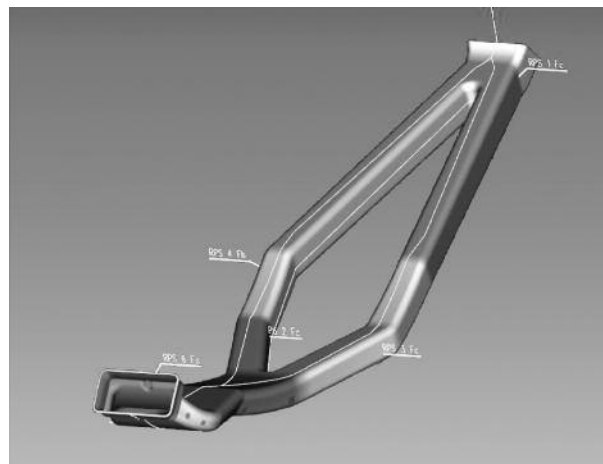

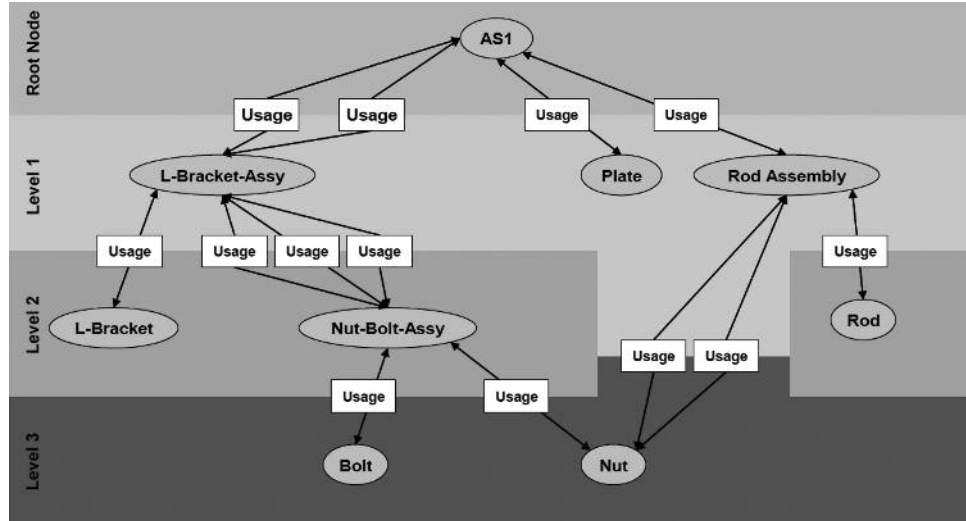
Figure 1: JT-Loop test: Test model

Figure 3: JT with AP242 XML: Assembly Structure of the test model

4.2.2 Testing procedure

The JT-Loop test is divided into three sub-tests. First, the created CAD models are compared with the source JT model. In the second step, the created JT models are compared with the CAD models that are created in the first translation step. Finally, the JT models created in the second translation step are compared with the source JT model.

In every step, the geometry, the PMI and the Attributes are compared by using the check tools.

4.3 JT with STEP AP242 XML

4.3.1 Test model

The geometry (cf. Figure 2) of the test model is simple by comparison, and was not evaluated explicitly, as the focus was on the exchange of the assembly structure (cf. Figure 3), the correct positioning of the components and the assembly attributes.
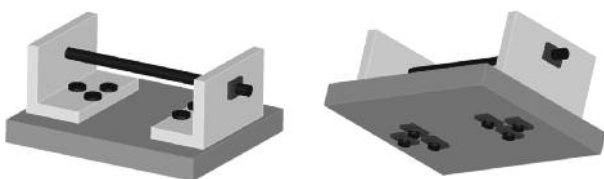
4.3.2 Check tools

Altova's XMLSpy 2009 was used to validate the generated XML files against the STEP AP242 XML schema and as editor for the manual check of the assembly attributes and the product structure.

4.3.3 Testing procedure

The second building block of this benchmark is also divided in three comparison steps. In the first step, the created XML file validated against the STEP AP242 XML schema by the use of Altova's XMLSpy and the product structure and the assembly attributes in the XML file are compared to the source CAD model. In the second step, the product structure and the assembly attributes of the derived CAD models from the second translation step are compared with the XML file from the first translation step. Finally, the CAD models from the second translation step are compared with the source CAD model. All checks without the XML validation are done manually.

Figure 2: JT with STEP AP242 XML: Test model

5   JT-Loop test results

In the following chapter, the results of the translator tests are depicted. First, a short description of the translators is given. Then, the results are listed in three separated categories: General trends, translations from JT to CAD and translations from CAD to JT. For each translation, the geometry, PMI and attributes were checked. Within this short report a result overview is given. The detailed results are published within the long report.

5.1 Involved translators

Table 1 shows the translators tested in the JT-Loop test of this benchmark. It also shows which CAD systems were tested as source and target formats of these translators.

Vendor	Name	Version	Tested source CAD formats	Tested target CAD formats
CT CoreTechnologie	3D_Evolution	2012.405	CATIA V5 R19 NX 8.5 Creo Parametric 2.0 Solidworks 2012	No participation in this test case
Elysium	ASFALIS	EX5.2	CATIA V5 R19 NX 8.5 Creo Parametric 2.0 Solidworks 2012	CATIA V5 R19 NX 8.5 Creo Parametric 2.0 Solidworks 2012
ITI TranscenData	CADfix	9.0	CATIA V5 R19 Creo Parametric 2.0 Solidworks 2012	CATIA V5 R19 NX 8.5 Creo Parametric 2.0 Solidworks 2012
PTC	Creo	2.0 M060	Creo Parametric 2.0	Creo Parametric 2.0
Siemens PLM	JT Bi-directional Translator for CATIA V5	8.0	CATIA V5 R19	CATIA V5 R19
Siemens PLM	JT Translator for Creo Parametric/ Pro/ENGINEER	10.1.1	Creo Parametric 2.0	Translator not applicable for JT import
Siemens PLM	NX	8.5.1.3	NX 8.5	NX 8.5
SpaceClaim	SpaceClaim Engineer	2013	CATIA V5 R19 Creo Parametric 2.0 Solidworks 2012	CATIA V5 R19
Theorem Solutions	CADverter	16.0.001	CATIA V5 R19	CATIA V5 R19
T-Systems	COM/FOX	5.4.3	CATIA V5 R19	CATIA V5 R19

Table 1: Translators involved in the JT-Loop tests

5.2 JT to CAD comparison

The first step of the JT-Loop test was the JT to CAD translation. In Figure 4 an overview about the XT-BREP results in the JT → CAD comparison is given. In the field of six JT → CATIA translators, three transferred the XT-BREP correct. Two of the three JT → Creo translators had problems while converting the XT-BREP. In the JT → NX checks, two of three models were translated correctly regarding XT-BREP. The two JT → Solid-Works translators were not able to transfer the XT-BREP correct.

5.3 CAD to JT comparison

In this section, the results of the second step in the JT-Loop test, the translation from CAD to JT, are shown.

In Figure 5 an overview of the XT-BREP results in the CAD to JT comparison is given. It is shown that 27 out of 42 JT models had correct geometry compared to their source CATIA models. Seven out of 18 JT models had correct geometry compared to their Creo source models. All JT models generated by NX to JT and SolidWorks to JT translators had correct geometry compared with their source CAD models.
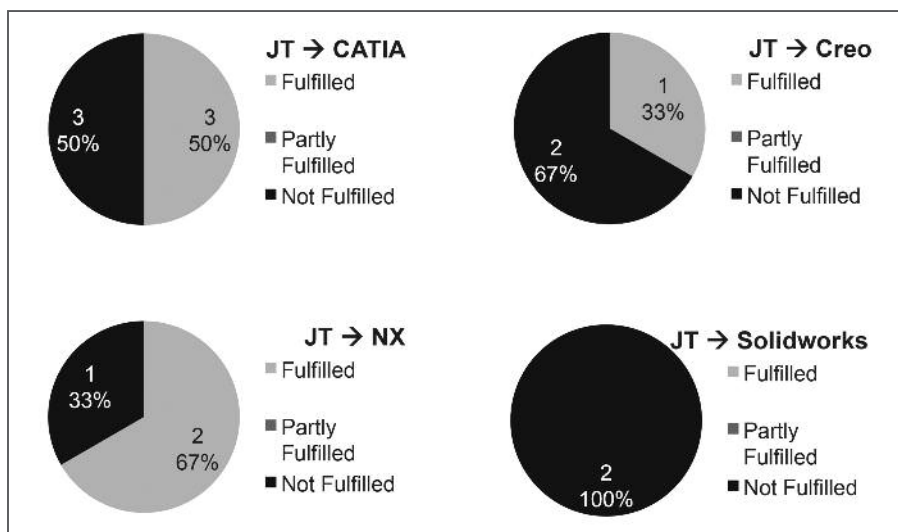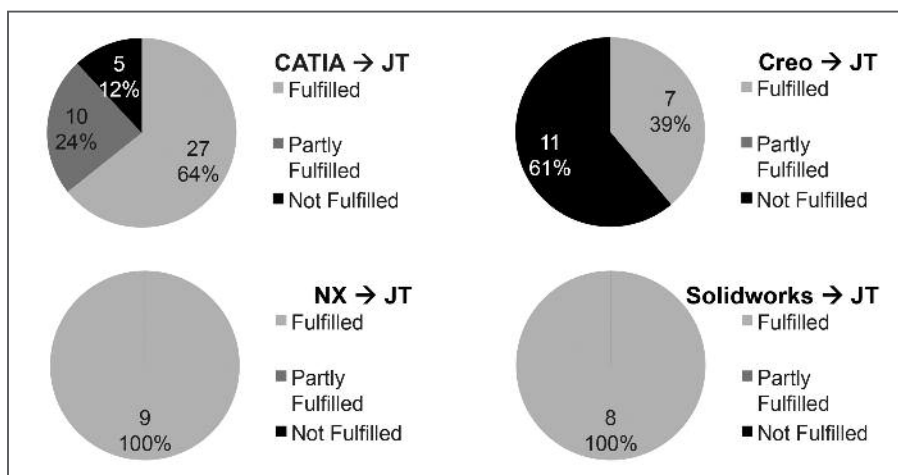

Figure 4: JT → CAD: XT-BREP result overview

Figure 5: CAD → JT: XT-BREP result overview

6 JT with STEP AP242 XML test results

6.1 Involved translators

Table 2 shows the translators tested in the JT-Loop test of this benchmark. It also indicates the tested import / export direction.

We would like to take this opportunity to thank the involved vendors that have participated in this test, although the STEP AP242 XML schema is no international standard yet and the development on the basis of a Draft International Standard carries the risk that there are still changes to the schema.

6.2 Source to JT with STEP AP242 XML comparison

In Table 3 the results of the translations from a given CATIA V5 assembly to its corresponding STEP AP242 XML structure with JT models are shown. You can see that the instantiation of parts were correct in all created XML files. The XML files from CT CoreTechnologie and T-Systems could be successfully validated against the STEP AP242 XML schema. The product structure in the XML file generated with the translator from T-Systems was correct, the XML files created with the translators from Theorem and CT CoreTechnologie had some minor issues in the product structure. During the validation of the XML files against the STEP AP242 XML schema, it was found that the XML file created with the translator from Theorem does not fit to the given XML schema.

Additionally, none of the participating translators were able to translate the assembly attributes.

Test Criteria / Translator	Product Structure	Instantiation of Parts	XML file is valid	Assembly Attributes
CoreTechnologie	Δ	√	√	X
Theorem	Δ	√	X	X
T-Systems	√	√	√	X

√ criterion fulfilled
Δ criterion partly fulfilled
X criterion not fulfilled/not supported
O criterion not tested

Table 3: JT with STEP AP242 XML: Source to JT with STEP AP242 XML comparison results

Vendor	Name	Version	Source → JT with STEP AP242 XML	JT with STEP AP242 XML → Target
CT CoreTechnologie	3D_Evolution	2013.206	Yes	No
Kronion	eMMA Analyst	1.5.14	No	Yes
Theorem Solutions	CADverter	16.1	Yes	Yes
T-Systems	COM/FOX	5.4.5	Yes	Yes

Table 2: Translators involved in the JT with STEP AP242 XML tests

6.3 JT with STEP AP242 XML to target comparison

In Table 4 the results of the translations from the in the first step created STEP AP242 XML structure with JT models back to CATIA V5 assemblies are shown. As none of the created XML files had assembly attributes in it, this criterion was not tested. Additionally, the XML file created with the translator from Theorem could only be read by the translator from Theorem because of the using of a different XML schema. Because of that, it was not possible to test the translators with this input file, so this criterion was not tested.

The viewer from Kronion and the translator from T-Systems both were able to process the XML input files from the translators from CT CoreTechnologie and T-Systems. The test criteria product structure and the instantiation of parts were fulfilled.

The translator from Theorem only was able to read the XML file that was created with the translator from Theorem in the first translation step. This is due the using of a different XML schema. The input files from CT CoreTechnologie and T-Systems were correct, but the translator was unable to process them, so the criterion was not fulfilled.

Translator/Viewer — Test Criteria — Import file from...	Product Structure	Instantiation of Parts	Assembly Attributes
Kronion CoreTechnologie	√	√	O
Kronion Theorem	O	O	O
Kronion T-Systems	√	√	O
TH CoreTechnologie	X	X	O
TH Theorem	√	√	O
TH T-Systems	X	X	O
TS CoreTechnologie	√	√	O
TS Theorem	O	O	O
TS T-Systems	√	√	O

√   criterion fulfilled
Δ   criterion partly fulfilled
X   criterion not fulfilled/not supported
O   criterion not tested

TH   Theorem
TS   T-Systems

Table 4: JT with STEP AP242 XML: JT with STEP AP242 XML to target comparison results

6.4 Source to target comparison

In the last step, a comparison of the created target models and the original source assembly was done. As the assembly attribute were lost in the first translation step, this criterion was not fulfilled in all test cases (cf. Table 5). The criteria instantiation of parts and placement/orientation of parts were fulfilled in all test cases. Regarding the product structure, some minor changes were detected in the Kronion model with input file from CT CoreTechnologie, in the Theorem model with input file from Theorem and in the T-System models with input files from CT CoreTechnologie and T-Systems. Additionally, the Theorem translator created XML files that could not be processed by all other translators and viewers so there are no target models to compare. So this criterion was not tested.

In Figure 6 an example for the differences in the product structure between the source and the target assembly is given. On the left side, the nut-bold-assembly (7), nut-bold-assembly (8) and nut-bold-assembly (9) are referenced twice in the product structure – on the right side is shown that the nut-bold-assemblies have continuous numbers. The sub-assemblies are copied instead of referencing them.

Translator/Viewer	Test Criteria Import file from...	Product Structure	Instantiation of Parts	orientation and placement of parts	Assembly Attributes
Kronion	CoreTechnologie	Δ	√	√	X
	Theorem	O	O	O	O
	T-Systems	√	√	√	X
TH	CoreTechnologie	O	O	O	O
	Theorem	Δ	√	√	X
	T-Systems	O	O	O	O
TS	CoreTechnologie	Δ	√	√	X
	Theorem	O	O	O	O
	T-Systems	Δ	√	√	X

√   **criterion fulfilled**
Δ   **criterion partly fulfilled**
X   **criterion not fulfilled/not supported**
O   **criterion not tested**

TH   **Theorem**
TS   **T-Systems**

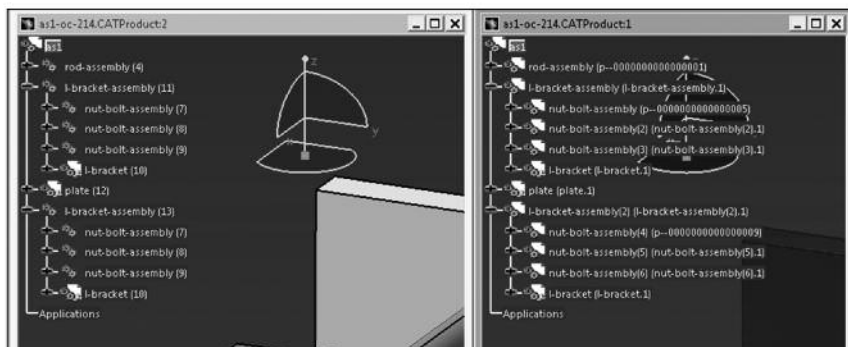*Table 5: JT with STEP AP242 XML: Source to target comparison results*

Figure 6: Example for wrong assembly structure

7 Summary and outlook

This JT Application Benchmark shows very different results for JT to CAD and CAD to JT conversion. While the latter showed satisfactory results, the JT to CAD conversion results have a lot of issues. While regular BREP geometry and properties can be converted correctly from JT to CAD, wireframe geometry and PMI is rarely converted correctly. Another focal point of this benchmark was to bring forward the use of JT in context of the new STEP AP 242 XML scheme. A STEP AP 242 XML file containing product structure information should reference JT files as geometry nodes. Although STEP AP 242 was only available as a draft during the testing period, first implementations were provided and tested. JT and STEP as a combination of standardized data formats could be used for engineering and planning processes as well as archiving; achieving solutions independent from proprietary data formats. The tests show that the combination can already be used to exchange assembly structure data. An issue is the lack of support of assembly level properties by the translators.

For the first time, multiple check tools are used to validate the benchmark results. The automated analysis makes the evaluation easier. Although, it is important to know what is actually checked by the used tools and how these checks are done. Another important thing is to know how to set the check tools up, so that the check criteria and thresholds match the benchmark requirements.

Due to the close cooperation between the software vendors and testers, issues found during the testing could be directly communicated. This allows the vendors to consider the benchmark results in the current development. With issues discussed in the JT Workflow Forum and the JT Implementor Forum, a common understanding of the users' requirements is achieved. Also, the discussion of issues and results among the vendors will lead to improved interoperability between the various tools.

As a consequence the preparations for the next benchmark in 2014 have already started. Discussed topics for this next benchmark are tests of validation tools, CAD to JT translation with focus on saved views, JT as input for CAE and a test of viewers. The combined use of STEP AP 242 XML for assembly representation with reference to JT for visualization will again be in the focus of the upcoming benchmark.

8 Publication

Detailed documentation on the 4th ProSTEP iViP / VDA JT Application Benchmark will be made available to members on the ProSTEP iViP Association website (www.prostep.org).

9 Acknowledgements

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