

PaladinRM User Tutorial

Version 1.1 June 24th, 2005

General Purpose

PaladinRM is visualization software designed specifically for representing and manipulating complex relationships between requirements. Instead of visualizing requirements hierarchically (a tree approach), we decided to visualize a network of requirements: a graph that holds all the information about the requirements. The graphical representation of the network will help the users to analyze requirements in many different way that were not possible before. For example, it is possible to view all the requirements relationships at the same time. This simple feature was not available before. Figure 1 illustrates this concept.

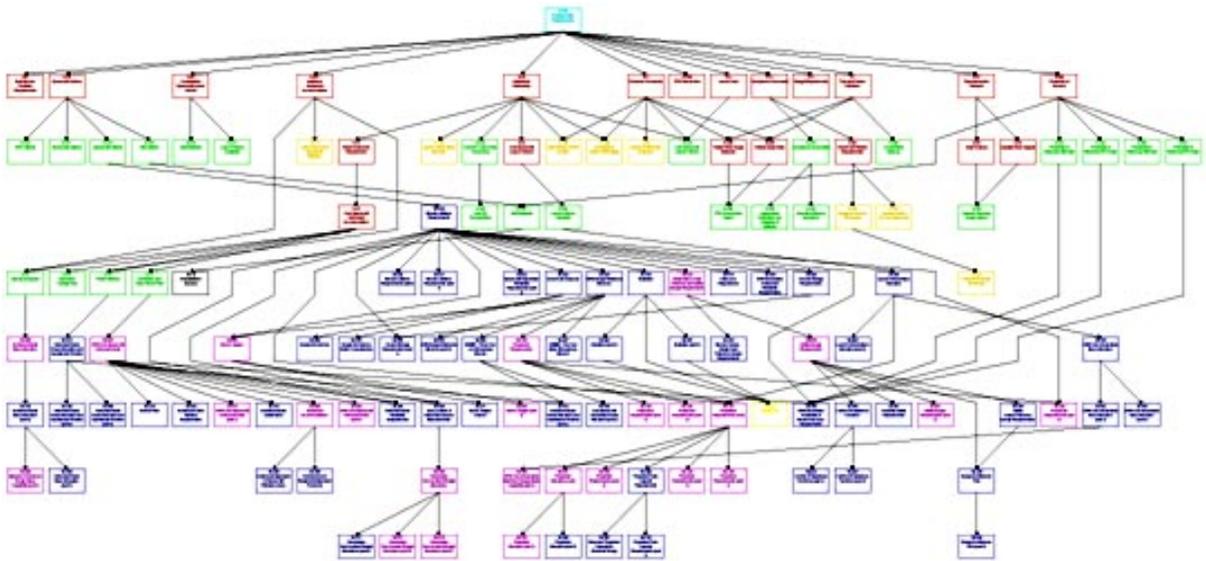


Figure 1. Requirements Graph.

Installation

System Requirements:

Java Virtual Machine(JVM) Java 1.4 or greater compatible virtual machine must be present. Make sure that the java runtime is in the PATH environment variable.

Microsoft Windows NT, 2000, and XP - To set the PATH permanently:

Choose Start, Settings, Control Panel, and double-click System. On Microsoft Windows NT, select the Environment tab; on Microsoft Windows 2000 select the Advanced tab and then Environment Variables. Look for "Path" in the User Variables and System Variables. If you're not sure where to add the path, add it to the right end of the "Path" in the User Variables. A typical value for PATH is:

C:\jdk1.4.2_<version>\bin

For further instructions please visit Java Installation Notes (<http://java.sun.com/j2se/1.4.2/install-windows.html>)

For Unix systems use the equivalent commands to set the path using the setenv command.

Unzip the distribution file PaladinRM.zip into a convenient directory

This will create a folder PaladinRM and will put all the contents of the software inside this directory. Henceforth, this directory will be referred to as <PALADINROOT>

How to Run:

Open a command window. Goto <PALADINROOT> and type

```
java -jar PaladinRM.jar
```

Alternately, you can run PaladinRM by double clicking PaladinRM.jar file included in the <PALADINROOT>

Interface

PaladinRM has a simple interface design (Figure 2). It consists of :

Property Frame – shows all the attributes of a particular requirement. In the next version of the tool users will be able to change the properties. It consists of two types of properties **Common Property Panel** and **Other Property Panel**. **Common Property Panel** holds the visual properties of the requirement boxes (color, size, visual text). The **Other Property Panel** holds information related specifically to the requirements.

Graph Frame – holds all documents or **Graph Editor Panels**.

Graph Editor Panel a drawing pallet where the graph of requirements is layed out.

Tool Bar – is a drawing tool. Users can create new requirements by clicking on the requirement button and then clicking inside the **Graph Frame**. The links between requirements are added the same way. The users can also zoom in and zoom out of the graph in order to see the details.

Status Bar – displayed all the necessary messages i.e., error messages, save/open commands, etc., etc.

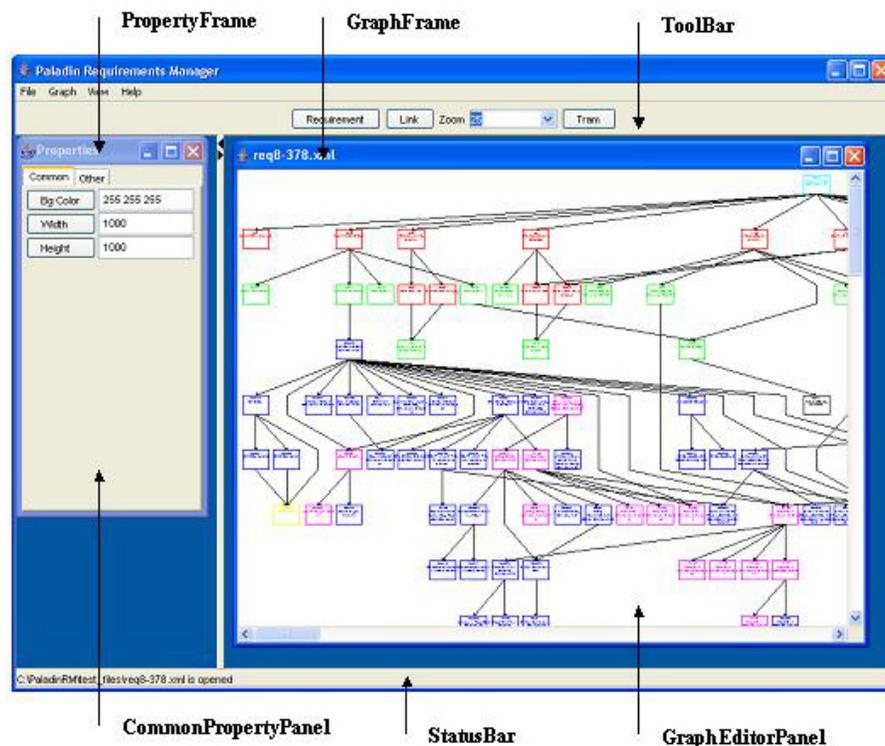


Figure 2. PaladinRM Graphical User Interface

The **File Menu** consists of the following options:

Open

Open command opens an existing xml file created in PaladinRM. This xml file has to be paired with another rdf file that stores the links between requirements in rdf format.

Save As

Saves the current requirement diagram to disk. PaldimRM creates three files:

filename.xml – file that stores the exact coordinates of all the requirements represented as boxes, colors, and other visual properties.

filenameReq.xml – stores all the properties of the requirements

filename.rdf – stores all the links among requirements.

Examples of these files can be found in the Appendix.

Print

This function prints the current requirement graph according to its zoom size. If the graph is shown at a size 25% it will be printed at this size.

Import

This function takes as input an xml file currently generated from the Slate database through use of a script file. This file can be generated from any other tool as long as it conforms to the file standard excepted by PaladinRM . Please see Appendix for the example of this file.

Export

This function exports the current graph contents into the following image formats: JPG, GIF, PNG, and SVG.

Exit

Exits the tool without saving or asking to save your work!

The **Graph Menu** consists of the following options:

New Graph

Creates new window (GraphFrame) where the new graph can be created.

Delete Graph

Deletes the currently selected graph window (GraphFrame)

Clear Graph

Deletes all the requirements from the screen.

Select All

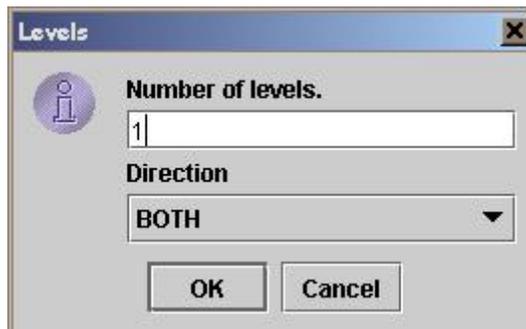
Selects all the requirements on the screen including the links.

SetOneSize

Sets all the requirement boxes to one size

View Sub Graph

This functionality is used to do selective visualization of the requirement document. Open a previously saved XML file. Select a root node and activate this command. This will cause the following dialog box to appear. Choose the number of levels which you want to see and the direction. The requirements satisfying the “selective visualization” will be highlighted.



Merge Two Graphs

Input of this function is an XML file containing two graphs. Create and save diagrams with two graphs in it. Open this XML file using the OPEN command. Clicking on "Merge Graphs" will cause the two graphs to be merged on the basis

of their titles. Meaning two objects having the same title on the two graphs are treated as the same entities. The resulting graph is loaded from a RDF meta-model merge operation using a Random Graph layout algorithm. Looking ahead, this functionality should be enhanced/explored further by adding semantics.

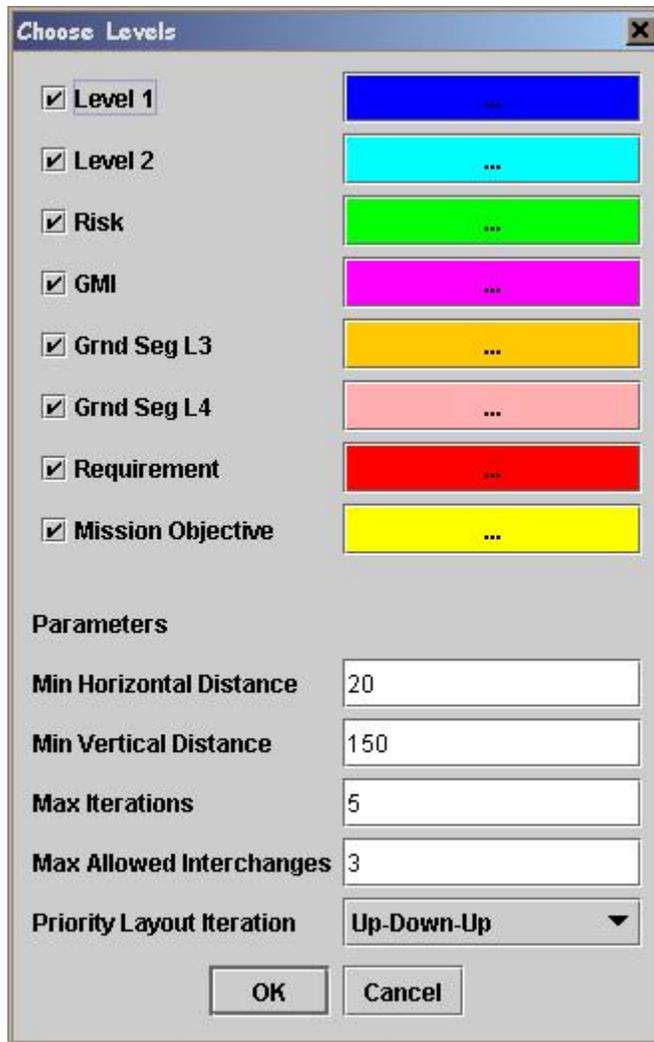
Collapse Graph

This functionality is provided to collapse graph objects on the basis of their labels. Two requirement objects having the same title within the same graph are considered duplicate. To use this function, first create a diagram with a duplicate in the same graph. Save it as a xml file abc.xml. Now use this functionality to open the graph using its RDF meta-model. Specify abc.rdf as the input file. The result graph won't have the duplicates.

Layout

Spring Layout tries to arrange the nodes and edges on the current panel using the Spring Embedder graph layout algorithm. Nodes are thought as masses and edges are Springs. Two non connected nodes repel each other and two connected nodes attract each other. This algorithm tries to minimize the total energy of the system. Known Issue: It tries to confine entire graph in a 1000/1000 pixel panel. For large graphs the result in a very cluttered graph output. This algorithm works best for small number of nodes and edges.

Hierarchical Layout supports hierarchical or tree view of the requirement graph. Prior to using this menu function you must have a slate xml file imported using the "Import Slate" command from the File menu. Using this command, you will get this dialog box:



Select the levels that you want to see and the colors of the requirement objects (By default all the requirement objects are checked). Select the algorithm parameters which are as follows:

Min Horizontal Distance: Min horizontal distance between two requirement objects on the same level.

Min Vertical Distance: Min vertical distance between two requirement objects on adjacent levels.

Max Iterations: Number of times the barycentric algorithm is performed to minimize the edge crossings. A high number will generally result in a less cluttered graph but it takes more machine time to compute the final layout.

Max Allowed Interchanges: This is used to minimize the edge crossings further if the iteration above reaches a deadlock when it can't reduce number of crossings.

Priority Layout Iteration: This method is used for the graph balancing so that parent nodes are almost centered over the child nodes. There are two options Up-Down-UP and Down-Up-Down. Both strategies result in different balancing of the graph. For the requirement graph it is generally found that Up-Down-Up method works better.

For more details of the algorithm for interested readers are referred to Sugiyama Layout Algorithm web site located at http://plg.uwaterloo.ca/~itbowman/CS746G/Notes/Sugiyama1981_MVU/

Cluster Layout is based upon Hierarchical layout. However, it organizes information into clusters not levels. Known Issues: currently there cannot be a cluster inside a cluster.

Save Modifies Links

This function generates a log file. Once the hierarchy layout is completed, a snapshot of the graph is saved into a temporary file. Afterwards if users modify a link and if they need to generate a log of the modified links then they can use this command. This feature compares the content of the temporary file with the current state of the graph and generates a log file specified by the user input.

Export Selected Requirements

Saves a list of selected requirements into an xml file.

Filter Display

This functionality helps to customize two attributes that can be shown inside a requirement box. As a default only ROIN and a title is shown.

Acknowledgements

Paladin is built on top of other sub-systems which we gratefully acknowledge:

Xecers -- XML API, included in Java version 1.4 or later

Batik -- Supports SVG output of requirements graph

Jena – Semantic Web Framework, RDF API

Support

The PaladinRM research project has been generously supported by NASA Goddard Space Flight Center. Dave Everett has been a technical lead at NASA. Their technical and financial assistance is very much appreciated.

Known Issues

This version of the tool has the following issues which will be fixed or added in future releases (Depending on the available time/funding and the research focus).

- No Cut, Copy and Paste functionality.
- No Undo / Redo functionality.
- Java exceptions if thrown are handled mostly on console display. They will be replaced with more meaningful error message displays in the future.
- Absence of the Project concept which will link together all the diagrams for a particular system development project.
- Exiting the tool without saving any unsaved work does not cause a prompt to be thrown. Make sure you save all work prior to exiting.
- Printing is a limited functionality.
- Currently the attributes for the requirements can only be added by importing them via an XML file. Direct addition through the tool is not supported.
- This tool is not AP233 compliant.

Almost all of the above issues are mechanical features of the tool, which requires a lot of time on our part to incorporate. Being a research institution, our efforts are more focussed towards new research initiatives which are more compelling to think about. Nevertheless we understand the importance of above features, and will try our best to shorten the above list in future releases.

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License

PaladinRM is distributed under a BSD style open source license.

It includes packages developed by

Apache Software Foundation (<http://www.apache.org/>)

Helwett Packard Laboratories, Bristol (<http://hpl.hp.com/semweb>)

International Busniess Machines Corporation (<http://www.ibm.com>)

in the form of jar files.

Software Distribution

To license the PaladinRM software, please contact

Jim Poulos,
Office of Technology Commercialization,
University of Maryland,
College Park,
Ph. (301)-403-2711
E-mail: jpoulos@umd.edu

APPENDIX

Example of filename.rdf

```
<rdf:RDF
  xmlns:rdf='http://www.w3.org/1999/02/22-rdf-syntax-ns#'
  xmlns:vcard='http://www.w3.org/2001/vcard-rdf/3.0#'
>
  <rdf:Description rdf:about='http://somewhere/8-
2!!Budget%20Requirements'>
    <vcard:N>8-2!!Budget%20Requirements</vcard:N>
  </rdf:Description>
  <rdf:Description rdf:about='http://somewhere/8-
4!!Launch%20Date'>
    <vcard:N>8-4!!Launch%20Date</vcard:N>
    <vcard:Given rdf:resource='http://somewhere/4-
343!!Core%20Spacecraft!!Launch%20Vehicle' />
  </rdf:Description>
  <rdf:Description rdf:about='http://somewhere/8-
5!!Schedule%20Constraints'>
    <vcard:N>8-5!!Schedule%20Constraints</vcard:N>
  </rdf:Description>
  <rdf:Description rdf:about='http://somewhere/4-
343!!Core%20Spacecraft!!Launch%20Vehicle'>
    <vcard:N>4-
343!!Core%20Spacecraft!!Launch%20Vehicle</vcard:N>
  </rdf:Description>
  <rdf:Description rdf:about='http://somewhere/8-
378!!Programmatic!!Requirements'>
    <vcard:N>8-378!!Programmatic!!Requirements</vcard:N>
    <vcard:Given rdf:resource='http://somewhere/8-
5!!Schedule%20Constraints' />
    <vcard:Given rdf:resource='http://somewhere/8-
2!!Budget%20Requirements' />
    <vcard:Given rdf:resource='http://somewhere/8-
4!!Launch%20Date' />
  </rdf:Description>
</rdf:RDF>
```

```

    <?xml version="1.0" encoding="UTF-8" ?>
- <ReqFlow>
- <Requirement ID="-7558735756588831112" text="4-343<nl>Core
  Spacecraft<nl>Launch Vehicle">
  <Attribute text="ID" value="" />
  <Attribute text="Requirement Title" value="Core Spacecraft Launch Vehicle" />
  <Attribute text="Rationale" value="JAXA is providing a launch vehicle to launch
    GCOM-A1 and GPM-Core together from TnSC, Japan." />
  <Attribute text="Assigned To" value="None" />
  <Attribute text="Description" value="The Core Spacecraft shall be compatible for
    a flight in early 2009 on the H-IIA 202 with a 1194M payload adapter in a
    4/4D-LS fairing." />
  <Attribute text="Level" value="Level 2" />
  <Attribute text="Level Type" value="2" />
  </Requirement>
- <Requirement ID="-7198235536323852257" text="8-
  378<nl>Programmatic<nl>Requirements">
  <Attribute text="Assigned To" value="None" />
  <Attribute text="Change Proposals Allowed" value="Not Assigned" />
  <Attribute text="Criticality" value="None" />
  <Attribute text="ID" value="" />
  <Attribute text="Inheritable" value="Yes" />
  <Attribute text="Qualification Date/Time" value="YY/MM/DD-24:00" />
  <Attribute text="Rationale" value="" />
  <Attribute text="Requirement State" value="Uncontrolled" />
  <Attribute text="Requirement Status" value="Active" />
  <Attribute text="Requirement Title" value="Programmatic Requirements" />
  <Attribute text="Test Report Number" value="" />
  <Attribute text="Verification Date/Time" value="YY/MM/DD-24:00" />
  <Attribute text="Verification Description" value="" />
  <Attribute text="Verification Level" value="None" />
  <Attribute text="Verification Method" value="None" />
  <Attribute text="Verification Status" value="None" />
  <Attribute text="Verified By" value="None" />
  <Attribute text="Description" value="The GPM shall adhere to program
    requirements as agreed between the NASA Earth Science Enterprise and the
    NASA/GSFC GPM program office." />
  <Attribute text="Level" value="Mission Objective" />
  <Attribute text="Level Type" value="0" />
  </Requirement>
- <Requirement ID="1163281812227984139" text="8-2<nl>Budget
  Requirements">
  <Attribute text="ID" value="" />
  <Attribute text="Requirement Title" value="Budget Requirements" />
  <Attribute text="Rationale" value="Imposed by HQ." />
  <Attribute text="Assigned To" value="Adams Jim" />
  <Attribute text="Requirement Status" value="Active" />
  <Attribute text="Description" value="To Be Determined" />
  <Attribute text="Level" value="Level 1" />

```

```

<Attribute text="Level Type" value="1" />
  </Requirement>
= <Requirement ID="6850455589105029029" text="8-4<nl>Launch Date">
<Attribute text="ID" value="" />
<Attribute text="Requirement Title" value="Launch Date" />
<Attribute text="Rationale" value="This requirement is based on the JAXA
  development schedule as well as a reasonable development time and
  funding profile for the NASA elements." />
<Attribute text="Assigned To" value="Adams Jim" />
<Attribute text="Requirement Status" value="Active" />
<Attribute text="Criticality" value="None" />
<Attribute text="Inheritable" value="Yes" />
<Attribute text="Verification Status" value="None" />
<Attribute text="Verified By" value="None" />
<Attribute text="Verification Date/Time" value="YY/MM/DD-24:00" />
<Attribute text="Verification Level" value="Segment" />
<Attribute text="Verification Method" value="Analysis" />
<Attribute text="Test Report Number" value="" />
<Attribute text="Qualification Date/Time" value="YY/MM/DD-24:00" />
<Attribute text="Requirement State" value="Uncontrolled" />
<Attribute text="Change Proposals Allowed" value="Not Assigned" />
<Attribute text="Verification Description" value="" />
<Attribute text="Description" value="The launch of the GPM Core spacecraft
  shall be planned for within the US Government Fiscal Year 2008." />
<Attribute text="Level" value="Level 1" />
<Attribute text="Level Type" value="1" />
  </Requirement>
= <Requirement ID="1932898830409023753" text="8-5<nl>Schedule
  Constraints">
<Attribute text="ID" value="" />
<Attribute text="Requirement Title" value="Schedule Constraints" />
<Attribute text="Rationale" value="To realize the full impact of GPM, foreign
  partnerships are required, so the GPM schedule must align with the
  schedules of those partners. The JAXA partnership has the highest priority
  since the primary spacecrat depends on this partnership for its instrument
  and launch." />
<Attribute text="Assigned To" value="Adams Jim" />
<Attribute text="Requirement Status" value="Active" />
<Attribute text="Criticality" value="None" />
<Attribute text="Description" value="The GPM development shall be
  synchronized with the JAXA instrument and launch vehicle schedules to
  maximize partnership opportunities. Also, where appropriate, programmatic
  schedules will be synchronized to enhance other international partnership
  opportunities." />
<Attribute text="Level" value="Level 1" />
<Attribute text="Level Type" value="1" />
  </Requirement>
</ReqFlow>

```

filename.xml

```
<?xml version="1.0" encoding="UTF-8" ?>
- <Graph>
- <Object ID="-7558735756588831112" type="1">
  <Text value="4-343<nl>Core Spacecraft<nl>Launch Vehicle" />
  <Dimension value="264 416 366 464" />
  <Color blue="255" green="0" red="0" />
  </Object>
- <Object ID="-7198235536323852257" type="1">
  <Text value="8-378<nl>Programmatic<nl>Requirements" />
  <Dimension value="142 20 244 68" />
  <Color blue="0" green="255" red="0" />
  </Object>
- <Object ID="1163281812227984139" type="1">
  <Text value="8-2<nl>Budget Requirements" />
  <Dimension value="142 218 244 266" />
  <Color blue="255" green="0" red="255" />
  </Object>
- <Object ID="6850455589105029029" type="1">
  <Text value="8-4<nl>Launch Date" />
  <Dimension value="264 218 366 266" />
  <Color blue="255" green="0" red="255" />
  </Object>
- <Object ID="1932898830409023753" type="1">
  <Text value="8-5<nl>Schedule Constraints" />
  <Dimension value="20 218 122 266" />
  <Color blue="255" green="0" red="255" />
  </Object>
- <Object ID="-548992081195807640" type="2">
  <Dimension value="315 266 315 416" />
  <Color blue="0" green="0" red="0" />
  <Link fromID="6850455589105029029" toID="-7558735756588831112" />
  </Object>
- <Object ID="-6264692562803577368" type="2">
  <Dimension value="193 68 71 218" />
  <Color blue="0" green="0" red="0" />
  <Link fromID="-7198235536323852257" toID="1932898830409023753" />
  </Object>
- <Object ID="8258959992611279550" type="2">
  <Dimension value="193 68 193 218" />
  <Color blue="0" green="0" red="0" />
  <Link fromID="-7198235536323852257" toID="1163281812227984139" />
  </Object>
- <Object ID="3450282406926812079" type="2">
  <Dimension value="193 68 315 218" />
  <Color blue="0" green="0" red="0" />
  <Link fromID="-7198235536323852257" toID="6850455589105029029" />
  </Object></Graph>
```

XML file created from SLATE database:

```
<?xml version="1.0" encoding="UTF-8" ?>
- <!--
  comment SLATE Database sampled 11/26/2003  11:20:25
-->
- <ReqFlow>
- <Req ROIN="8-378" type="Mission Objective" level="0">
  <Title text="Programmatic Requirements" />
  <Description text="The GPM shall adhere to program requirements as agreed
    between the NASA Earth Science Enterprise and the NASA/GSFC GPM
    program office." />
- <ReqList>
  <CompReq ROIN="8-2" />
  <CompReq ROIN="8-4" />
  <CompReq ROIN="8-5" />
  </ReqList>
  <Attribute text="Assigned To" value="None" />
  <Attribute text="Change Proposals Allowed" value="Not Assigned" />
  <Attribute text="Criticality" value="None" />
  <Attribute text="ID" value="" />
  <Attribute text="Inheritable" value="Yes" />
  <Attribute text="Qualification Date/Time" value="YY/MM/DD-24:00" />
  <Attribute text="Rationale" value="" />
  <Attribute text="Requirement State" value="Uncontrolled" />
  <Attribute text="Requirement Status" value="Active" />
  <Attribute text="Requirement Title" value="Programmatic Requirements" />
  <Attribute text="Test Report Number" value="" />
  <Attribute text="Verification Date/Time" value="YY/MM/DD-24:00" />
  <Attribute text="Verification Description" value="" />
  <Attribute text="Verification Level" value="None" />
  <Attribute text="Verification Method" value="None" />
  <Attribute text="Verification Status" value="None" />
  <Attribute text="Verified By" value="None" />
  </Req>
- <Req ROIN="8-2" type="Level 1" level="1">
  <Title text="Budget Requirements" />
  <Description text="To Be Determined" />
  <Attribute text="ID" value="" />
  <Attribute text="Requirement Title" value="Budget Requirements" />
  <Attribute text="Rationale" value="Imposed by HQ." />
  <Attribute text="Assigned To" value="Adams Jim" />
  <Attribute text="Requirement Status" value="Active" />
  </Req>
- <Req ROIN="8-4" type="Level 1" level="1">
  <Title text="Launch Date" />
  <Description text="The launch of the GPM Core spacecraft shall be planned for
    within the US Government Fiscal Year 2008." />
- <ReqList>
```

```

<CompReq ROIN="4-343" />
  </ReqList>
<Attribute text="ID" value="" />
<Attribute text="Requirement Title" value="Launch Date" />
<Attribute text="Rationale" value="This requirement is based on the JAXA
  development schedule as well as a reasonable development time and
  funding profile for the NASA elements." />
<Attribute text="Assigned To" value="Adams Jim" />
<Attribute text="Requirement Status" value="Active" />
<Attribute text="Criticality" value="None" />
<Attribute text="Inheritable" value="Yes" />
<Attribute text="Verification Status" value="None" />
<Attribute text="Verified By" value="None" />
<Attribute text="Verification Date/Time" value="YY/MM/DD-24:00" />
<Attribute text="Verification Level" value="Segment" />
<Attribute text="Verification Method" value="Analysis" />
<Attribute text="Test Report Number" value="" />
<Attribute text="Qualification Date/Time" value="YY/MM/DD-24:00" />
<Attribute text="Requirement State" value="Uncontrolled" />
<Attribute text="Change Proposals Allowed" value="Not Assigned" />
<Attribute text="Verification Description" value="" />
  </Req>
= <Req ROIN="4-343" type="Level 2" level="2">
  <Title text="Core Spacecraft Launch Vehicle" />
  <Description text="The Core Spacecraft shall be compatible for a flight in early
    2009 on the H-IIA 202 with a 1194M payload adapter in a 4/4D-LS fairing."
  />
  <Attribute text="ID" value="" />
  <Attribute text="Requirement Title" value="Core Spacecraft Launch Vehicle" />
  <Attribute text="Rationale" value="JAXA is providing a launch vehicle to launch
    GCOM-A1 and GPM-Core together from TnSC, Japan." />
  <Attribute text="Assigned To" value="None" />
  </Req>
= <Req ROIN="8-5" type="Level 1" level="1">
  <Title text="Schedule Constraints" />
  <Description text="The GPM development shall be synchronized with the JAXA
    instrument and launch vehicle schedules to maximize partnership
    opportunities. Also, where appropriate, programmatic schedules will be
    synchronized to enhance other international partnership opportunities." />
  <Attribute text="ID" value="" />
  <Attribute text="Requirement Title" value="Schedule Constraints" />
  <Attribute text="Rationale" value="To realize the full impact of GPM, foreign
    partnerships are required, so the GPM schedule must align with the
    schedules of those partners. The JAXA partnership has the highest priority
    since the primary spacecrat depends on this partnership for its instrument
    and launch." />
  <Attribute text="Assigned To" value="Adams Jim" />
  <Attribute text="Requirement Status" value="Active" />
  <Attribute text="Criticality" value="None" />
  </Req></ReqFlow>

```