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Visualization of Computer Networks Using Graph Rewriting Systems

Graph rewriting system is used to transform initial low-level computer network structure to the graph convenient for visual presentation.

Graph Rewriting System

Graph Rewriting System is a system which applies specified *rewriting rules* to the given *host graph*.

Graph rewriting rule is a rule specified by the following elements:

- $g_l \rightarrow g_r$

  During rule application, sub-graph of a host graph isomorphic to g_l is replaced by a new sub-graph created to be isomorphic to g_r.

- Embedding Information

  Specifies how to embed new sub-graph into the host graph.

- Application Condition

  Defines conditions on attribute values or host graph structure. These conditions must hold for rule application to proceed.

- Attribute Transfer Function

  Assigns attribute values to the new sub-graph.

Object Model of Computer Network

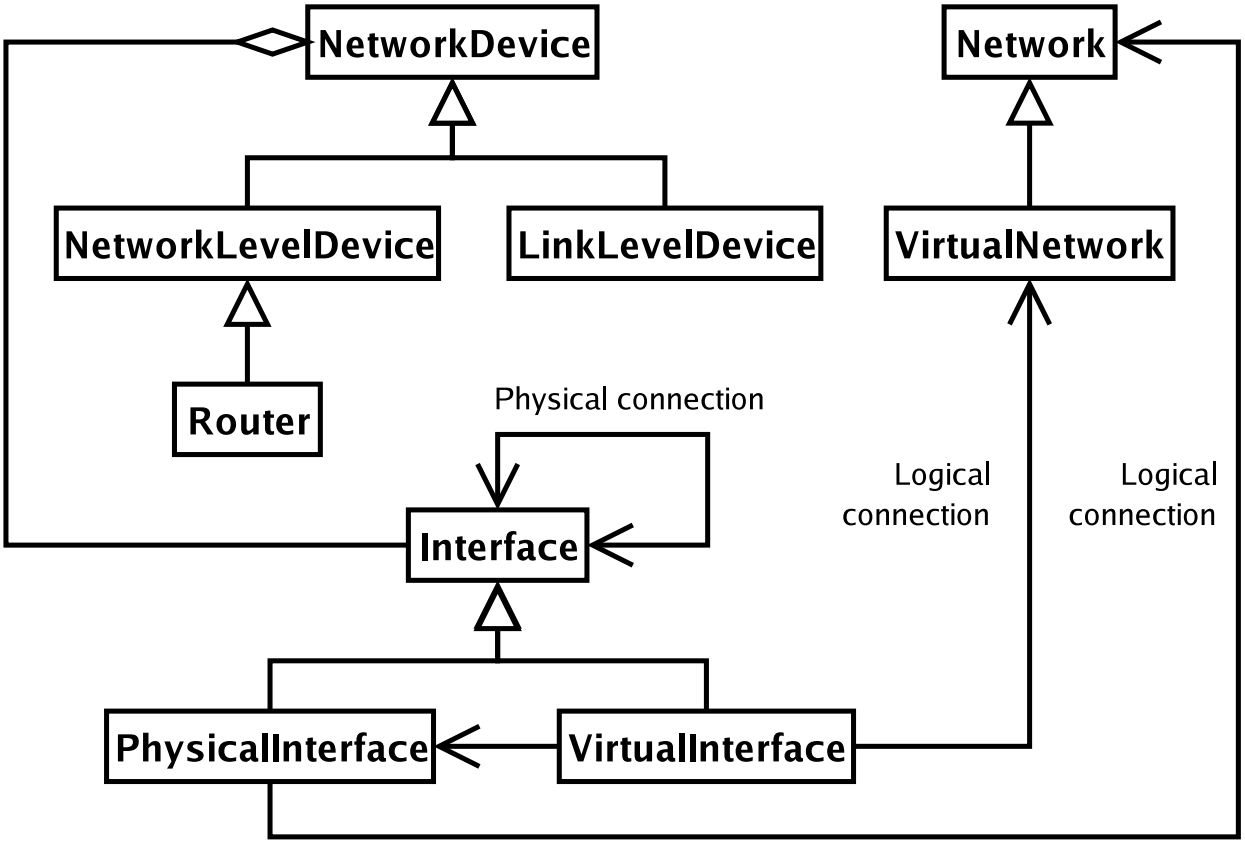

Figure 1. Object model of computer network.

Examples of Rewriting

User defines graph rewriting system which will create desired representation of the computer network.

For example, rewriting system could be used to:

- remove less informative elements form the representation,
- merge several network objects into one,
- extract sub-networks hierarchy,
- perform calculations on attributes of network objects.

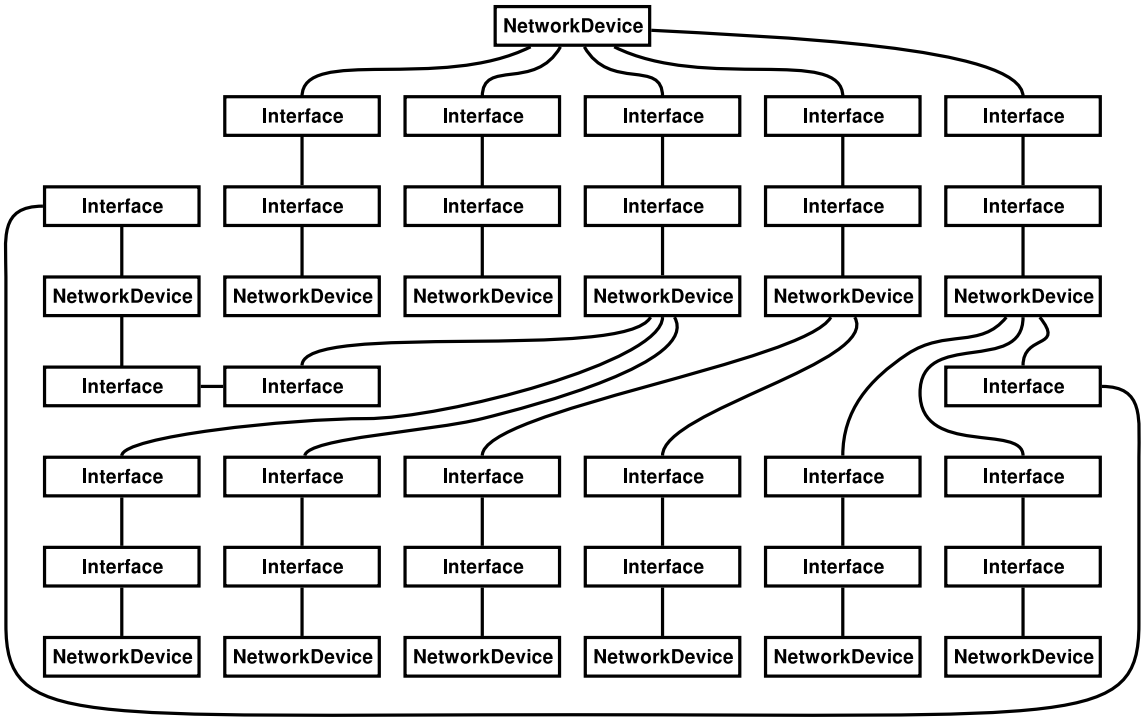

Figure 2. Sample host graph.

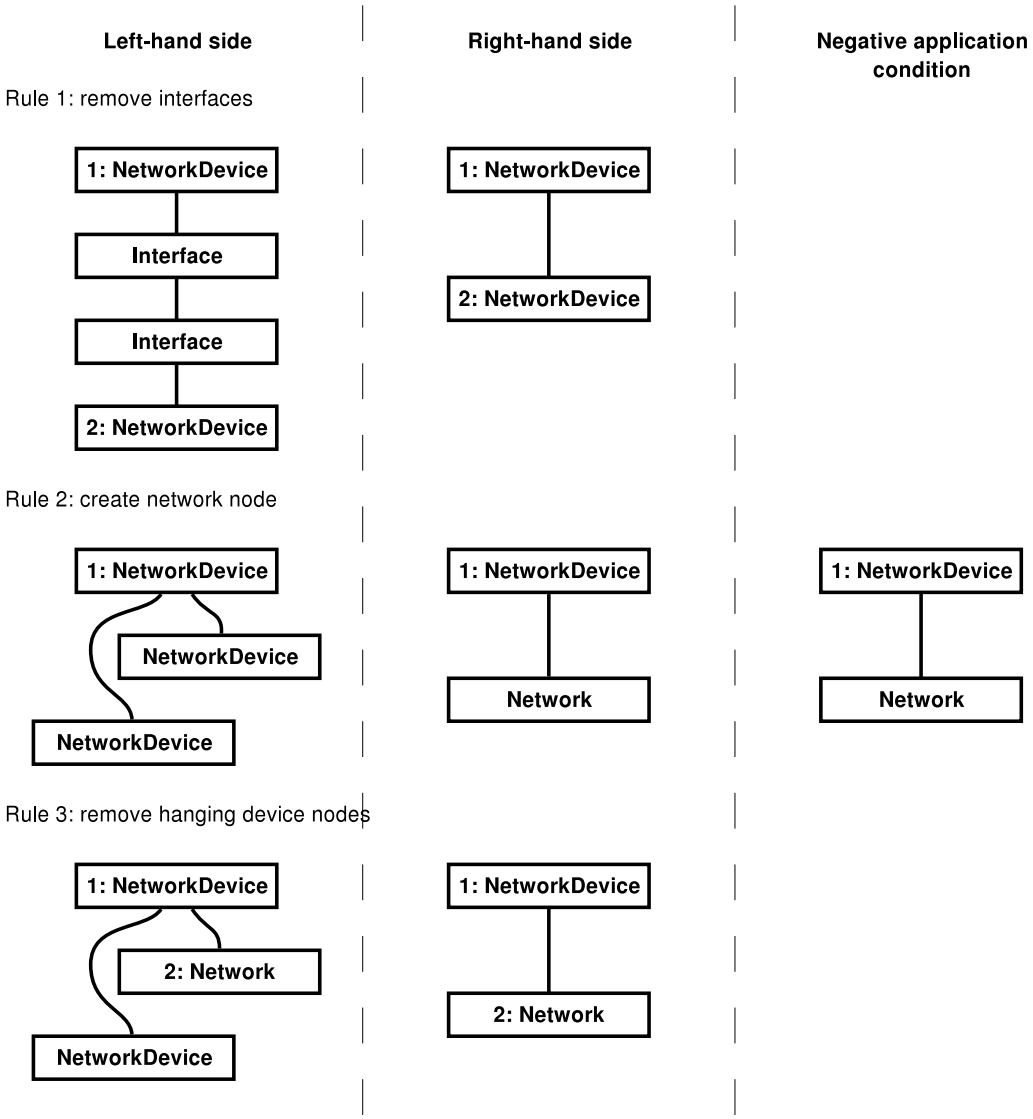

Figure 3. Sample rewriting rules (AGG notation).

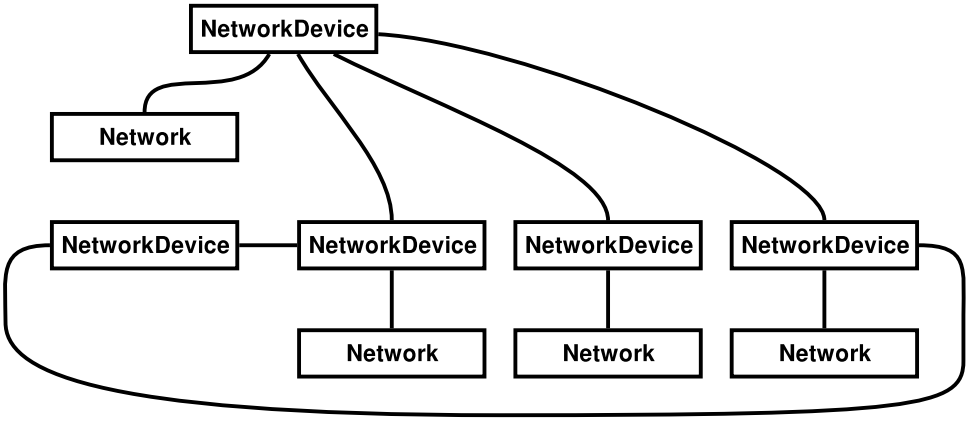

Figure 4. Transformation result.

Computer Network Structure in LDAP

The network structure is stored in LDAP directory according to the "network–subnetwork–device–interface" hierarchy.

Problem
Some devices could have it's interfaces connected to different sub-networks.

Solution
Preserve the "network–subnetwork–interface" hierarchy, store every device entry in the directory so that all of it's interfaces are in the same sub-tree.

Implementation

Prototype implementation uses AGG system (http://tfs.cs.tu-berlin.de/agg/) as a graph transformation engine.

Current work

Software system for representation of the computer network structure of PetrSU along with the administrative and geographical structures.

- Team project "Nest".
- Using SNMP to discover the network structure.
- Storing the structures in LDAP directory.