

# T0olbox for Traffic Engineering Methods

Supported Standards

OSPF/IS-IS

BGP

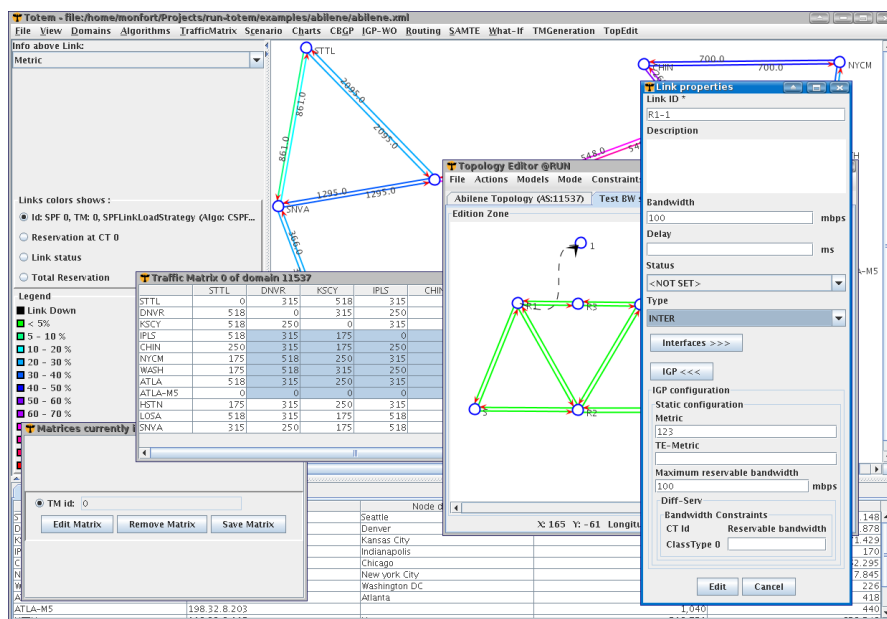
MPLS

DiffServ

Fast reroute

## New features of TOTEM 3.0

- Further improvements to the Graphical User Interface
- Now include a graphical topology editor and a graphical traffic matrix editor
- Improved IGPWO algorithm speed



## IP and MPLS simulations

The toolbox can be used to simulate how the traffic will be routed on a network using SPF, CSPF or other TE routing algorithms. TOTEM can simulate “what-if” scenarios to help understand the effects of metric changes, failures, traffic changes or BGP policy changes.

## Traffic engineering methods

- **IP-metric based Traffic Engineering:** TOTEM integrates an IP metric optimisation tool based on a tabu-search meta-heuristic. This tool can be used to balance the traffic load by using an optimised metric set.
- **MPLS source-based routing:** TOTEM provides several efficient tools for computing paths in an MPLS network. The first tool - DAMOTE - can optimise different score functions like load-balancing, resource minimisation or a hybrid combination. It can be used in a centralised or decentralised on-line mode and is DiffServ-TE aware. The second algorithm is based on MIRA, which lies on the principle of Minimum Interference Routing. The third one - SAMCRA - is an exact multi-constrained shortest path algorithm. Different kinds of CSPF algorithms are also integrated in the toolbox.
- **MPLS resilient network routing:** another module provides an MPLS backup computation functionality. This tool is unique in its ability to optimise bandwidth sharing between backup and primary paths that cannot be active at the same time. It can compute local or end-to-end backup, link/node disjoint from the protected primary path.
- **Hybrid IP/MPLS Optimisation:** the toolbox includes the tool called SAMTE for Scalable Approach for MPLS Traffic Engineering. This approach lies between the pure IP metric-based optimisation (as IGP-WO) and the full mesh of LSPs. SAMTE uses the simulated annealing meta-heuristic to find a small number of LSPs (given as parameter) to establish in the network.
- **BGP decision process simulator:** TOTEM includes C-BGP, an efficient BGP decision process simulator. This tool can be used to evaluate the impact of input/output policies on the routing tables of various ASes. It can also be used to experiment with a modified decision process and additional BGP attributes.

## System requirements

PC with linux  
32bits JVM  
256 Mb RAM  
JAVA 1.5

## Technology used

JAVA 1.5  
XML  
XML Schema  
JAXB  
JNI  
Ant  
Log4j  
Jung  
Tomcat

Licence  
GPL

## Toolbox architecture

**Interoperable network representation:** TOTEM uses an interoperable XML format integrating topology, label switched path and BGP configurations. The traffic matrix is also represented using an XML file. These data can be assembled from a variety of sources such as router's configurations, MRT, Netflow, SRLG.

**Flexible simulation scenario:** the simulation scenario integrates link utilisation computation using SPF, LSP creation with or without backup, link or node failure simulation. All these scenarios can be automatically executed by the toolbox.

**Topology generation:** the BRITE universal topology generator is integrated for generating state of the art realistic topologies.

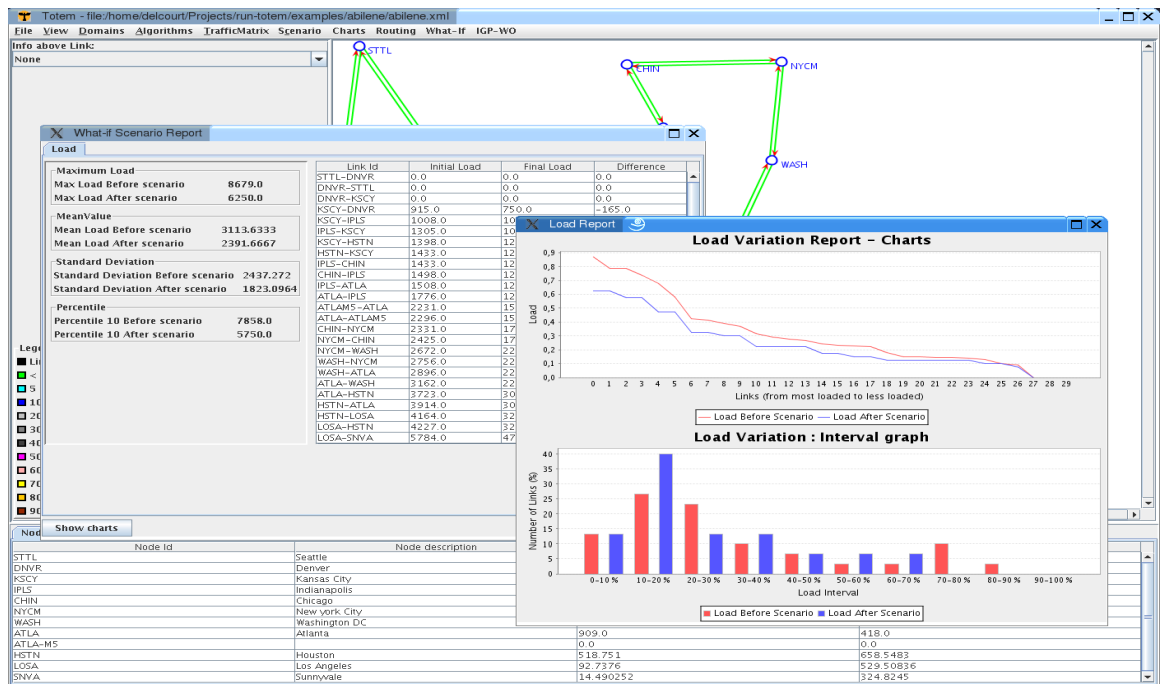
**Traffic matrix deduction:** traffic matrix can be inferred from link load using a simple gravity model or directly from Netflow traces. If no link utilisation information is available, we can also generate random traffic matrices following classical distributions.

**Open architecture:** TOTEM's most interesting features is its open source architecture that allows developers and researchers to easily integrate their TE methods in the toolbox.

## New TE algorithms design

The open framework provided by the toolbox allows a rapid integration of new methods. The benefits are :

- reuse of existing components like the topology or traffic matrix modules
- comparison with existing algorithms already in the toolbox like IP metric optimiser
- integration of new TE algorithms with existing ones, such as the BGP simulator



## About TOTEM

The TOTEM project is funded by the Direction Générale des Technologies, de la Recherche et de l'Energie of the Walloon government (Belgium). The toolbox was also promoted by the European Network of Excellence E-Next.

## Partners

University of Liege (ULG) - Research Unit in Networking - Guy Leduc  
Université catholique de Louvain (UCL) - Dept Computing Science and Engineering - Olivier Bonaventure  
Université catholique de Louvain (UCL) - Operations Management and Management Science - Bernard Fortz

Toolbox URL : <http://totem.run.montefiore.ulg.ac.be>

Project URL (with publications, other tools, ...) : <http://totem.info.ucl.ac.be>

Release URL (with forums, development tools, ...) : <http://gforge.info.ucl.ac.be/projects/totem/>

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