BRITE: Boston University Representative Internet Topology gEnerator: A Flexible Generator of Internet Topologies

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A Flexible Generator of Internet Topologies

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BRITE is a parametrized topology generation tool, which can be used to flexibly control various parameters (such as connectivity and growth models) and study various properties of generated topologies (such power laws, average path length, etc).
Overview

BRITE is a parametrized topology generator that can be used to study the relevance of possible causes for power laws and other metrics recently observed in Internet topologies. Different combinations of possible causes can be tested. In this version, we consider four possible causes: preferential connectivity, incremental growth, node placement, and connection locality. For each combination, the generated topologies can be analyzed in terms of power laws and other metrics observed in real networks. The following table lists the various parameters of BRITE. We describe each parameter next.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Meaning</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS</td>
<td>Size of one side of the plane</td>
<td>Integer &gt; 1</td>
</tr>
<tr>
<td>LS</td>
<td>Size of one side of a high-level square</td>
<td>Integer &gt;= 1</td>
</tr>
<tr>
<td>NP</td>
<td>Node Placement</td>
<td>0: Random, 1: Heavy-Tailed</td>
</tr>
<tr>
<td>m</td>
<td>Number of links added per new node</td>
<td>Integer &gt;= 1</td>
</tr>
<tr>
<td>PC</td>
<td>Preferential Connectivity</td>
<td>0: NONE, 1: ONLY, 2: BOTH</td>
</tr>
<tr>
<td>IG</td>
<td>Incremental Growth</td>
<td>0: INACTIVE, 1: ACTIVE</td>
</tr>
</tbody>
</table>

The Plane:

The nodes of the generated topology are distributed in a plane divided into $HS \times HS$ squares. Each one of these high-level squares is further subdivided into smaller $LS \times LS$ low-level squares. Each low-level square can be assigned at most one node.

Node Assignment:

A Random placement of nodes in the plane is achieved by simply selecting a low-level square randomly and dropping a node there while avoiding collisions. To achieve a Heavy-Tailed distribution of nodes, for each one of the high-level squares, the generator picks a number of nodes to be assigned to that square.
according to a *bounded Pareto distribution*. A node is then placed randomly in one of the $\mathcal{L}_x \times \mathcal{L}_y$ low-level squares while avoiding collisions.

**Number of Links for a New Node:**

The parameter $m$ controls the number of neighbor nodes to which a new node connects when it joins the network (or in other words, the number of new links to be added to the topology). The greater the value of $m$, the denser the generated topology. We refer to the set of nodes from which a neighbor is selected for a new node as the *candidate neighbor set*.

**Incremental Growth:**

This parameter controls incremental growth and can take one of two values:

- **INACTIVE** places all nodes at once in the plane before adding any link. In this case, a new node considers *all* other nodes as candidate neighbors when joining the network.
- **ACTIVE** places nodes in the plane gradually one at a time as they join the network. In this case, a new node considers as candidate neighbors only those nodes that have already joined the network (i.e. nodes that are already connected to some other node(s)).

Initially, before operating in either **INACTIVE** or **ACTIVE** mode, the generator generates a small randomly connected backbone of $m_0$ nodes. The remaining nodes are then connected.

** Preferential Connectivity:**

This parameter controls the activation or deactivation of preferential connectivity. There are three possible values for this parameter:

- **NONE** indicates that preferential connectivity is turned off. In this case, a new node connects to a candidate neighbor node using Waxman's probability function. This process is repeated to connect the new node to $m$ nodes.
• ONLY means that preferential connectivity is turned on. In this case, from the set of candidate neighbor nodes, a new node joining the network selects with high probability a node with a high outdegree. This process is repeated to connect the new node to m nodes.

• BOTH combines preferential connectivity and connection locality. In this case, for a new node, the probability of connecting to a candidate neighbor node is a function of both Waxman's probability and outdegree. This process is repeated to connect the new node to m nodes.

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**Papers**


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**Software**

Please see the new BRITE release at

http://www.cs.bu.edu/brite

Download BRITE version 1.0. Please read copyright notice.

We apologize BRITE is not available for downloading at this time as we prepare the new version. Please send us email and we will notify you once the new version is released (expected end of March 2001).
Please send comments and suggestions to Alberto Medina, Ibrahim Matta, John Byers.

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