

Appendix

Appendix A: Simulator Manual

Running the Simulator

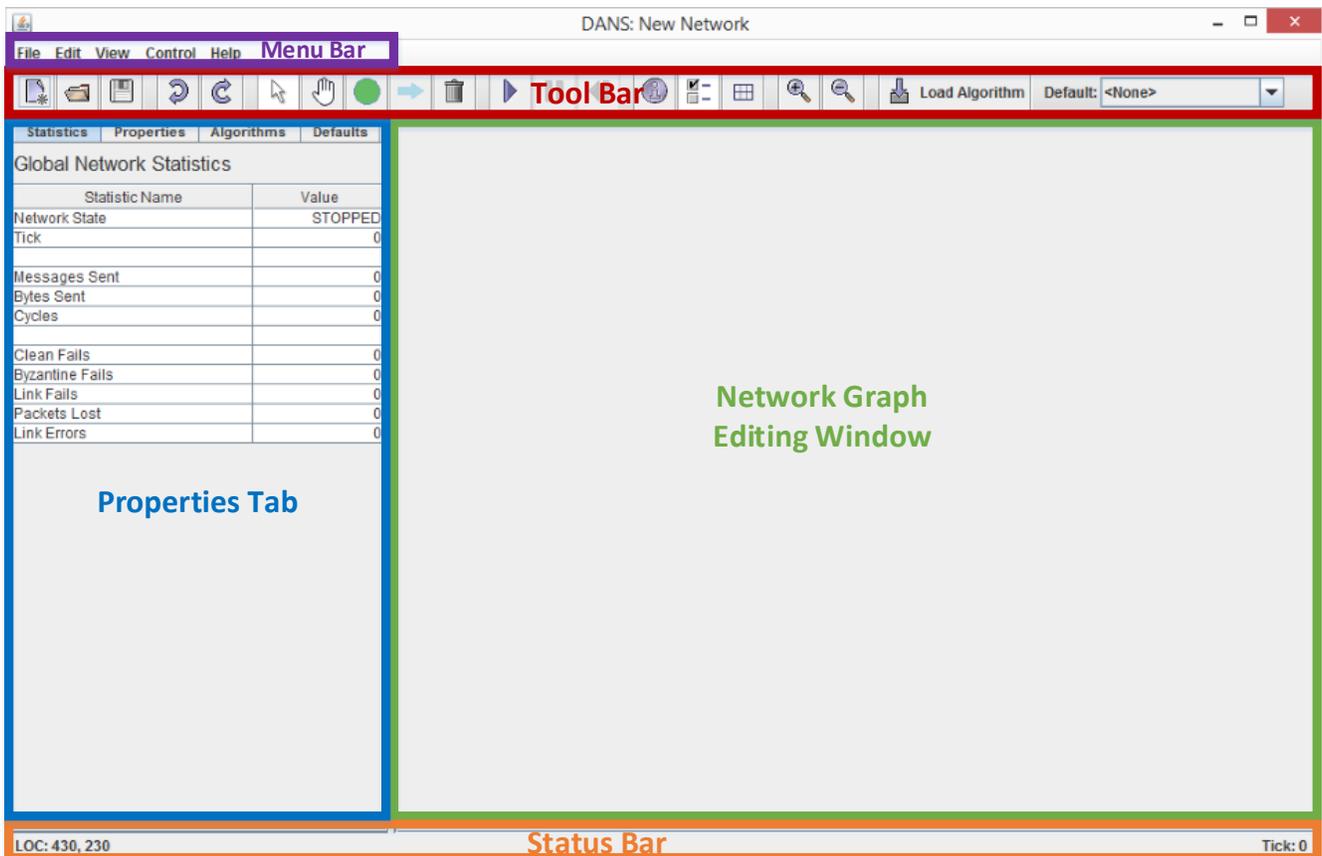
DANS requires a Java version of 8 or higher to function properly. The JGraphX and JLFGR libraries are also required but should be embedded in the jar build of DANS. To run the simulator ensure DANS.jar is in the current directory and type the following in to the console/command line:

```
java -jar DANS.jar
```

DANS will only function correctly in desktop environments that support the swing GUI (i.e. it will not work in console only environments).

Using the GUI

GUI Components:



Network Graph Editing Window: This window displays the current visualization of the network graph and allows editing of links and processors while the simulation is stopped. Selecting a processor or link in this window will change what properties are displayed in the

properties tab (e.g. if a processor is selected, settings for that processor will be shown in the properties tab).

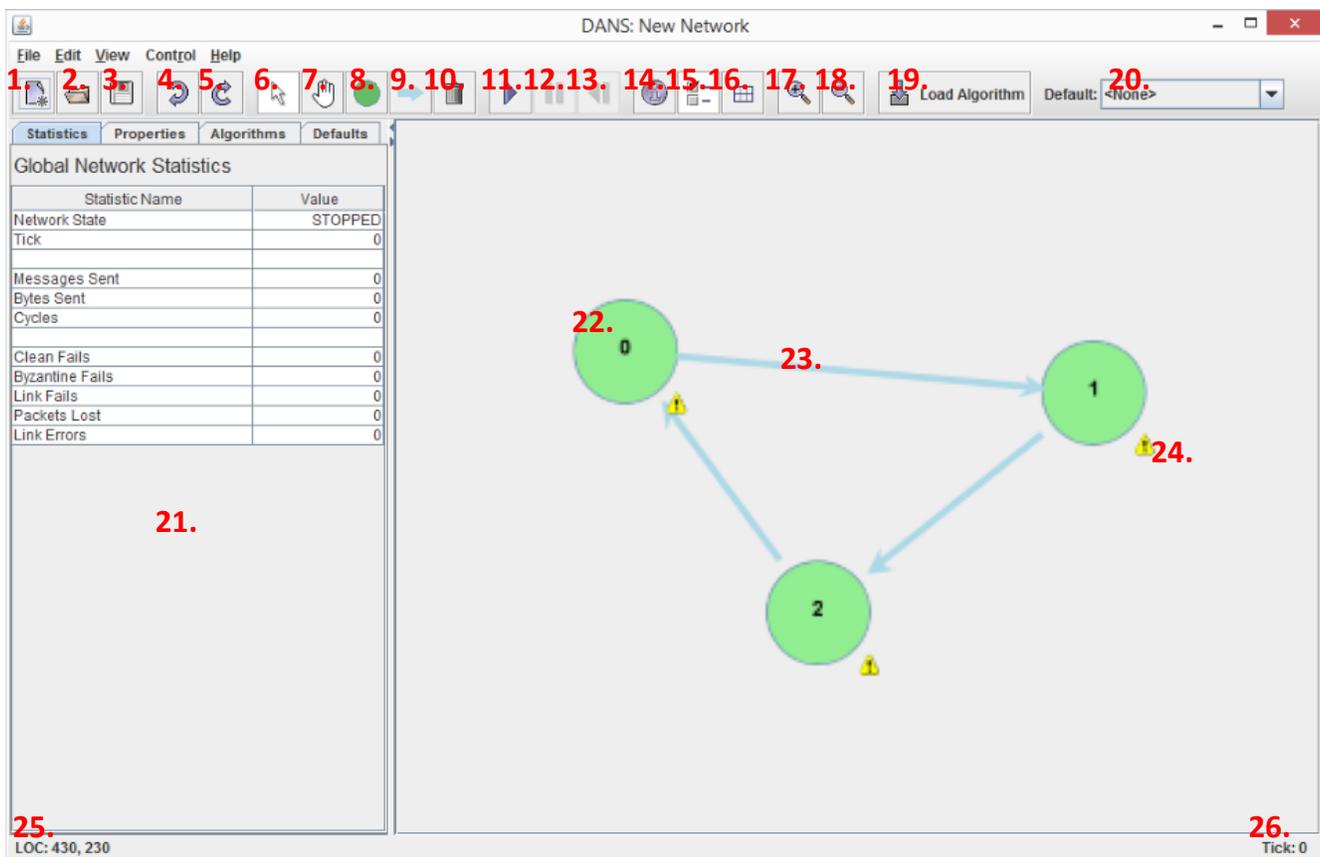
Properties Tab: This window displays statistics and settings for the currently selected object in the network graph editing window. The tabs change what kind of settings or statistics are displayed (e.g. the algorithms tab displays details about the algorithms registered with the currently selected processor). A detailed description of each setting and statistic is given in Appendix B.

Status Bar: The status bar displays the current tick the simulation is on as well as the current location of the mouse relative to the network graph (and accounting for zoom levels).

Tool Bar: The tool bar displays buttons that activate different tools or editing modes. See the next subsection for details on each button's function.

Menu Bar: The menu bar displays additional features not necessarily displayed on the tool bar.

Button functions & Other GUI Elements:



1. **New:** Create a new simulation. Any unsaved work will be lost.
2. **Open:** Open a previously saved simulation. Any unsaved work will be lost.

3. **Save:** Save the current simulation to a file.
4. **Undo:** Undo the last network graph editing action (does not effect settings changed in the properties tab).
5. **Redo:** Redo the last network graph editing action (does not effect settings changed in the properties tab).
6. **Selection:** Activates the selection editing mode. In the selection editing mode, clicking on a processor or link will select them and allow you to hold down the mouse button to move the object.
7. **Pan:** Activates the panning editing mode. If the network graph is zoomed in to the point that scroll bars are shown, the panning editing mode will allow you to move your view of the graph. This has no effect if the scroll bars are not shown.
8. **Add Processor:** Activates the processor editing mode. In this editing mode clicking in any blank space in the network graph editing window will create a processor.
9. **Add Link:** Activates the link editing mode. In this editing mode clicking on a processor will allow you to create a link to the processor that is clicked next. Clicking on a blank space will remove the incomplete link.
10. **Delete:** Activates the delete editing mode. Any processor or link clicked on while in this editing mode will be deleted.
11. **Play:** Start the simulation. While the simulation is running most editing features will be disabled.
12. **Pause:** Pause the currently running simulation. A simulation must be paused before it can be restarted.
13. **Restart:** If the simulation has terminated or is currently paused you may restart the simulation. Restarting the simulation will return the simulation to an editable state like it was before the play button was pressed. A running simulation must be paused before it may be restarted.
14. **Toggle Log:** Display or hide the logging window.
15. **Toggle Properties:** Display or hide the properties tab.
16. **Toggle Grid:** Display or hide the grid.
17. **Zoom In:** Zoom in on the network graph.
18. **Zoom Out:** Zoom out on the network graph.
19. **Load Algorithm:** Displays a file chooser window so that you can select an algorithm to load. The first time an algorithm is loaded it is automatically set as the default algorithm.

20. **Select Default Algorithm:** Sets the default algorithm for processors to run. When selected, all algorithms registered as listening on the default port are changed to the selected default algorithm and processors created in the future will have the default algorithm registered on the default port.
21. **Properties Tab:** See Appendix B for details on the settings and statistics displayed in the properties tab.
22. **Processor:** Circles in the network graph editing window represent processors. Processors that are green are in an OK or running state. Processors that are red are terminated and/or have encountered an exception. Processors that are orange have experienced a failure as a result of the failure probability setting in the processor's settings. Double clicking on a processor will allow you to edit its current ID.
23. **Link:** Arrows in the network graph editing window represent links between processors. Links that are blue are in an OK or not transmitting state. Links that are green are actively transmitting a message that should be displayed in text beside the link (blue text for messages going into the link and green for messages leaving it). Links that are orange have experienced a failure as a result of the failure probability setting in the link's settings. Clicking on either end of a link will allow you to drag it to a new processor to reassign it.
24. **Warning:** A flashing yellow exclamation mark icon indicates that an algorithm has not yet been assigned to the processor. If the simulation is run without assigning an algorithm to a processor, the processor will terminate immediately.
25. **Mouse Location:** The current mouse location relative to the network graph (accounting for zoom levels).
26. **Tick:** The current tick value of the simulation.

Keyboard Shortcuts:

Delete: Delete the currently selected object in the network graph editing window.

Ctrl-a: Select all objects in the network graph editing window.

Ctrl-d: Select none.

Ctrl-x: Cut.

Ctrl-c: Copy.

Ctrl-p: Paste.

Ctrl-=: Zoom in.

Ctrl-: Zoom out.

=: Reset zoom.

Ctrl-z: Undo.

Ctrl-y: Redo.

F1: Selection edit mode.

F2: Pan edit mode.

F3: Processor edit mode.

F4: Link edit mode.

F5: Delete edit mode.

F12: Toggle fullscreen mode.

Appendix B: Properties Tab Settings & Statistics

Statistics

Table 4: Global Network Statistics

Statistic	Description
Network State	The current state of the network (e.g. running, stopped, paused, etc.).
Tick	The current tick the simulation is on.
Messages Sent	The number of messages in total that have been sent up to this point in the simulation.
Bytes Sent	The number of bytes in total that have been sent up to this point in the simulation.
Cycles	The total number of cycles all processors have completed.
Clean Fails	The total number of processors that have encountered a clean failure.
Byzantine Fails	The total number of processors that have encountered a Byzantine failure.
Link Fails	The total number of links that have encountered a failure.
Packets Lost	The total number of messages that all links have dropped.
Link Errors	The total number of bytes that have had errors in all messages sent.

Table 5: Processor Statistics

Statistic	Description
Status	The status of the selected processor (e.g. running, terminated, failed, etc.).
Messages	The number of messages this processor has sent (includes totals from all algorithms running on that processor).
Messages in Bytes	The number of bytes this processor has sent (includes totals from all algorithms running on that processor).
Cycles	The number of cycles completed by all algorithms running on this processor.

Table 6: Link Statistics

Statistic	Description
Status	The status of the selected link (e.g. inactive, active, failed, etc.).
Messages	The number of messages that have been sent through the selected link.
Messages in Bytes	The number of bytes that have been sent through the selected link.
Messages per Tick	The number of messages this link sends per tick on average.
Packets Lost	The number of messages that have been dropped by this link.
Packets Errors	The number of bytes that have contained errors due to faults in this link.

Properties

Table 7: Processor Settings

Setting	Description
ID	A unique identifier assigned to the selected processor. The ID is used to identify what processors to send messages to in user created algorithms.
Delay	The time in ticks it will take the processor to complete a cycle. If the value is set to 0, the processor will ignore the tick system and the next cycle will start immediately after the last cycle finished. If all processors have a delay of 1 and all links have a delay of 0 the simulation will be synchronous.
Speed Change Method	The method used for determining the change in the processors delay. NONE will keep the delay constant (no change). UNIFORM will choose a uniformly distributed pseudo random number each cycle to be added to the delay (this number can be negative). NORMAL will choose a normally (Gaussian) distributed pseudo random number each cycle to be added to the delay (this number can be negative). CONSTANT a constant value will be added to the delay each cycle (can be negative).
Change Seed	The seed used for generating pseudo random changes to the delay.
Change Min	The minimum value the processor's delay can fall to. Should be 1 or more.
Change Max	The maximum value the processor's delay can rise to. Should be greater than min.
Normal Change Mean	Sets the mean of the normal distribution if a normal change method is being used.
Normal Change STDV	Sets the standard deviation of the normal distribution if a normal change method is being used.
Uniform Change Min	Sets the minimum random value chosen if the uniform change method is being used (can be negative).
Uniform Change Max	Sets the maximum random value chosen if the uniform change method is being used. Can be negative but should be greater than the minimum change.
Constant Change Amount	Sets the constant amount the delay changes by if the constant change method is being used (can be negative).
Clean Failure Rate	The probability (in percent) that the processor will fail in any given cycle. Should be a value between 0 and 100. If the processor fails using this method, all message will be sent before it terminates.
Byzantine Failure Rate	The probability (in percent) that the processor will fail after sending any message. Should be a value between 0 and 100. No guarantee is given that all messages in a given cycle will be sent.

Table 8: Link Settings

Setting	Description
ID	A unique identifier assigned to the selected link. The ID can be used to identify what link to send messages on in user created algorithms.
Delay	The time in ticks it will take for the selected link to transmit its message to the target processor. If a delay of 0 is given, messages will skip the link output queue and be directly placed in the target algorithm's input queue.
Bandwidth	The bandwidth of the selected link measured in messages per tick. This value is a double and can be less than one (but should be more than 0). A bandwidth of 0 disables restricting the links bandwidth.
Speed Change Method	The method used for determining the change in the links delay. NONE will keep the delay constant (no change). UNIFORM will choose a uniformly distributed pseudo random number each cycle to be added to the delay (this number can be negative). NORMAL will choose a normally (Gaussian) distributed pseudo random number each cycle to be added to the delay (this number can be negative). CONSTANT a constant value will be added to the delay each cycle (can be negative).
Change Seed	The seed used for generating pseudo random changes to the delay.
Change Min	The minimum value the link's delay can fall to. Should be 1 or more.
Change Max	The maximum value the link's delay can rise to. Should be greater than min.
Normal Change Mean	Sets the mean of the normal distribution if a normal change method is being used.
Normal Change STDV	Sets the standard deviation of the normal distribution if a normal change method is being used.
Uniform Change Min	Sets the minimum random value chosen if the uniform change method is being used (can be negative).
Uniform Change Max	Sets the maximum random value chosen if the uniform change method is being used. Can be negative but should be greater than the minimum change.
Constant Change Amount	Sets the constant amount the delay changes by if the constant change method is being used (can be negative).
Failure Rate	The probability (in percent) that the link will fail after sending any message. This value should be between 0 and 100. Messages left in the links queue after a failure will not be sent.
Packet Loss Rate	The probability (in percent) that any given message will be dropped by the link. This value should be between 0 and 100.
Byte Error Rate	The probability (in percent) that any given byte in a message transmitted by the link will contain an error. If a byte contains an error its value will be randomly altered to that of a different printable character. This value should be between 0 and 100.

Defaults

Table 9: Global Default Settings

Default Setting	Description
tickSpeed	The minimum time in milliseconds that a tick will last.
loggingLevel	The verbosity of the log.
defaultPort	The port that will be considered the default port. New processor will automatically have the default algorithm assigned to this port. When the default algorithm is changed, the algorithm listening on this port will also be changed.
defaultSpeedChangeSeed	The default speed for the processor and link delay change methods.
defaultProcSpeed	Default delay setting for new processors.
defaultProcSpeedChangeMethod	Default delay change method for new processors.
defaultProcSpeedChangeNormMean	Default normal mean for new processors.
defaultProcSpeedChangeNormSTDV	Default normal standard deviation for new processors.
defaultProcSpeedChangeUniMin	Default uniform minimum for new processors.
defaultProcSpeedChangeUniMax	Default uniform maximum for new processors.
defaultProcSpeedChangeMin	Default minimum change amount for new processors.
defaultProcSpeedChangeMax	Default maximum change amount for new processors.
defaultProcSpeedChangeConstant	Default constant change amount for new processors.
defaultLinkSpeed	Default link delay for new links.
defaultLinkSpeedChangeMethod	Default delay change method for new links.
defaultLinkSpeedChangeNormMean	Default normal standard deviation for new links.
defaultLinkSpeedChangeNormSTDV	Default normal standard deviation for new links.
defaultLinkSpeedChangeUniMin	Default uniform minimum for new links.
defaultLinkSpeedChangeUniMax	Default uniform maximum for new links.
defaultLinkSpeedChangeMin	Default minimum change amount for new links.
defaultLinkSpeedChangeMax	Default maximum change amount for new links.
defaultLinkSpeedChangeConstant	Default constant change amount for new links.
defaultProcCleanFailRate	Default clean failure rate for new processors.
defaultProcByzantineFailRate	Default Byzantine failure rate for new processors.
defaultLinkBandwidth	Default bandwidth for new links.
defaultLinkFailRate	Default failure rate for new links.
defaultLinkLossRate	Default packet loss rate for new links.
defaultLinkErrorRate	Default byte error rate for new links.