LinkDelay

Version 5.0.4

Revision History

June 2013 - Created by Volpe Center

The **LinkDelay** program is used to:

1. Merge, average, and/or convert Link Delay files.

2. Smooth the link delays between time increments.

Syntax is LinkDelay [-flag] [control\_file]

The control\_file is the file name of an ASCII file that contains the control strings expected by the program. The control\_file is optional. If a file name is not provided, the program will prompt the user to enter a file name. The flag parameters are also optional. Any combination of the following flag parameters can be included on the command line:

Optional Flags:

-Q[uiet] = execute without screen messages

-H[elp] = show program syntax and control keys

-C[ontrol] = create/update a default control file

-K[eyCheck] = list unrecognized control file keys

-P[ause] = pause before exiting

-N[oPause] = never pause before exiting

-D[etail] = execute with detailed status messages

-X[ML] = write an XML file with control keys

The program automatically creates a printout file based on the control file name. If the filename includes an extension (e.g., “.ctl”), the extension is replaced with “.prn”. The printout file will be created in the current working directory and will overwrite an existing file with the same name.

# Version 5 Features

Functionality is similar to that in the version 4 Link Delay program, except that some control keys have been changed.

# Control Key List

The list of control file keys appears in the tables below:

* Req / Opt indicates whether the key is **req**uired or **opt**ional
* The types include **Text**, Input **File**name, **New** file, **Bool**ean, **Path** (to a file), **Time**, **Int**eger, **Dec**imal, and **List** of items
* The Default is the default value, used if the key does not appear in the control file.
* I/O/P indicates Input, Output or Parameter.

For a more detailed description of the Parameter control keys, refer to the Parameter Reference. For a more detailed description of the Input or Output control keys, refer to the File Reference. These two documents also provide the possible values or range of values allowed for each control key listed below. For instance, files can usually be output to numerous formats beyond TAB\_DELIMITED for additional post-processing / file manipulation actions.

## Configuration Keys

| **Control File Keys:** | **Req/Opt** | **Type** | **Default** | **I/O/P** |
| --- | --- | --- | --- | --- |
| TITLE | Opt | Text |  | P |
| REPORT\_FILE | Opt | File |  | O |
| REPORT\_FLAG | Opt | Bool | FALSE | P |
| PAGE\_LENGTH | Opt | Int | 65 | P |
| PROJECT\_DIRECTORY | Opt | Path |  | P |
| DEFAULT\_FILE\_FORMAT | Opt | Text | TAB\_DELIMITED | P |
| TIME\_OF\_DAY\_FORMAT | Opt | Text | DAY\_TIME | P |
| MODEL\_START\_TIME | Opt | Time | 0:00 | P |
| MODEL\_END\_TIME | Opt | Time | 24:00:00 | P |
| MODEL\_TIME\_INCREMENT | Opt | Time | 15 minutes | P |
| UNITS\_OF\_MEASURE | Opt | Text | METRIC | P |
| RANDOM\_NUMBER\_SEED | Opt | Int | 0 | P |
| MAX\_WARNING\_MESSAGES | Opt | Int | 100000 | P |
| MAX\_WARNING\_EXIT\_FLAG | Opt | Bool | TRUE | P |
| MAX\_PROBLEM\_COUNT | Opt | Int | 0 | P |
| NUMBER\_OF\_THREADS | Opt | Int | 1 | P |

## System File Keys

| **Control File Keys:** | **Req/Opt** | **Type** | **Default** | **I/O/P** |
| --- | --- | --- | --- | --- |
| NODE\_FILE | Req | File |  | I |
| NODE\_FORMAT | Opt | Text | TAB\_DELIMITED | P |
| LINK\_FILE | Req | File |  | I |
| LINK\_FORMAT | Opt | Text | TAB\_DELIMITED | P |
| LINK\_DELAY\_FILE | Req | File |  | I |
| LINK\_DELAY\_FORMAT | Opt | Text | TAB\_DELIMITED | P |
| NEW\_LINK\_DELAY\_FILE | Req | File |  | I |
| NEW\_LINK\_DELAY\_FORMAT | Opt | Text | TAB\_DELIMITED | P |
| CONNECTION\_FILE | Opt | File |  | I |
| CONNECTION\_FORMAT | Opt | Text | TAB\_DELIMITED | P |
| SAVE\_LANE\_USE\_FLOWS | Opt | Bool | FALSE | P |

## Data Service Keys

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Control File Keys:** | **Req/Opt** | **Type** | **Default** | **I/O/P** |
| DAILY\_WRAP\_FLAG | Opt | Bool | FALSE | P |
| SUMMARY\_TIME\_RANGES | Opt | Text | ALL | P |
| SUMMARY\_TIME\_INCREMENT | Opt | Time | 15 minutes (0, 2..240) | P |

## Link Delay Control Keys

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Control File Keys:** | **Req/Opt** | **Type** | **Default** | **I/O/P** |
| MERGE\_LINK\_DELAY\_FILE | Opt | File |  | I |
| MERGE\_LINK\_DELAY\_FORMAT | Opt | Text | TAB\_DELIMITED | P |
| PROCESSING\_METHOD | Opt | Text | SIMPLE\_AVERAGE | P |
| MERGE\_WEIGHTING\_FACTOR | Opt | Dec | 1 | P |
| MAX\_TRAVEL\_TIME\_RATIO | Opt | Dec | 0 | P |
| SET\_MIN\_TRAVEL\_TIME | Opt | Bool | FALSE | P |

## Data Smoothing Keys

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Control File Keys:** | **Req/Opt** | **Type** | **Default** | **I/O/P** |
| SMOOTH\_GROUP\_SIZE | Opt | Int | 3 | P |
| PERCENT\_MOVED\_FORWARD | Opt | Dec | 20 | P |
| PERCENT\_MOVED\_BACKWARD | Opt | Dec | 20 | P |
| NUMBER\_OF\_ITERATIONS | Opt | Int | 3 | P |
| CIRCULAR\_GROUP\_FLAG | Opt | Bool | TRUE | P |

#### Notes

Each '\_FILE' key has a corresponding '\_FORMAT' key. The following file formats can be used for input and output files:

TEXT, BINARY, FIXED\_COLUMN, COMMA\_DELIMITED, SPACE\_DELIMITED, TAB\_DELIMITED, CSV\_DELIMITED, DBASE, SQLITE3, VERSION3. The default format is TAB\_DELIMITED.

# New and Changed Control Keys

## MAX\_TRAVEL\_TIME\_RATIO

Default is 0. Valid values are zero, or a value greater than or equal to 1. If this is set to a non-zero value, limits the changes in travel times that are made. It only seems to be used when the link delay files include turning movements.

## MERGE\_LINK\_DELAY\_FILE

This replaces the PREVIOUS\_LINK\_DELAY\_FILE in the version 4 LinkDelay program

## MERGE\_WEIGHTING\_FACTOR

This replaces the PREVIOUS\_WEIGHTING\_FACTOR in the version 4 LinkDelay program. If two link delay files (merge and current) this factor gives the weight for the merge file, in instances where the Processing\_Method is WEIGHTED\_AVERAGE. Its default is 1, and it should be a value greater than or equal to 0.5. Let

MERGE\_VAL = value in the Merge\_Link\_Delay\_File

CURR\_VAL= value in the Link\_Delay\_File

MERGE\_FACTOR = Merge\_Weighting\_Factor

NEW\_VAL = value in the New\_Link\_Delay\_File

In the absence of time smoothing,

NEW\_VAL = (MERGE\_VAL \* MERGE\_FACTOR + CURR\_VAL) / (MERGE\_FACTOR + 1)

## PROCESSING\_METHOD

Valid values for PROCESSING\_METHOD are REPLACE\_LINKS, SIMPLE\_AVERAGE, WEIGHTED\_AVERAGE, REPLACE\_OR\_AVERAGE.

Both the WEIGHTED\_AVERAGE and REPLACE\_OR\_AVERAGE methods use the MERGE\_WEIGHTING\_FACTOR. If the flow is 0, the REPLACE\_OR\_AVERAGE key functions as a REPLACE\_LINKS key. Otherwise REPLACE\_OR\_AVERAGE functions as a WEIGHTED\_AVERAGE key.

## SET\_MIN\_TRAVEL\_TIME

SET\_MIN\_TRAVEL\_TIMES is the true/false key (defaults to false) which sets the travel time for links with zero flows in any given time period to the minimum travel time of any time period with flow. This replaces the default free flow travel time with the minimum simulated travel time. It will lead to the creation of a link\_delay record for all time periods.

# Examples

## Example 1 - Smoothing by time of day for a single file

Note that in the link delay control file, SMOOTH\_GROUP\_SIZE needs to be set to a positive value, such as 3, 5, or 7.

The control file is as follows:

TITLE Link Delay Averaging for One Link

NODE\_FILE node.txt

LINK\_FILE link.txt

LINK\_DELAY\_FILE linkdelay.txt

NEW\_LINK\_DELAY\_FILE newlinkdelay.txt

SMOOTH\_GROUP\_SIZE 3

The output .prn file is as follows:

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

| |

| LinkDelay - Version 5.0.4 |

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| Fri Jun 14 13:19:51 2013 |

| |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Control File = T.LinkDelay.ctl

Report File = T.LinkDelay.prn (Create)

Link Delay Averaging for One Link

Project Directory = ./

Default File Format = TAB\_DELIMITED

Time of Day Format = HOUR\_CLOCK

Model Start Time = 6:00

Model End Time = 10:00

Units of Measure = ENGLISH

Random Number Seed = 1371230391

Number of Threads = 2

Warning: LinkDelay is Not Thread Enabled

Input System Network Files:

Node File = ./node.txt

Link File = ./link.txt

Input System Demand Files:

Link Delay File = ./linkdelay.txt

Output System Demand Files:

New Link Delay File = ./newlinkdelay.txt

Data Service Controls:

Number of Time Periods = 16

LinkDelay Control Keys:

Smooth Group Size = 3

Number of Node File Records = 4

Number of Link File Records = 3

Number of Directional Links = 6

Number of Link Delay File Records = 14

Number of Link Direction Records = 14

Number of Link Connection Records = 0

Number of Summary Time Periods = 16

Percent of Link Periods with Travel Time Data = 14.6%

Percent of Time Periods with Link Delay Data = 56.3%

New Link Delay File Records = 27

Fri Jun 14 13:19:51 2013 -- Process Complete with 1 Warning (0:00:00)

A portion of the input link delay file is as follows

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LINK | DIR | START | END | FLOW | TIME |
| 30 | 1 | 7:00 | 7:15 | 107.25 | 64.3 |
| 30 | 1 | 7:15 | 7:30 | 150.5 | 65.7 |
| 30 | 1 | 7:30 | 7:45 | 256.5 | 80 |
| 30 | 1 | 7:45 | 8:00 | 409 | 168.3 |
| 30 | 1 | 8:00 | 8:15 | 285.25 | 88.5 |
| 30 | 1 | 8:15 | 8:30 | 184 | 68.1 |
| 30 | 1 | 8:30 | 8:45 | 82 | 64 |
| 30 | 1 | 8:45 | 9:00 | 40.25 | 63.8 |
| 30 | 1 | 9:00 | 9:15 | 6.75 | 63.8 |

Because the flows are smoothed over time, the output file includes records from 6:15 AM to 9:45 AM. Its flows and times, set alongside the input flows and times are shown below. The free flow travel time on this link is approximately 64 seconds.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| START | Flow-Before | Flow-After | Time-Before | Time-After |
| 6:15 |  | 0.86 |  | 63.8 |
| 6:30 |  | 8.93 |  | 63.9 |
| 6:45 |  | 38.63 |  | 64.2 |
| 7:00 | 107.25 | 96.47 | 64.3 | 66.4 |
| 7:15 | 150.5 | 173.21 | 65.7 | 76.2 |
| 7:30 | 256.5 | 256.35 | 80 | 97 |
| 7:45 | 409 | 302.86 | 168.3 | 111.7 |
| 8:00 | 285.25 | 270.91 | 88.5 | 100 |
| 8:15 | 184 | 188.83 | 68.1 | 79 |
| 8:30 | 82 | 107.64 | 64 | 67.5 |
| 8:45 | 40.25 | 51.32 | 63.8 | 64.4 |
| 9:00 | 6.75 | 19.47 | 63.8 | 63.8 |
| 9:15 |  | 5.17 |  | 63.8 |
| 9:30 |  | 0.81 |  | 63.8 |
| 9:45 |  | 0.05 |  | 63.8 |

## Example 2 - Link Replacement

The control file is as follows:

TITLE Link Delay Averaging for One Link

NODE\_FILE node.txt

LINK\_FILE link.txt

LINK\_DELAY\_FILE linkdelay.txt

MERGE\_LINK\_DELAY\_FILE mergelinkdelay.txt

NEW\_LINK\_DELAY\_FILE newlinkdelay.txt

PROCESSING\_METHOD REPLACE\_LINKS

The next table shows the input and output flows and times for link 30, direction 0. In this case, if values in the Link Delay file are available, they are used, replacing the values in the Merge file.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | Link Delay (input) | | Merge (input) | | New Link Delay | |
| LINK | DIR | START | END | FLOW | TIME | FLOW | TIME | FLOW | TIME |
| 30 | 0 | 7:00 | 7:15 | 4 | 60 | 8 | 65 | 4 | 60 |
| 30 | 0 | 7:15 | 7:30 | 3.2 | 61 | MISSING | | 3.2 | 61 |
| 30 | 0 | 7:30 | 7:45 | 2.8 | 58 | 9 | 68 | 2.8 | 58 |
| 30 | 0 | 7:45 | 8:00 | MISSING | | 13 | 69.5 | 13 | 69.5 |
| 30 | 0 | 8:00 | 8:15 | 5.4 | 62.5 | 15 | 70 | 5.4 | 62.5 |
| 30 | 0 | 8:15 | 8:30 | 5 | 63 | 10 | 65 | 5 | 63 |

## Example 3 - Weighted Average

This example uses a weighted average. It does not include time smoothing. The control file is as follows:

TITLE Link Delay Averaging for One Link

NODE\_FILE node.txt

LINK\_FILE link.txt

LINK\_DELAY\_FILE linkdelay.txt

MERGE\_LINK\_DELAY\_FILE mergelinkdelay.txt

NEW\_LINK\_DELAY\_FILE newlinkdelay.txt

MERGE\_WEIGHTING\_FACTOR 2

PROCESSING\_METHOD WEIGHTED\_AVERAGE

The next table shows the input and output flows and times for link 30, both directions.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | Link Delay (input) | | Merge (input) | | New Link Delay | |
| LINK | DIR | START | END | FLOW | TIME | FLOW | TIME | FLOW | TIME |
| 30 | 0 | 7:00 | 7:15 | 4 | 60 | 8 | 65 | 6.67 | 63.3 |
| 30 | 0 | 7:15 | 7:30 | 3.2 | 61 | MISSING | | 3.2 | 1.07 |
| 30 | 0 | 7:30 | 7:45 | 2.8 | 58 | 9 | 68 | 6.93 | 64.7 |
| 30 | 0 | 7:45 | 8:00 | MISSING | | 13 | 69.5 | 13 | 8.67 |
| 30 | 0 | 8:00 | 8:15 | 5.4 | 62.5 | 15 | 70 | 11.8 | 67.5 |
| 30 | 0 | 8:15 | 8:30 | 5 | 63 | 10 | 65 | 8.33 | 64.3 |
| 30 | 1 | 7:00 | 7:15 | 107.25 | 64.3 | 107.25 | 64.3 | 107.25 | 64.3 |
| 30 | 1 | 7:15 | 7:30 | 150.5 | 65.7 | 186.5 | 68.3 | 174.5 | 67.4 |
| 30 | 1 | 7:30 | 7:45 | 256.5 | 80 | 278.5 | 86.3 | 271.17 | 84.2 |
| 30 | 1 | 7:45 | 8:00 | 409 | 168.3 | 283.75 | 88 | 325.5 | 114.8 |
| 30 | 1 | 8:00 | 8:15 | 285.25 | 88.5 | 278.25 | 86.2 | 280.58 | 87 |
| 30 | 1 | 8:15 | 8:30 | 184 | 68.1 | 133 | 65 | 150 | 66 |

## Example 4 - Weighted Average and Time Smoothing

This example combines weighted average and time smoothing. The control file is as follows:

TITLE Link Delay Averaging for One Link

NODE\_FILE node.txt

LINK\_FILE link.txt

LINK\_DELAY\_FILE linkdelay.txt

MERGE\_LINK\_DELAY\_FILE mergelinkdelay.txt

NEW\_LINK\_DELAY\_FILE newlinkdelay.txt

MERGE\_WEIGHTING\_FACTOR 2

PROCESSING\_METHOD WEIGHTED\_AVERAGE

SMOOTH\_GROUP\_SIZE 3

PERCENT\_MOVED\_FORWARD 20

PERCENT\_MOVED\_BACKWARD 20

NUMBER\_OF\_ITERATIONS 1

CIRCULAR\_GROUP\_FLAG YES

The next table shows the input and output flows and times, for link 30, direction 1.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | Link Delay (input) | | Merge (input) | | New Link Delay | |
| LINK | DIR | START | END | FLOW | TIME | FLOW | TIME | FLOW | TIME |
| 30 | 1 | 6:45 | 7:00 | MISSING | | MISSING | | 7.15 | 63.8 |
| 30 | 1 | 7:00 | 7:15 | 107.25 | 64.3 | 107.25 | 64.3 | 102.98 | 64.4 |
| 30 | 1 | 7:15 | 7:30 | 150.5 | 65.7 | 186.5 | 68.3 | 178.68 | 68.3 |
| 30 | 1 | 7:30 | 7:45 | 256.5 | 80 | 278.5 | 86.3 | 274.27 | 89.1 |
| 30 | 1 | 7:45 | 8:00 | 409 | 168.3 | 283.75 | 88 | 307.08 | 103.6 |
| 30 | 1 | 8:00 | 8:15 | 285.25 | 88.5 | 278.25 | 86.2 | 282.08 | 90.9 |
| 30 | 1 | 8:15 | 8:30 | 184 | 68.1 | 133 | 65 | 149.95 | 67.1 |
| 30 | 1 | 8:30 | 8:45 | 82 | 64 | 81 | 64 | 85.35 | 64.3 |
| 30 | 1 | 8:45 | 9:00 | 40.25 | 63.8 | 40.25 | 63.8 | 40.8 | 63.8 |
| 30 | 1 | 9:00 | 9:15 | 6.75 | 63.8 | 6.75 | 63.8 | 8.53 | 63.8 |
| 30 | 1 | 9:15 | 9:30 | MISSING | | MISSING | | 0.45 | 63.8 |