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     |
|  Copyright 2012 by TRANSIMS Open-Source  |
|         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