

Characterizing Network Failover Time in an Industrial Ethernet Network

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Redundancy in Industrial Ethernet

Industrial Ethernet networks must be highly reliable and continue to operate during harsh environmental conditions, accidental network disruptions, and equipment failures. Network downtime can be dangerous and expensive. Network reliability is largely achieved by the use of redundancy for all critical links. There are four popular redundancy schemes for Ethernet: Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), Link Aggregation (Trunking), and proprietary ring topology.

Independent of the redundancy scheme, EtherScope coupled with a LinkRunner provides precise measurement of failover recover time with submillisecond accuracy. The characterization is performed under load, up to full gigabit line rate, to ensure worst cast measurement conditions.

Characterizing Network Dead Time using EtherScope

Dead time characterizes the maximum that a network goes quiet and is useful for measuring breaks like ring failover or access point handoff times. There are 2 methods to measure dead time, either by a loss of frames, or the maximum frame interarrival time.

Measurement Resolution

In both methods, the accuracy and load of the measurement can be controlled using an RFC test frame rate. Depending on the deployment phase of the network, the user may wish to test dead time at maximum throughput, up to a gigabit, or with light loading in the case of a production network. For example, if 1 ms timing accuracy is desired then 1000 frames per second (fps) must be generated. To do this with minimum load, 64 byte frames can be used. To generate 1000 fps with 64 byte frames, a rate of 672 Kbps is used.

Frame Loss

Configure an RFC throughput test to run for duration longer than the total test time required to capture the break, for example 60 seconds. First validate that the network is lossless in normal operation at 672 Kbps. The network dead time can then be characterized multiplying the # of lost frames by 1 ms + 1 ms. For example the loss of 2 frames would equate to (2 frames x 1 ms) + 1 ms. Note that in the figure the frame size is exaggerated relative to the time between the frames.



Maximum Frame Interarrival Time

The Frame Loss method relies on otherwise lossless network that drops frames on handoff/failover rather than buffer during failover. In ESv4.1, the RFC maximum jitter result can be used to more accurately characterize network dead time as max jitter represents the worst case frame interarrival time over the duration of the RFC jitter test. For example using the max jitter method, the loss of 2 frames would result in 3ms of frame interarrival time.



Configuring the EtherScope & Interpreting the Results

1. Performance Test

After powering on the EtherScope and linking, select Performance Tests and press Details.



2. Selecting the Correct Test and Target Device Expand Performance Test and uncheck all tests except Jitter. Select Jitter and press Add Device. Add the IP address of the LinkRunner Reflector to the Remote Device field.

Line La	Include Test/Device	Status
66	Performance Tests	- Ready to run
Link Status	- Loss Rate	- Will not run/report
IP: 192.168.000.068 Speed: 100Mb Duplex: Half	- RFC 2544 Throughput	- Will not run/report
	- RFC 2544 Latency	 Will not run/report
	RFC 2544 Loss	- Will not run/report
	RFC 2544 Back To Back	- Will not run/report
	E Jitter	-Ready to run
	192.168.000.074	 Ready to run
	Bit Error Bate	- Will not run/report
Change Device Remove Device Save Script Load Script		

3. Configuring the Test Parameters

Select the IP address of the reflector and press Configure. For a 1 ms measurement resolution

- Set the frame Size to 64
- Select the Rate field and using the keyboard enter a value of 672 K
- Select the desired Duration for the test (e.g. 30 seconds)

When done setting the Size, Rate and Duration, press Apply.

66	Override Frame Defaults	
192.168.000.074	Content: Increment Byte ·	Priority: 0
Remote Device	Timeout: 10	
Link Status	Size: 64 ·	DSCP: 0
Speed: 100Mb	Ports 3842	
ſ	Duration:	
	Duration: 30 seconds * Rate (bos):	□ Pass/Fail Jitter:
Apply Defaults	Duration: 30 seconds * Rate (bps): 672K *	Pass/Fail Jitter:

4. Running the Test without Dead Time

Run the test without the impairment to verify zero frame loss. Press Start to begin the active test. The screen will change to the Jitter Device Results. At the conclusion of the Duration, the Downstream - 64 bytes frame size row will display the number of frames used in the test and the number lost, in this case zero.

10	Upstream (local to remote) Jitter Results					
00	Status	Frame Size	Frames Rovd	Frames Lost	Jitte	
192.168.000.074						
Remote Device	MM				-	
IP: 192.168.000.074						
MAC: 00c017b629f7						
Local Device					-	
BO2.1Q: Disabled					-	
Pass/fail: n/a	Downstream (remote to local) Jitter Results					
Complete Elapsed time: 000.00:36	Complete	64	30.00K	0	198.9 n	
Dieplay Mada					-	
Frame loss Frame spacing					-	
					-	
View Mode						
Graph						
1001/b Conf			Start	Report	SCORE	

5. Characterizing the Dead Time

Run the test and create the dead time impairment during the duration of the test. At the conclusion of the test, the number of frames that were lost during the test is displayed in the Frames Lost column when in the Frame loss Display Mode (e.g. 2000 frames)

~n	Upstream (local to remote) Jitter Results					
00	Status	Frame Size	Frames Rovd	Frames Lost	Jitte	
192.168.000.074					-	
Remote Device					-	
IP: 192.168.000.074	=				1.00	
MAC: 00c017b629f7						
Local Device					-	
902.10: Disabled						
Pass/fail: n/a	Downstream (remote to local) Jitter Results					
Elapsed time: 000:00:35	- Complete	64	28.00K	2000	12.0 m	
Capitor and addition	=				-	
Diselau Mada						
Erame loss	=				-	
O Frame spacing	=					
View Mode						
Table						
Graph						
			Ob-ref.	Benert	5000	

Change the Display Mode to Frame spacing and the Max spacing column displays the maximum frame interarrival time which represents the dead time.

🔳 Jitter Device F	Results – Unt	itled	Ϋ́	k.	
	Upstream (local to remote) Jitter Results				
	Status	Frame Size	Min spacing	Max spacing	Jitter
192.168.000.074					
Remote Device					
IP: 192.168.000.074					
MAC: 00c017b629f7					
Local Device					
802.1Q: Disabled					
Pass/fail: n/a		Downstream (r	emote to local)	Jitter Results	
Complete Elapsed time: 000:00:35	- Complete	64	946.0 us	2.0 s	12.0 ms
- Dienlay Mode					
C Frame loss					
 Frame spacing 					

