

## 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 sub-millisecond 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

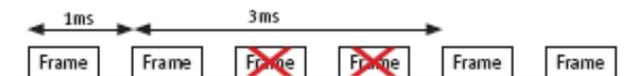
Configure an RFC throughput test to run for duration longer than the total test time required to capture the break, for example 60 seconds. First validate that the network is lossless in normal operation at 672 Kbps. The network dead time can then be characterized multiplying the # of lost frames by 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

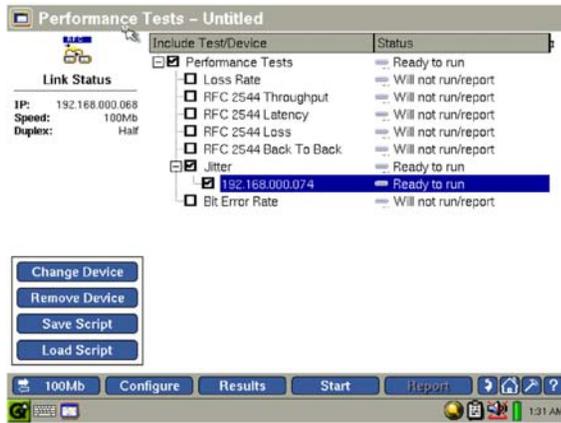
#### 1. Performance Test

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.

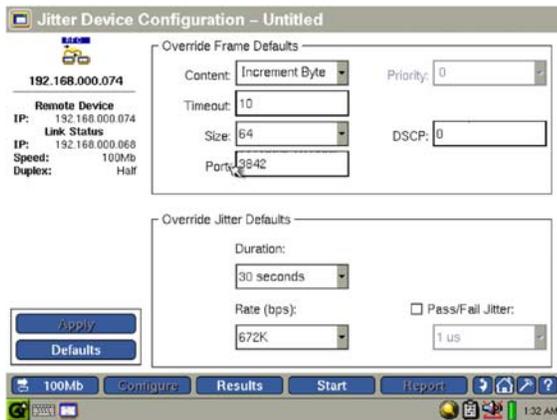


### 3. Configuring the Test Parameters

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

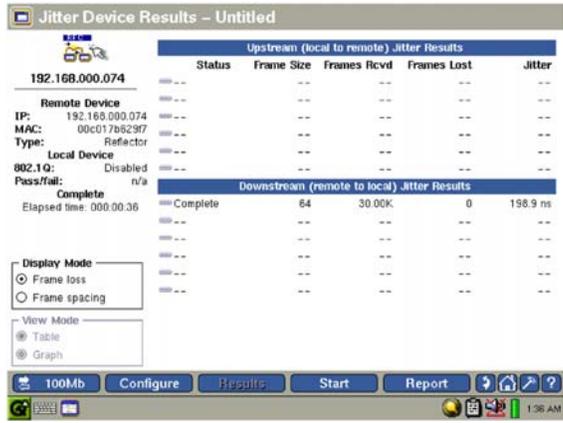
- Set the frame Size to 64
- Select the Rate field and using the keyboard enter a value of 672 K
- Select the desired Duration for the test (e.g. 30 seconds)

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



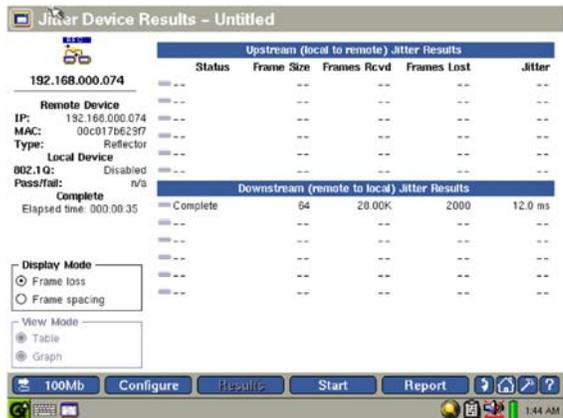
### 4. Running the Test without Dead Time

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.



### 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)



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

