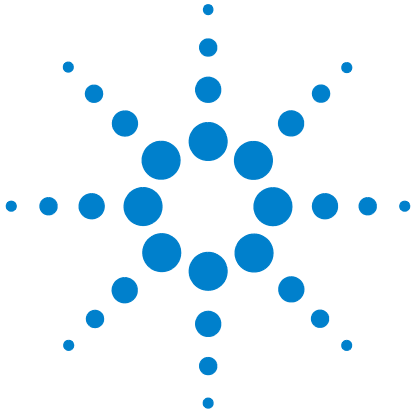

Agilent
RDX Test Platform for DigRFv4

User's Guide

Agilent Technologies

Notices

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Installation Guides

You can find the installation guides for different components of the product on the product CD. Agilent recommends you to do not switch on the instrument before you have understood all the applicable installation instructions and have met all the installation prerequisites.

Where to find more information

You can find more information about DigRF v4 from the following link:

http://www.agilent.com/find/DigRFv4

You can also look for search a local contact for assistance on the following link:

http://www.agilent.com/find/assist

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WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols on Instruments

Indicates warning or caution. If you see this symbol on a product, you must refer to the manuals for specific Warning or Caution information to avoid personal injury or damage to the product.

Frame or chassis ground terminal. Typically connects to the equipment's metal frame.

Indicates hazardous voltages and potential for electrical shock.

Indicates that antistatic precautions should be taken.

Indicates hot surface. Please do not touch.

Indicates laser radiation turned on.

CSA is the Canadian certification mark to demonstrate compliance with the Safety requirements.

CE compliance marking to the EU Safety and EMC Directives.

ISM GRP-1A classification according to the international EMC standard.

ICES/NMB-001 compliance marking to the Canadian EMC standard.

Safety Summary

General Safety Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

Agilent Technologies Inc. assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

General

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.

Environment Conditions

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.

Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.

Ground the Instrument

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Environmental Information

This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Agilent office, or see www.agilent.com/environment/product/ for more information.

Printing History

Agilent Technologies, Inc. can issue revisions between the product releases to reflect the latest and correct information in the guide. Agilent Technologies, Inc. also reserves its right to not issue a new edition of the guide for every system release.

Manual Name: Agilent RDX Test Platform for DigRF v4 - User's Guide

The edition number of the guide, publishing time of the guide, and applicable release number of the product are given in the following table.

Edition	Published	Applicable Release
1.2	August, 2011	1.9

Contents

What's New in this Release

The following are the new/key features of this release of RDX Test Platform for DigRFv4.

- Discontinuous transmission supported for signal frames. You can enable discontinuous transmission while generating a DigRFv4 compliant stimulus file using the Signal Inserter tool. To know more, refer to the Signal Inserter online help.
- For the GSM\EDGE TX and GSM\EDGE TX HUGE data formats, you can add Filler Symbols that you want to use per time slot. You can specify these filler symbols while generating a DigRFv4 compliant stimulus file using the Signal Inserter tool. To know more, refer to the Signal Inserter online help.
- A new set of APIs have been added to improve data upload speed. Refer to the API help to know more.
- In this release, it is possible to extract the IQ data directly using the newly added APIs instead of using the Signal Extractor tool in the Logic Analyzer GUI. The direct IQ data extraction is much faster than using the Signal Extractor tool. Based on the parameters that you specify for IQ data extraction, the new APIs fetch the required number of frames and extract the IQ data from these frames. You can save the extracted IQ data in a CSV file and use this file for further signal analysis in VSA. Refer to the API help to know more about the new APIs.
- The direct IQ data extraction using the new set of APIs is licensed. You need to have the appropriate hardware license to use these new APIs.

Refer to the **Release Notes** for details on the new features and known issues in this release.

0 What's New in this Release

1 Agilent RDX Test Platform for DigRFv4

This chapter introduces the RDX Test Platform for DigRFv4. It provides an overview of how you can use the components of this platform for testing, analysis, and debug of BBIC and RFIC. The chapter also describes the various software and hardware components that are a part of this platform.

Introduction to Agilent RDX Test Platform for DigRFv4

The RDX (Radio Digital Cross Domain) test platform for DigRFv4 is a comprehensive test solution to:

- test and validate an RFIC or a BBIC over the DigRF link by emulating the DigRF link partner.
- analyze and debug the captured control information and IQ data encapsulated in DigRF frames exchanged between a BBIC and an RFIC.

BBIC and RFIC Stimulation

By providing the stimulus capabilities over the DigRF link, the RDX test platform helps you test and validate that the DUT operates according to the DigRF v3 / v4 standards. You can test the DigRF data exchanged with an RFIC/BBIC over the DigRF TxData and RxData sublinks and detect protocol violations. Refer to the **Testing and Validating an RFIC or a BBIC over the DigRF Interface** help topics in this online help to know more.

Rx and Tx Data Capture and Analysis

You can capture the DigRF data either from the Tx or Rx line or simultaneously from both the lines over the DigRF link. You can then analyze the captured data using a variety of DigRF analysis tools to perform digital data analysis or pass it to Agilent's RF analysis tools for further RF analysis. Refer to the topics **Capturing/Getting the DigRF Data for Analysis** and **Analyzing the Captured DigRF Data** in this online help to know more.

RFIC Transmit and Receive Path Testing

Besides DigRF protocol level testing and analysis, the RDX test platform also enables you to do RF testing and analysis for an RFIC. To help you perform RF testing for an RFIC, the RDX test platform components interoperate with the Agilent RF stimulus and analysis tools such as Agilent Signal Studio software, Signal Generator, and 89600 VSA analysis software. Refer to the Cross Domain Testing of an RFIC on page 185 help topic in this online help to know more.

RDX test platform provides an integrated set of digital and protocol exercising and analysis tools interoperating with RF measurement tools for a complete test environment for

cross-domain RFIC testing. These tools together help you characterize the digital and wireless behavior of RFIC. The cross domain testing features can also help you rapidly verify and integrate DigRFv3 and DigRFv4 based RFIC and BBIC. Refer to the Testing BBIC and RFIC Integration on page 191 help topic in this online help to know more.

Features and Uses

This topic lists the key features and uses of the RDX Test Platform for DigRFv4.

Features

- Provides tools for the stimulus and analysis of the DUT in both the digital (baseband) and RF (Wireless) domains. The stimulus tool emulates protocol state machine as well.
- Supports the 3.9G (LTE, WiMAX/MIMO), 3G, and 2.5G Air Standards for stimulating an RFIC and a BBIC.
- Provides stimulus to test an RFIC or a BBIC over the DigRF link as per the DigRFv3, DigRFv4 version 60, or DigRFv4 version 70 protocol specifications. While emulating an RFIC or a BBIC, it can follow the DigRF ACK, NACK, and RETRAN mechanisms.
- Supports speeds up to 3 Gb/s.
- Allows single lane and multi lane configurations for a DigRF link to stimulate a DUT.
- Provides triggering capabilities. This includes:
  - setting a transmission pattern that will generate a trigger out pulse.
  - setting the trigger conditions that will start the capture of DigRF frames.
- Supports testing the RFIC/BBIC under error conditions by allowing you to inject selected errors in DigRF frames transmitted as stimulus over the DigRF link.
- Provides features to generate various types of DigRFv3 and DigRFV4 frames as stimulus.
- You can also customize the header, payload, behavior, and sequence of DigRF control nand data frames to be sent as stimulus to DUT over the DigRF link.
- Can simultaneously capture the Tx and Rx DigRF traffic exchanged over the DigRF link.
- Provides a number of analysis tools that interoperate with the exercising and capture tools to analyze the captured DigRF frames in digital and RF domains. Using these analysis tools, you can extract and transfer digital IQ from DigRF frames to Agilent 89601A VSA software for further analysis.

Uses

You can use various tools and components of the RDX test platform in multiple ways as per your testing requirements. Some of the broad uses in the context of the RDX test platform components are listed below. To know about the RDX test platform components, refer to the RDX Test Platform for DigRFv4 Components on page 19 topic.

- By using the Exerciser module as a stimulus provider over the DigRF link, you can emulate the missing link partner and test the DUT (RFIC/BBIC) in the absence of the other link partner. This also enables you to evaluate and tune the behavior of the DUT's components independent of the other link partner. By providing DigRF stimulus to a DUT, you can:
  - check DUT's responses.
  - test and validate DigRF protocol layer and DigRFv4 Link.
  - detect DigRF protocol errors in the frames received from DUT.
  - exercise protocol state machine.
  - inject DigRF errors in the frames transmitted to DUT to test the error recovery mechanisms of the DUT.
- By using the Exerciser module as a data capture tool, you can capture the Rx as well as Tx data between the Exerciser and DUT over the DigRF link. You can then analyze this captured data using a variety of DigRF Analysis tools to perform digital data analysis.
- By using the Analyzer module, you can capture and analyze the data from the Tx and Rx lines between an RFIC and BBIC over the DigRF link. Once the data is captured, you can analyze it using a variety of DigRF Analysis tools to perform digital data analysis or pass it to RF analysis tools for further analysis.
- By using the Exerciser/Analyzer module along with the Agilent RF stimulus and analysis tools, you can characterize the RFIC in digital and RF domains. You can provide RF and DigRF stimulus to test the RFIC over the DigRF and RF interface and then analyze the captured data in both domains.

- With the capabilities to characterize the interactions between the RFIC and BBIC, you can isolate defects and optimize performance. This is helpful in determining the root cause of problems during the integration process specifically when the RFIC and BBIC are developed by different vendors.

Refer to the topic Usage Scenarios for RDX Test Platform for DigRFv4 on page 24 to understand the overall working and usage of various components of RDX test platform in different possible combinations and configurations.

RDX Test Platform for DigRFv4 Components

This topic briefly describes the various components (hardware and software) that are a part of RDX Test Platform for DigRFv4. To get a detailed description of these components and how to set up and install these components, refer to the Hardware Guide and Installation Guide of the RDX Test Platform.

The following are the primary hardware and software components that comprise the RDX Test Platform.

- DigRF Exerciser Module (N5343A)
- DigRF Analyzer Module (N5344A)
- Chassis
- Probe
- System Controller
- RDX Test Platform software including the Logic Analyzer Software

These RDX test platform components interoperate with the Agilent RF tools such as VSA and Signal studio to provide RF domain testing features. However, these RF tools are not installed as a part of RDX test platform installation.

The following figure illustrates a sample setup of the RDX Test platform with all the components described later in this topic.

Figure 1 RDX Test Platform Components

Hardware Components

DigRF Exerciser Module (N5343A)

RDX Test platform provides the DigRF Exerciser module that you can use as a DigRF stimulus provider and as a DigRF data capture tool.

As a stimulus provider, it can emulate an RFIC or a BBIC and allows you to send customized stimulus (DigRF control and data frames) to an RFIC or a BBIC over the DigRF link.

As a capture tool, it provides the dual capture feature that allows you to capture the DigRF frames simultaneously from both Tx and Rx lines over the DigRF link between Exerciser and RFIC/BBIC.

You can plug the DigRF Exerciser module in either a 2 slot or a 4 slot chassis and then connect it to the DUT (RFIC/BBIC) using the N5443A DUT cable.

You can use the following GUIs to configure, manage, and use the stimulus and capture capabilities of DigRF Exerciser module. These GUIs are installed when you install the RDX Test platform software on the system controller.

- Agilent Protocol Exerciser for DigRF GUI
- DigRF Test Wizard GUI
- Agilent Logic Analyzer GUI

To know how to use these GUIs to perform stimulus and capture using the DigRF Exerciser module, refer to the help topics **Testing and Validating an RFIC or a BBIC over the DigRF Interface**.

DigRF Analyzer Module (N5344A)

RDX Test platform provides the DigRF Analyzer module to capture Rx and Tx traffic between a BBIC and an RFIC for analysis using the DgRF analysis tools. This module transparently monitors DigRF v3 and v4 bus activity, helping you integrate and troubleshoot RFIC/BBIC across a wide variety of over the air standards. This module along with a probe passively monitors and probes the DigRF link when the RFIC and BBIC are integrated.

You can plug the Analyzer module in either a 2 slot or a 4 slot chassis. You can use the Analyzer module alone or along with the DigRF Exerciser module to capture the data for

analysis. If used alone, you need to connect the Analyzer module to the DUT and capture the data using either a N5345A soft touch probe or a flying lead probe. If used with the Exerciser module, you need not connect it to the DUT as it connects to the Exerciser module to get the captured data for analysis.

The DigRF Analyzer module connects to the Agilent Logic Analyzer software to display the captured data for analysis. You use the Logic Analyzer GUI to configure, control, and use the DigRF Analyzer module to capture DigRF data over the DigRF link.

Refer to the help topics in **Capturing and Obtaining the DigRF Data for Analysis** to know more about the usage of the Analyzer module.

Chassis

You use the N5302A/N5304A Chassis (2 slot or 4 slot) to plug in the DigRF Exerciser and Analyzer module. The chassis is connected to the system controller using the LAN interface or the USB network adapter. Refer to the Hardware guide and Installation guide of RDX test platform to know more about chassis.

Probe

You can use either N5345A Soft Touch Probe or N5346A Flying Lead Probe to passively probe the DigRF link between the integrated RFIC and BBIC with minimal intrusion.

You use a probe with the DigRF Analyzer module to transparently monitor and capture Tx and Rx data over the DigRF link.

Refer to the Hardware guide for RDX test platform to know more about probes.

System Controller

A system controller hosts the software components of the RDX test platform. For instance, it hosts the Protocol Exerciser for DigRF GUI, DigRF Test Wizard, and Logic Analyzer GUI.

The system controller is connected to the chassis which has the DigRF Exerciser / Analyzer modules plugged in. To configure, control, and use the DigRF Exerciser or Analyzer

modules, you need to create a session between the system controller and the module using the appropriate RDX test platform GUI hosted on the system controller.

Refer to the topic Creating a DigRF Exerciser Session on page 38 to know more.

Software Components

RDX Test Platform Software including Logic Analyzer Software

The RDX Test Platform software provides various GUIs to configure, control, and use the DigRF Exerciser and Analyzer modules. The following table describes the purpose of some of the frequently used GUIs of the platform.

GUI	Purpose
Agilent Protocol Exerciser for DigRF GUI	Allows you to configure and use the DigRF Exerciser module to provide stimulus to DUT. You can use this GUI to: • configure the DigRF Exerciser module to create a DigRF link between the DigRF Exerciser and DUT. • create and customize the control and data frames that you want the DigRF Exerciser to send as stimulus to DUT. • start the stimulus flow as per the configured settings and frames. • view the status of the stimulus flow in terms of errors and the statistics for the sent and received frames.
DigRF Test Wizard	Allows you to configure and use the stimulus as well as capture capabilities of the DigRF Exerciser module. The DigRF Test Wizard provides guided step-by-step procedures to use the stimulus and capture capabilities of the DigRF Exerciser module in a simplified manner and perform basic Tx and Rx testing over the DigRF link. You can use it to provide DigRF stimulus to DUT and to capture the Tx or Rx data exchanged between DiigRF Exerciser and DUT. The wizard collects the required data and invokes the relevant screens of various GUIs when needed so that you do not have to struggle with the logical sequence of the different applications. The aim of this wizard is to minimize the complexity and enable you to set up a test scenario with minimum effort. The wizard launches different applications such as Signal Inserter, Logic Analyzer, VSA, Protocol Exerciser for DigRF GUI as required by the test scenario, with appropriate settings.
Agilent Logic Analyzer GUI	Allows you to configure and use the capture capabilities of DigRF Exerciser and DigRF Analyzer modules. The Agilent Logic Analyzer software is installed when you install the RDX test platform software. In the RDX test platform, Logic Analyzer software is integrated with the DigRF Exerciser and Analyzer modules to provide comprehensive features for the capture, display, extraction, and analysis of the DigRF data.

GUI	Purpose
DigRF Analysis tools and utilities	Agilent Logic Analyzer software provides a number of DigRF Analysis tools and utilities such as: • **Packet Decoder** to decode the DigRF packets captured using the DigRF Exerciser/Analyzer modules. • **Packet Viewer** to view the decoded packets in the Logic Analyzer GUI. • **Signal Extractor** to extract digital IQ data from the captured DigRF packets and do signal analysis or pass the data to the 89601A VSA software for RF domain analysis. • **Signal Inserter** to generate DigRF frames from the input IQ data to use these frames as stimulus to DUT.

You create a session between the GUIs and the DigRF Exerciser/Analyzer module to configure and start the stimulus / capture flow.

Usage Scenarios for RDX Test Platform for DigRFv4

RDX Test platform is a flexible and a scalable test solution providing options to set up, configure, and use its software and hardware components in different combinations to suit your specific test scenario.

This topic describes some usage scenarios of the RDX test platform depicting how its various components (hardware and software) are set up in that scenario to work together as RDX Test Platform.

Active DigRF protocol level testing and validating a DUT independently

In active DigRF testing scenarios, DigRF Exerciser emulates the peer device and communicates with the DUT (RFIC/BBIC) as an active DigRF link partner over the DigRF link. You can use either the stimulus or capture or both capabilities of DigRF Exerciser to actively test a DUT. The active testing scenarios are described below.

Providing DigRF Stimulus to an RFIC/BBIC for DigRF testing

You can test an RFIC or a BBIC at the DigRF protocol level by stimulating it using the DigRF Exerciser module. DigRF Exerciser can emulate an RFIC or a BBIC to act as the DigRF link partner and exercise and stimulate the DUT with various customized DigRF control and data frames.

By emulating an RFIC or a BBIC, DigRF Exerciser lets you test the DUT independently for DigRF protocol compliance without the peer device availability or interference.

The following figure depicts an example of this usage scenario where DigRF Exerciser emulates a BBIC.

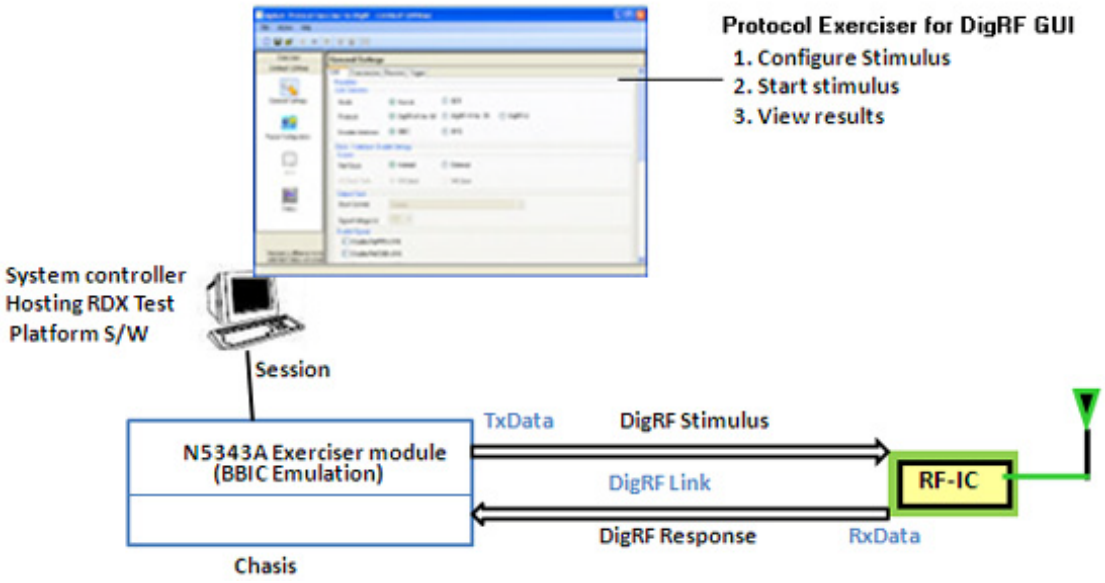


Figure 2 RFIC Stimulus Example

In the above figure, DigRF Exerciser is sending DigRF stimulus to the DUT (RFIC) over the configured DigRF link. The link and stimulus frame configurations are as per the settings done using the Protocol Exerciser for DigRF GUI or DigRF Test Wizard hosted on the system controller. Using these GUIs, a session is created to interact with the DigRF Exerciser hardware to configure and use it for stimulus. When DigRF stimulus is started, DigRF Exerciser sends the configured sequence of frames with a configured timing to DUT and checks the DigRF frames sent by DUT. Accordingly, the status is updated in the applicable GUI (DigRF GUI or DigRF Test Wizard). Using the status information, you can view the DigRF protocol errors that DigRF Exerciser detected in DigRF frames received from the DUT. You can also view the hardware statistics in terms of the number of frames, ACKs, NACKs, etc that the DigRF Exerciser sent and received from DUT over the DigRF link.

Refer to the **Providing DigRF Stimulus to an RFIC or a BBIC** and **Performing DigRF Protocol Level Testing** topics to know more about how to use DigRF Exerciser as a DigRF stimulus provider.

Capturing Tx and Rx DigRF data for digital analysis

You can use DigRF Exerciser to capture the DigRF frames exchanged over the DigRF link for debug and analysis at the digital level. You can capture DigRF data from the Tx and Rx lines simultaneously.

When you want to capture DigRF data from both Tx and Rx lines simultaneously while providing stimulus, you can use the DigRF Exerciser's dual capture feature. Using this feature, you can capture the traffic flowing both ways, that is from the DUT and to the DUT. For dual capturing, Exerciser performs time-correlated capturing that is, it captures the Rx data in relation to the Tx data.

Logic Analyzer software is integrated with the DigRF Exerciser module to get the captured data from this module and display it for analysis.

The following figure depicts a dual capture usage scenario using the DigRF Exerciser module. In this scenario, both the stimulus and capture capabilities of DigRF Exerciser module have been used.

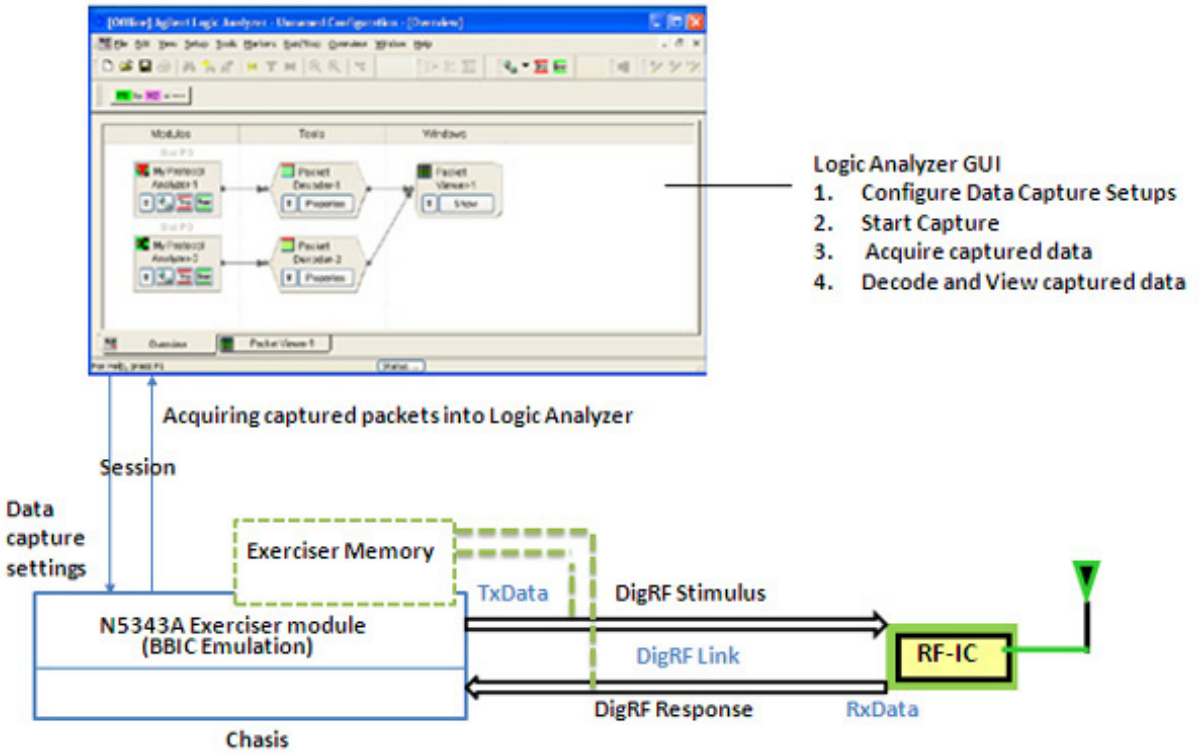


Figure 3 Data capture usage scenario

In the above figure, a connection has been made to a DigRF Exerciser module by creating a session between Logic Analyzer software and DigRF Exerciser module. Using this session, you configure, control, and start the data capture and obtain the captured data from DigRF Exerciser memory and display it in the Logic Analyzer GUI. Once the DigRF packets are available in the Logic Analyzer GUI, you can add DigRF Analysis tools in the Logic Analyzer GUI to analyze the captured data. For instance, Packet Decoder and Packet Viewer are used in the above figure to decode and view the captured DigRF data. You can also use Signal Extractor to extract digital I/Q data from the captured frames and display it with Listing or Waveform windows or send it to the 89601A VSA software for further analysis.

Refer to the topics Configuring a Tx or Rx Data Capture Setup on page 91, Configuring a Dual Capture Setup on page 98, and Obtaining/Acquiring the Captured Data on page 109 to know more about how to use the DigRF Exerciser / Analyzer modules to capture data and how to analyze it using the DigRF Analysis tools.

RFIC characterization in digital and RF domains

You can do the complete testing of the Transmit and Receive paths of an RFIC in digital and RF domains using the Agilent RF tools in combination with RDX test platform components. Together, these provide digital stimulus and analysis for the digital IQ data and RF stimulus and analysis for the RF antenna side to help you do cross domain testing of an RFIC.

You can validate whether or not the RFIC is able to:

- generate the digital IQ data and packetize it in DigRF frames for transmission over the DigRF link to BBIC.
- receive the DigRF frames from BBIC over the DigRF link, depacketize these into IQ data, and transmit over the air interface.

The following figure depicts the usage of RDX test platform with Agilent RF tools to do RFIC testing in digital and RF domains.

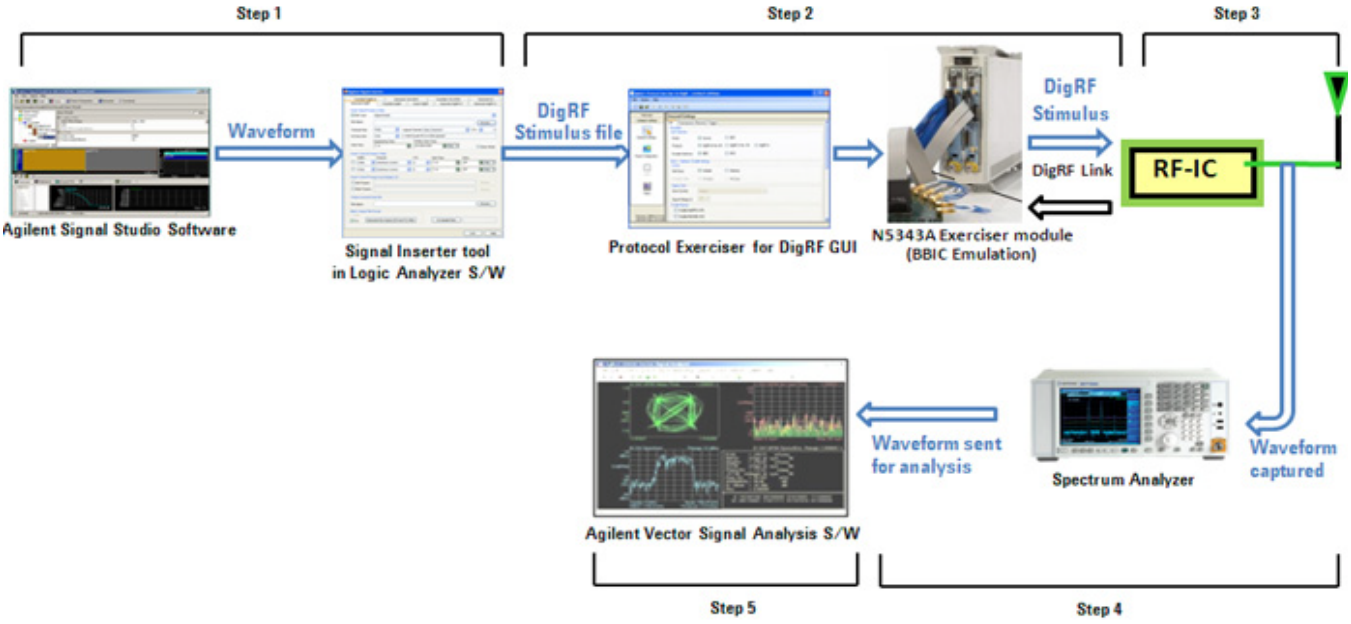


Figure 4 RFIC Testing

In the above figure, the RFIC transmit path (transmitting to air interface) testing is done. Refer to the topic Cross Domain Testing of an RFIC on page 185 to get a detailed description.

Passive testing for RFIC and BBIC integration issues

When the RFIC and BBIC are integrated, you can passively probe the DigRF link between these ICs using the DigRF Analyzer module. This enables you to monitor the link transparently with non intrusive probing. The probe captures the data exchanged between an RFIC and a BBIC and provides it to the DigRF Analyzer module. You can view the captured data in Logic Analyzer and then analyze it using various DigRF Analysis tools.

The following figure depicts this usage scenario.

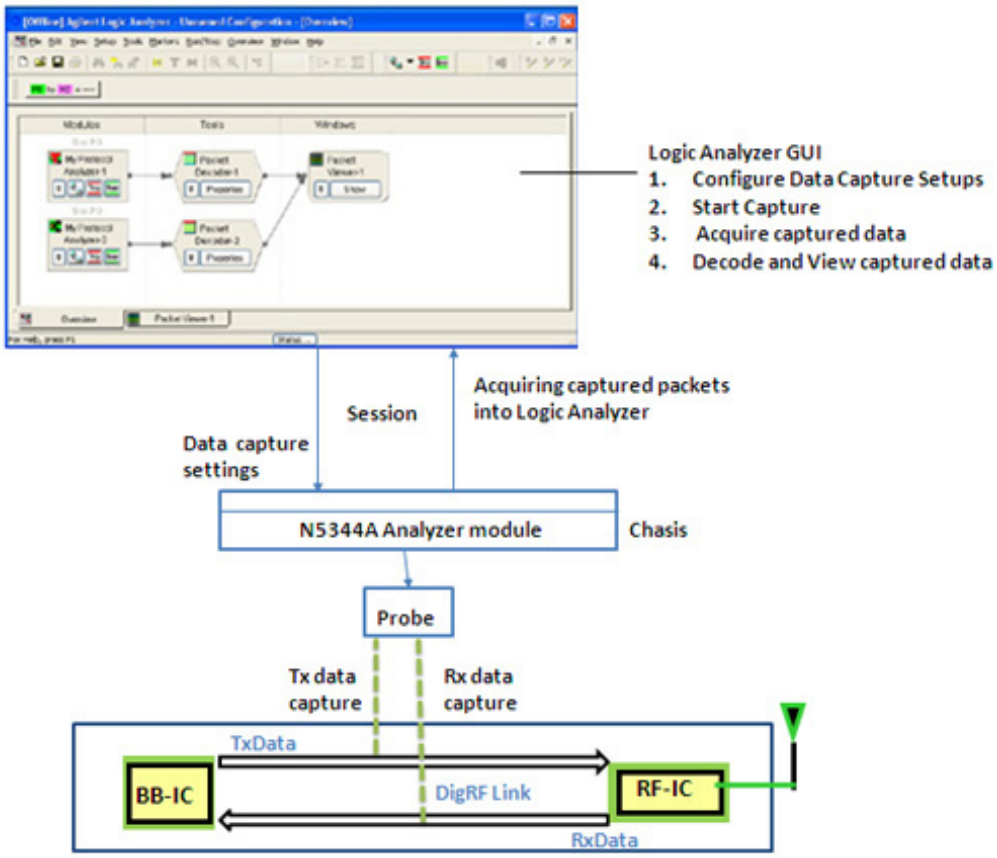


Figure 5 Passive testing

In the above figure, a probe is used on a DigRF link between an RFIC and a BBIC to capture Tx and Rx data. A session is created between the Logic Analyzer software and DigRF Analyzer module to configure the data capture settings and acquire the captured data from the DigRF Analyzer module's memory to Logic Analyzer GUI. The data capture is started from the Logic Analyzer GUI and captured data is decoded, viewed, and analyzed using the DigRF Analysis tools in Logic Analyzer GUI. The captured data helps you analyze whether or not the BBIC and RFIC work together and identify any integration issues between these. Refer to the topic Testing BBIC and RFIC Integration on page 191 to get a detailed description.

1 Agilent RDX Test Platform for DigRFv4

2
Adding and Viewing Available Licenses

The RDX Test Platform configuration can include either the DigRF Exerciser module (N5343A) or the DigRF Analyzer module (N5344A) or both these modules in the chassis.

Appropriate licenses are available for each of these two modules to get the required stimulus and capture capabilities. For instance, if you want to use the capture capabilities of Exerciser, you can add the N5343A Exerciser capture license for DigRF V3 or V4. Or if you want to use the dual capture feature of Exerciser, you can add the Dual capture license for the Exerciser module.

You use the **License Programmer** tool to add new licenses for Exerciser and Analyzer modules. You can access this tool by clicking **Start** > **Programs** > **Agilent RDX for DigRF** > **License Programmer** option on the Windows task bar.

The following screen displays this tool. The licenses available for the N5343A Exerciser module are displayed.

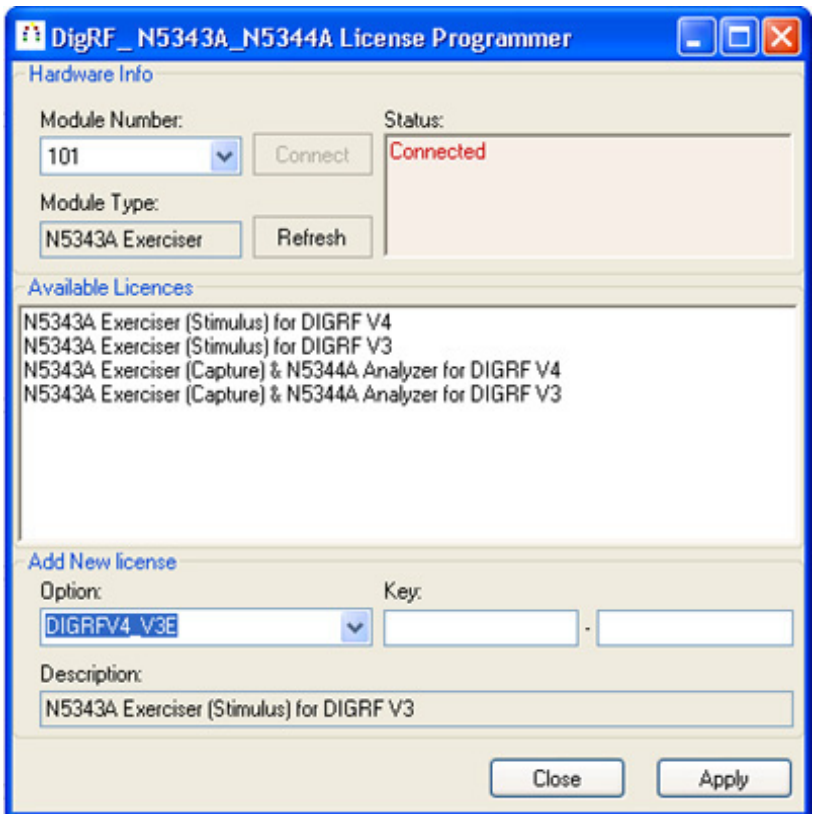


Figure 6 License Programmer

To add a new license for a module:

1. From the **Module Number** drop-down listbox, select the module number for the Exerciser or Analyzer module for which you want to add a license.
2. Based on the module number that you select, the **Module Type** is displayed.
3. Click **Connect**.
4. When the status is **Connected**, the licenses available for the selected module are displayed in the **Available Licenses** list.
5. Select the required license from the **Option** drop-down listbox in the **Add New license** section. A description of the selected license is displayed in the **Description** field.
6. Specify the license key.
7. Click **Apply**.

3 Testing and Validating an RFIC or a BBIC over the DigRF link

This chapter describes how you can test and validate a BBIC or an RFIC over the DigRF link by using:

- the stimulus capabilities of the DigRF Exerciser module.
- the capture capabilities of the DigRF Exerciser and Analyzer modules.

This chapter also provides some examples of how you can use the stimulus results and the captured DigRF data to perform DigRF protocol testing and analysis.

Providing DigRF Stimulus to an RFIC or a BBIC

Overview

To provide DigRF stimulus to an RFIC or a BBIC, you use the stimulus capabilities of the DigRF Exerciser module. This module provides two GUIs - **Protocol Exerciser for DigRF** and **DigRF Test Wizard** to configure and start the stimulus flow.

The following diagram illustrates the basic sequence of the stimulus flow in RDX test platform followed by a brief description of this flow.

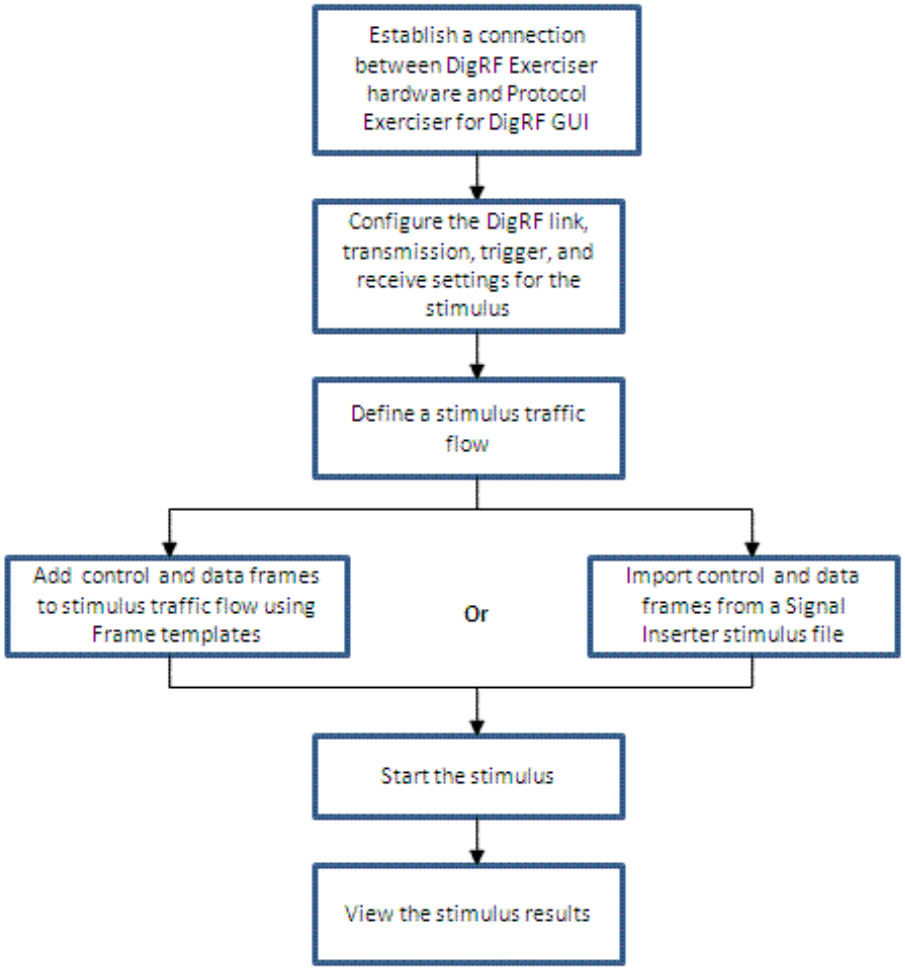


Figure 7 Stimulus flow

The topics that follow describe how to configure and start the stimulus using the Protocol Exerciser for DigRF and DigRF Test Wizard GUIs.

Generating DigRF Stimulus Using the Signal Inserter tool

You can generate DigRF stimulus to stimulate an RFIC or a BBIC from DigRF Exerciser emulating the other link partner by using the following two ways:

- Generating a DigRF stimulus file having a sequence of data ad control frames using the Signal Inserter tool.
- Creating data and control frames using the frame templates available in the Protocol Exerciser for DigRF GUI or the DigRF Test Wizard GUI. Refer to the topicUsing Default Set of Data and Control Frame Templates on page 55.

This topic describes how you can generate a DigRF stimulus file using the Signal Inserter tool. This tool converts the raw IQ data and user-defined control information to DigRF compliant data and control frames in a DigRF stimulus file. After generating the DigRF stimulus file, you can import the frames contained in this file into the Frame Configuration page of the Protocol Exerciser for DigRF GUI. These imported frames can then be sent as stimulus to DUT. Refer to the topic Importing DigRF Frames from a Signal Inserter Stimulus File on page 62 to know more.

A stimulus file created using Signal Inserter can ease the procedure of setting up or initializing a DUT by sending stimulus in a predefined controlled sequence.

You can insert either the control or data frames or a combination of both control and data frames in a stimulus file generated using Signal Inserter.

The following are the key components in the generation of a DigRF v4 compliant stimulus file using Signal Inserter:

- **Input signal file for generation of data frames** - In Signal Inserter, you can use an IQ data signal file as the input file for the generation of DigRF data frames. Signal Inserter supports various types of file formats for this input signal file. For instance, you can use a signal file generated using Agilent's Signal Studio software as the input file or a two column ASCII decimal file as the input file format.

- **Settings for the generation of DigRF packets from the input signal data** - You specify the DigRF related settings such as Data format or customized IQ data size and number of IQ pairs and the data rate. Based on these settings, Signal Inserter generates DigRF frames from the input signal data.
- **Input file for the generation of control frames** - You specify the ASCII format CSV input files to insert control frames in the Init and Main blocks of DigRF Exerciser while providing stimulus.
- **Output Signal Inserter stimulus file** - You specify the name and location of the output Binary Data file (.bdf) and Licensed Binary Data File (.ldf) that you can use as the DigRF stimulus file. Based on the input signal file and input files for control frames, Signal Inserter generates DigRF data and stores this data in the specified output file. The output files (.bdf and .ldf) are generated along with the TCL script.

To generate a DigRF stimulus file

1 Launch the Signal Inserter tool by clicking Start > Programs > Agilent Logic Analyzer > Signal Inserter option on the Windows task bar.

The **Agilent Signal Inserter** tool is displayed.

2 There are following tabs to generate DigRF stimulus.

- Click the **Generate DigRFv3** tab to generate a DigRF V3 complaint stimulus file.
- Click the **Generate DigRFv4** tab to generate a DigRF V4 complaint stimulus file.

3 Click the **Help** button to get a detailed description of fields in each of these tabs.

4 After specifying the input files, DigRF settings, and output file name and location, click the **Generate the Output LDF and TCL files** button.

Signal Inserter file - Example

The following screen displays the options set in Signal Inserter to generate a DigRFv4 complaint stimulus file containing a sequence of data frames of the LTE R8 Rx format. A Signal Studio file (.wfm) is used as the input signal file. HS Primary 1.x has been selected as the speed mode for the transmission of these data frames as stimulus to BBIC.

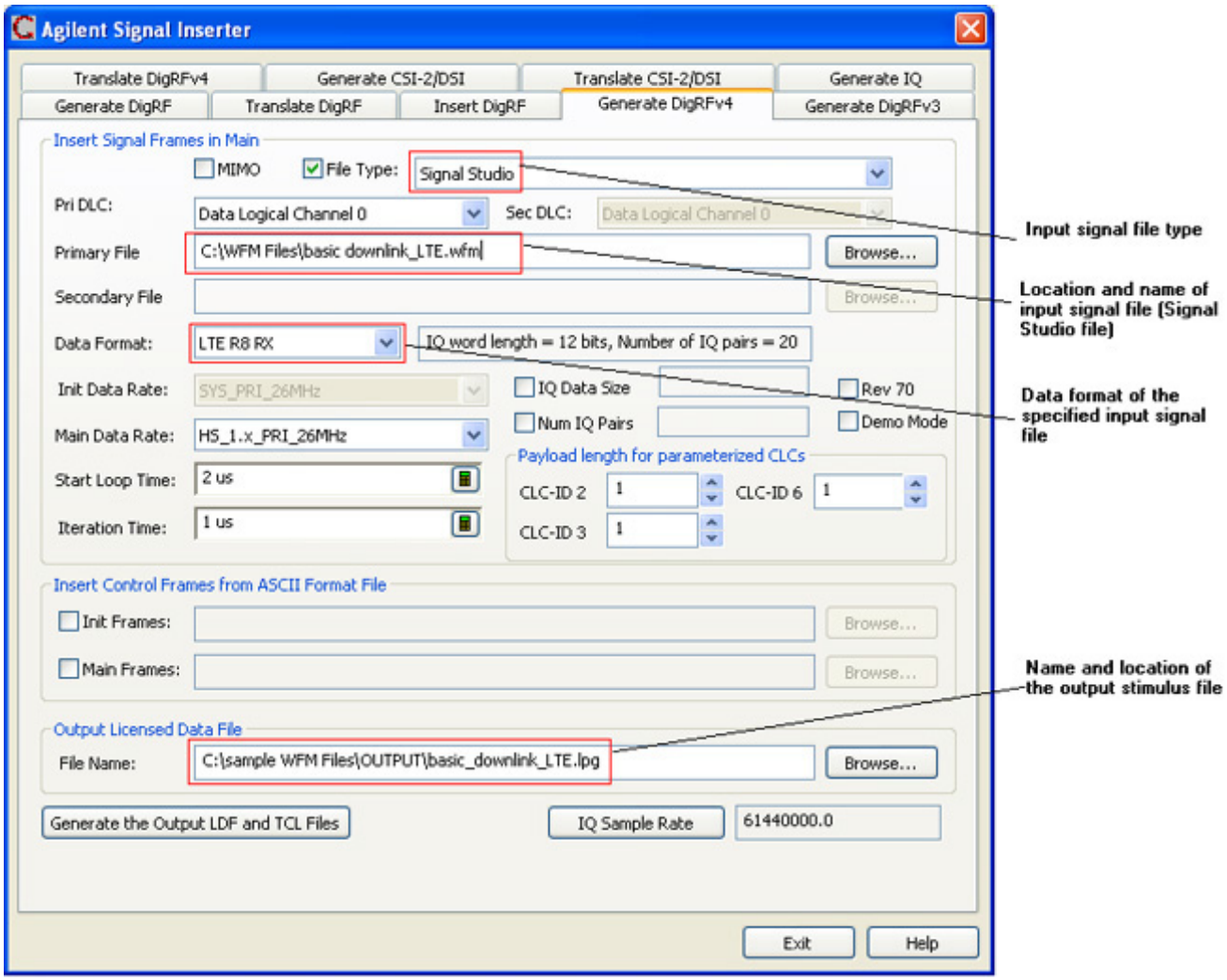


Figure 8 Settings for a DigRFv4 compliant stimulus file

As per the settings displayed above, the following three files are generated at the specified location on clicking the Generate the Output LDF and TCL files button:

- Basic_downlink_LTE.lpg
- Basic_downlink_LTE.ldf
- Basic_downlink_LTE.bdf
- Basic_downlink_LTE.tcl

DigRF frames from the Basic_downlink_LTE.ldf and Basic_downlink_LTE.bdf file can be imported in the Protocol Exerciser for DigRF GUI to send these data frames as stimulus. Refer to the topic Importing DigRF Frames from a Signal Inserter Stimulus File on page 62.

Configuring DigRF Exerciser for DigRF Stimulus

Creating a DigRF Exerciser Session

To use DigRF Exerciser to provide stimulus to an RFIC or a BBIC, you need to create a DigRF Exerciser session using the Protocol Exerciser for DigRF GUI. This session enables you to establish communication between the Protocol Exerciser for DigRF GUI hosted on the system controller and the DigRF Exerciser hardware. Once the session is created, you can use the Protocol Exerciser for DigRF GUI to configure, control, manage, and use the DigRF Exerciser module for stimulus.

You can create a DigRF Exerciser Session in the following two modes:

- **Online** - You use this mode when the system controller is connected to the DigRF Exerciser hardware. In this mode, you either create a new DigRF Exerciser session with the system controller or join an existing session on the system controller. Multiple clients can remotely connect to a single DigRF Exerciser session on the system controller.
- **Offline** - If you want to use the Protocol Exerciser for DigRF GUI without being connected to the DigRF Exerciser hardware, select the offline mode. You can use this mode when you want to create configuration specifications to be used later when an online session is established. Some GUI options are disabled in the offline mode due to their dependency on the connected hardware. For instance, the Run option is not available to start the stimulus and the status information is not available in the offline mode.

To create/use a DigRF Exerciser session:

1 Launch the Protocol Exerciser for DigRF GUI by clicking **Start > Programs >Agilent RDX for DigRF > Exerciser for DigRF** option on the Windows task bar.

  The **Select type of session** window is displayed.

2 Select the **Connect Offline** radio button and click **Start** to use the Protocol Exerciser for DigRF GUI in an offline mode.

3 To use an existing DigRF Exerciser session,

   a Select the **Connect to existing session** radio button.

   b In the **Server** text box, specify the name or IP address of the system controller that hosts the Protocol Exerciser for DigRF GUI and on which you want to use an existing session.

   The Session list listbox displays the list of DigRF Exerciser sessions existing on the specified server.

   c Select a session from the **Session list** listbox.

   d Click **Start**.

4 To create a new DigRF Exerciser session:

   a Select the **Connect to new session** radio button.

   b In the **Server** text box, specify the name or IP address of the system controller that hosts the Protocol Exerciser for DigRF GUI and on which you want to create a new session.

   c Click **Start**.

   The **Port Selection** dialog box is displayed. It displays a list of the DigRF Exerciser/Analyzer modules that you have added to the chassis.

   d Select the checkbox displayed in front of the DigRF Exerciser module with which you want to create a session.

   e Click **OK**.

The **Agilent Protocol Exerciser for DigRF** window is displayed. Depending on the selected mode of usage (online or offline), some GUI features are enabled/disabled.

Performing BER Testing

You can verify or debug the physical link between the transmitter and receiver side of the DigRF Exerciser to test that the physical link is set before moving on to the logical protocol layer. You do this by switching to the BER (Bit Error Rate) mode in the Protocol Exerciser for DigRF GUI. In this mode, you do basic line testing to get bit-error rate on a physical link.

Using the BER mode testing, you can send bits to the receiver side of DigRF Exerciser from its transmitter side. The count of the total bits and error bits received by the receiver side of the DigRF Exerciser are displayed as results of the BER testing.

To do BER testing:

1 Launch the Protocol Exerciser for DigRF GUI by clicking **Start** > **Programs** > **Agilent RDX for DigRF** > **Exerciser for DigRF** option on the Windows task bar.

   The **Select type of session** window is displayed.

2 Create a new session or use an existing session with the DigRF Exerciser module. Refer to the topic Creating a DigRF Exerciser Session on page 38 to know more about sessions.

   The **Agilent Protocol Exerciser for DigRF** window is displayed.

3 Click **General Settings**.

4 Select the **Link** tab.

5 Select **BER** as the **Mode** in the **Link Selection** group box.

   Selecting the BER mode disables all the Link options except the Lane settings and Speed options.

6 In the **Lane Settings** group box, select the number of lanes and their polarity for the Rx and Tx sublinks in the BER mode.

7 Select the speed to be used for the Tx and Rx sides of DigRF Exerciser in the BER mode.

8 Apply the settings by clicking the **Apply** button.

   On applying the BER mode settings, the BER icon is enabled in the navigation pane of the GUI.

9 Click the **BER** icon.

   The **BER** page is displayed.

10 Start sending bits from the transmit side of the DigRF Exerciser to its receiver side by clicking the **Start** button.

11 Click **Snap** to update the status of the total bits and error bits. Alternatively, select the **AutoUpdate** checkbox to automatically update the **Total Bit Count** and **Error Bit Count**.

To get a detailed description of a field in the BER page, refer to the BER page GUI Reference in this online help.

While doing BER testing, you can also insert errors in transmission by clicking the **Insert error** icon in the BER page. The following screen displays status on the BER page when errors are inserted in the transmission.

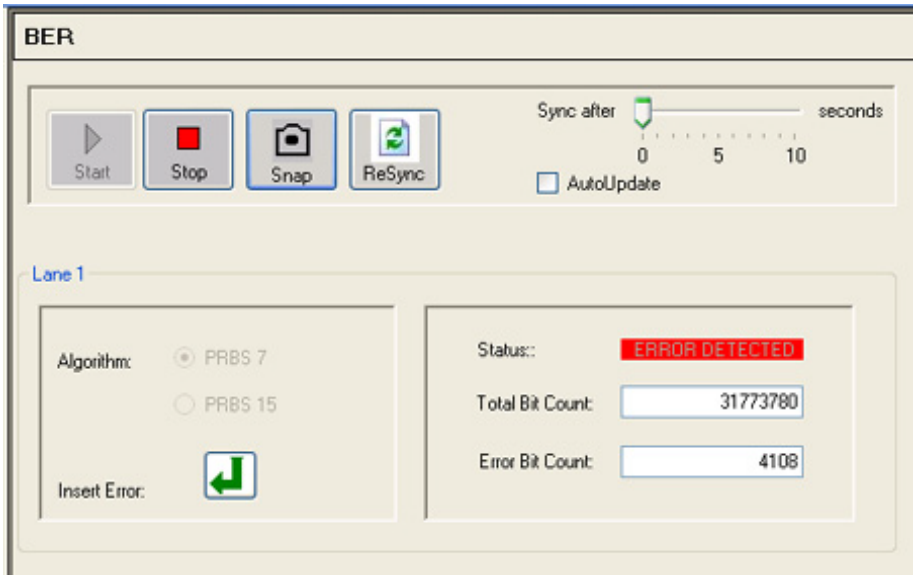


Figure 9 BER Results

Configuring a DigRF Link between DigRF Exerciser and DUT

When you want to use DigRF Exerciser to provide stimulus to an RFIC or a BBIC, the first task that you need to perform is to create a DigRF link between DigRF Exerciser and DUT. DigRF frames (data and control) are exchanged between DigRF Exerciser and DUT over this link.

DigRF Exerciser creates a link based on the link properties that you configure using the Protocol Exerciser for DigRF GUI.

Before configuring the link properties, decide the DigRF protocol version for which you want to test the DUT and the emulation mode (RFIC or BBIC) of the DigRF Exerciser. The link settings differ based on these choices.

To configure a DigRF link properties for the stimulus:

1 Launch the Protocol Exerciser for DigRF GUI by clicking **Start > Programs >Agilent RDX for DigRF > Exerciser for DigRF** option on the Windows task bar.

  The **Select type of session** window is displayed.

2 Select the type of session you want to create with the DigRF Exerciser module (online or offline). Refer to the topic Creating a DigRF Exerciser Session on page 38 to know more about sessions.

   The **Agilent Protocol Exerciser for DigRF** window is displayed.

3 Click **General Settings**.

4 Select the **Link** tab.

5 Configure the link properties. To get a detailed description of each field in the Link tab, refer to the General Settings - Link Tab on page 205 topic in this online help. Alternatively, click the Help button displayed in the link tab page to get a context-sensitive help page.

6 Save the link properties in a DigRF Exerciser setup file (.dxs file) by clicking File > Save. Refer to the topic Saving the DigRF Exerciser Stimulus Configurations on page 46 to know more about these setup files.

Configuring DigRF Exerciser Transmission Settings

The Transmission settings control and impact the transmission of DigRF frames that DigRF Exerciser transmits to DUT over a configured DigRF link. For instance, for a DigRF V4 link, you can set whether or not you want DigRF Exerciser should retransmit a frame in case DUT encounters an error in the transmitted frame and requests retransmission.

You configure these transmission settings using the Protocol Exerciser for DigRF GUI. These settings are applicable for the DigRF link between the DigRF Exerciser and DUT that you configured in the Link tab of the Protocol Exerciser for DigRF GUI.

To configure transmission settings for the DigRF Exerciser:

1 Launch the Protocol Exerciser for DigRF GUI by clicking **Start > Programs >Agilent RDX for DigRF > Exerciser for DigRF** option on the Windows task bar.

   The **Select type of session** window is displayed.

2 Select the type of session you want to create with the DigRF Exerciser module (online or offline). Refer to the topic Creating a DigRF Exerciser Session on page 38 to know more about sessions.

   The **Agilent Protocol Exerciser for DigRF** window is displayed.

3 Click **General Settings**.

4 Select the **Transmission** tab.

5 Configure the transmission properties. To get a detailed description of each field in the Transmission tab, refer to the General Settings - Transmission Tab on page 211 topic in this online help. Alternatively, click the Help button displayed in the link tab page to get a context-sensitive help page.

6 Save the transmission properties in a DigRF Exerciser setup file (.dxs file) by clicking File > Save. Refer to the topic Saving the DigRF Exerciser Stimulus Configurations on page 46 to know more about these setup files.

Configuring DigRF Exerciser Receive Settings

The Receive settings are applicable for the DigRF frames that DigRF Exerciser receives from DUT over a configured DigRF link. For instance, these settings let you define the frame level checks that you want DigRF Exerciser to perform on the frames received from DUT in a stimulus flow. You can set whether or not DigRF Exerciser should check the received frames for the CRI number assigned to the frames.

You configure these settings using the Protocol Exerciser for DigRF GUI. These settings are applicable for the frames received over the DigRF link that you configured in the Link tab of the Protocol Exerciser for DigRF GUI. Refer to the Configuring a DigRF Link between DigRF Exerciser and DUT to know how to configure a DigRF link.

The following screen displays the Receive settings for a DigRFv4 link. These settings are not applicable for a DigRF V3 link.

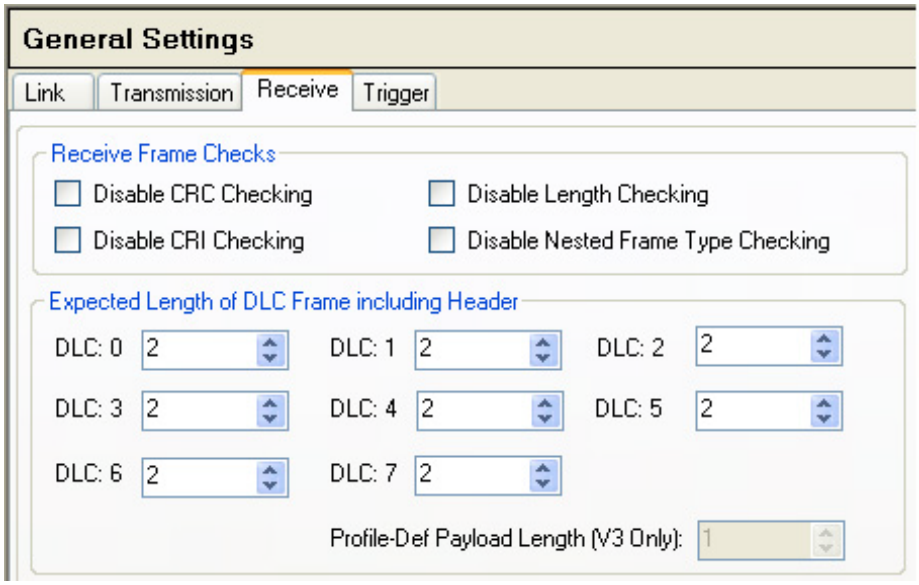


Figure 10 Receive tab

Based on the Receive settings, DigRF Exerciser checks the received frames and reports errors in the Status page of the Protocol Exerciser for DigRF GUI. For instance, if you enabled length checking and a received frame crosses the expected length of frames that you specified for that DLC type in the Receive settings, then it is reported as a **Frame with length error** in the Status page. Similarly, if you enabled CRI checking on the received frames, then DigRF Exerciser reports a **CRI error** in the Status page if a received frame has missing CRI.

To configure the receive settings for DigRF Exerciser:

1 Launch the Protocol Exerciser for DigRF GUI by clicking Start > Programs >Agilent RDX for DigRF > Exerciser for DigRF option on the Windows task bar.

The **Select type of session** window is displayed.

2 Select the type of session you want to create with the DigRF Exerciser module (online or offline). Refer to the topic Creating a DigRF Exerciser Session on page 38 to know more about sessions.

The **Agilent Protocol Exerciser for DigRF** window is displayed.

3 Click **General Settings**.

4 Select the **Receive** tab.

5 Configure the receive properties. To get a detailed description of each field in the Receive tab, refer to the General Settings - Receive Tab on page 214 topic in this online help. Alternatively, click the Help button displayed in the link tab page to get a context-sensitive help page.

6 Save the receive properties in a DigRF Exerciser setup file (.dxs file) by clicking **File** > **Save**. Refer to the topic Saving the DigRF Exerciser Stimulus Configurations on page 46 to know more about these setup files.

Configuring a Trigger Out on the Stimulus Transmission

While testing a DUT, you may want that when a specific frame is transmitted as stimulus to DUT, a trigger out pulse should be generated. The trigger out pulse can allow you to configure alerts, events, or actions such as capture or analysis from another test equipment in response to the trigger.

You can specify the pattern in the transmitted data that should generate a trigger using the **Trigger** tab in the Protocol Exerciser for DigRF GUI. When DigRF Exerciser transmits a DigRF frame to DUT matching the specified pattern, a trigger out pulse is generated from DigRF Exerciser to another test equipment. You can configure actions such as alerts, events, or data capture in response to such a trigger on this test equipment.

Trigger out pulse

The DigRF Exerciser module has a component, namely Trigger Out Connector. When the specified trigger condition is met, this component is used to generate a trigger out pulse from DigRF Exerciser to other test equipments such as Logic Analyzer, DigRF Analyzer, Oscilloscope, or any other test equipment. The trigger out pulse is generated at a fixed frequency and it is a Sharp edge pulse. However, you can configure the duration of the trigger out pulse using the AGT_DIGRF_PROP_TRIGGER_OUT_PULSE_DURATION property. Refer to the API help to know more.

Trigger out pattern

You can specify a control frame of a specific CLC type and payload or a data frame of a specific DLC type and payload as the pattern in the transmission that should generate the trigger.

To configure a trigger out on the stimulus transmission:

1 Launch the Protocol Exerciser for DigRF GUI by clicking **Start** > **Programs** > **Agilent RDX for DigRF** > **Exerciser for DigRF** option on the Windows task bar.

   The **Select type of session** window is displayed.

2 Select the type of session you want to create with the DigRF Exerciser module (online or offline). Refer to the topic Creating a DigRF Exerciser Session on page 38 to know more about sessions.

   The **Agilent Protocol Exerciser for DigRF** window is displayed.

3 Click **General Settings**.

4 Select the **Trigger** tab.

5 Select the **Enable Pattern** checkbox. By default, the trigger pattern on transmission is disabled.

6 Select the **Control** or **Data** radio button to specify whether you want a control frame or a data frame in the transmission to generate a trigger out pulse. If you do not want to distinguish the pattern based on the type of frame, Control or Data, then select **Don't care**.

   If you selected the **Control** radio button, the Control frame group box is enabled to specify the details of the control frame pattern to be used to generate a trigger out.

   If you selected the **Data** radio button, the Data frame group box is enabled to specify the details of the data frame pattern to be used to generate a trigger out.

7 Click **Apply** to confirm the settings.

8 You can save the trigger properties in a DigRF Exerciser setup file (.dxs file) by clicking **File** > **Save**. Refer to the topic Saving the DigRF Exerciser Stimulus Configurations on page 46 to know more about these setup files.

Refer to the topic Example - DigRF Stimulus on page 79 to get an example of a trigger out on the stimulus transmission.

Saving the DigRF Exerciser Stimulus Configurations

DigRF Exerciser creates a link and provides DigRF stimulus to an RFIC / BBIC based on the settings that you configure in the General Settings page of the Protocol Exerciser for DigRF GUI. You can save these settings in the DigRF

Exerciser setup file. You can also create multiple setup files for DigRF Exerciser emulation interfaces and different testing scenarios with DUTs.

The following table lists the settings in the Protocol Exerciser for DigRF GUI that are saved or not saved in the DigRF Exerciser setup file.

Link settings	Saved
Transmission settings	Saved
Receive settings	Saved
Trigger settings	Saved
User defined control and data frame templates	Saved
Traffic flow graph	Not Saved
Control and data frames that you added to different traffic blocks in the Frame configuration page	Not Saved

To save a DigRF Exerciser setup file

1 Launch the Protocol Exerciser for DigRF GUI.

2 Configure the link, transmission, receive, and trigger settings for the DigRF Exerciser stimulus.

3 Save the settings by clicking **File** > **Save**.

4 Type an appropriate name for the DigRF Exerciser setup file and click **Save**. The file is saved with a .dxs extension.

Defining a DigRF Traffic Flow

After configuring the link and other general settings between DigRF Exerciser and DUT, you define a DigRF traffic flow. This traffic flow lets you create a logical sequence of the DigRF stimulus traffic that you want DigRF Exerciser to sends to the DUT. You use the Frame Configuration page in the Protocol Exerciser for DigRF GUI to define a DigRF traffic flow.

DigRF Traffic Flow

In a DigRF traffic flow, you add different types of traffic blocks in a sequence with a loop and a condition defined to move from one block to the next block in the sequence. For each traffic block in the traffic flow, you add a list of DigRF

frames in a sequence. DigRF Exerciser sends these frames to the DUT in the defined sequence on running the stimulus flow.

Traffic Blocks

You can add the following types of traffic blocks in a DigRF traffic flow:

- **Init** - This traffic block is used to initialize the stimulus flow. This block can ideally serve the purpose of a control block which means it can contain control frames to transmit control information to DUT for initialization. This block doesn't have any break condition or a loop count attached to it thereby making it suitable for sending one time control information for initialization. This block is intended to initialize resources before sending any data frame. For example, you can use the Init block to turn on the clock test mode before the transmission starts. A traffic flow can have only one Init block and you cannot create a traffic flow without the Init bock as the first block in the flow.
- **Main** - You can use this block to send data or control frames in a sequence to the DUT after the initialization is completed using the Init block. You can add multiple Main blocks as per your requirement between the Init and Exit blocks in the traffic flow. Each Main block can have two components associated with it - Loop and break condition.
  - **Loop** - Each Main block that you add has a default loop count value set to 1. The loop count controls the number of times the frames in that Main block are sent consecutively to DUT before moving to the next block in the flow. You can either set the loop count as Infinite or a specific numeric value (0-255).
  - **Break condition** - You can specify the break condition for the loop in a traffic block. When this condition is met, the stimulus flow breaks out of the loop of the traffic block for which the condition was specified and moves to the next block. To enable you to set a condition for a Main block, the Main blocks are further categorized into the following two types:
  - **Conditional block** - A Main block with the Condition button attached which you can use to set the break condition for the block. If required, you can delete the break condition that you attached to the Conditional block.

- **Unconditional block** - A Main block with no break condition attached to move out of the loop of that block. You use an unconditional block when you want to repeat the block for a specified number of times in a loop and want the stimulus flow to come out of the loop after completion of the loop count. Therefore, if you set the loop count for an unconditional block as Infinite, a condition button is automatically attached to such a block to ensure a break from the infinite loop. If required, you can also add a break condition to an Unconditional block.

- **Exit** - This traffic block is used to configure the frames that you want to send at the exit of the stimulus flow. This block can serve the purpose of a control block which means it can contain control frames to transmit control information to DUT as a part of the exit procedure. This block doesn't have any break condition or a loop count attached to it thereby making it suitable for sending one time control information for exit. A traffic flow can have only one Exit block. You cannot create a traffic flow without the Exit bock as the last block in the flow.

You can add a maximum of eight traffic blocks in a traffic flow out of which the first block Init and the last block Exit is mandatory.

To know how to add a traffic block and set its loop count and break condition, refer to the subtopic Adding Traffic blocks, loops, and break conditions in this topic.

The following screen displays a traffic flow graph in the Frame Configuration page of the Protocol Exerciser for DigRF GUI.

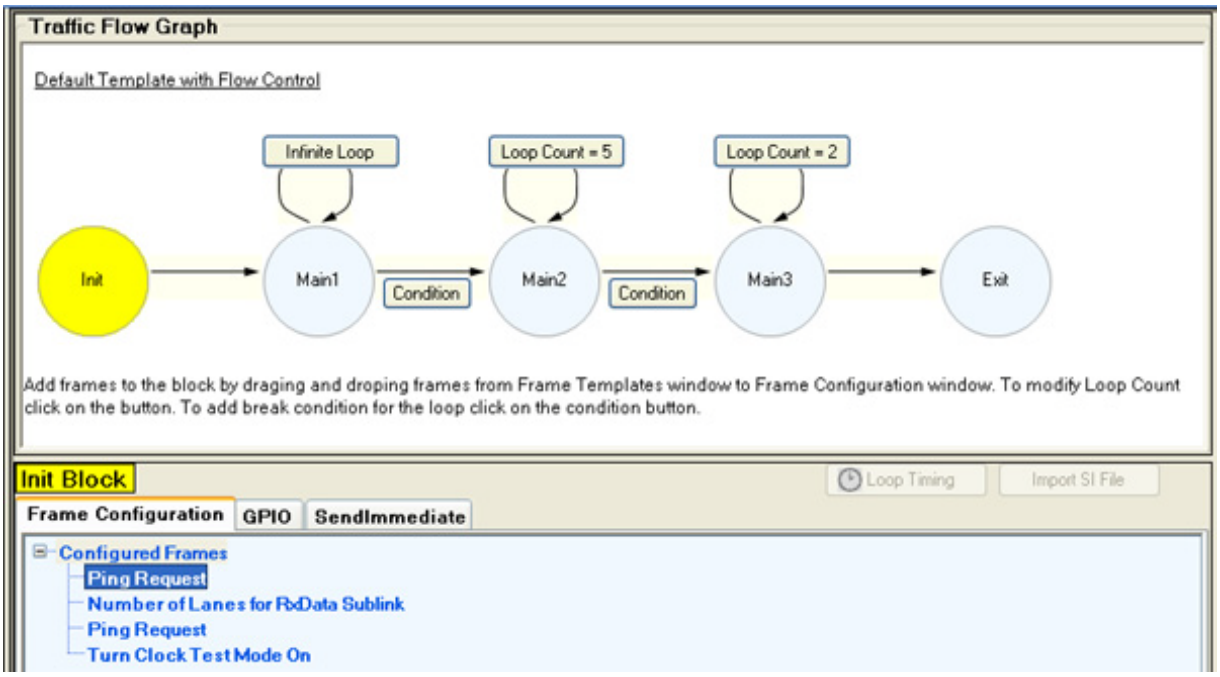


Figure 11 Traffic flow

The flow has three Main blocks between the Init and Exit blocks out of which two are conditional blocks. The first conditional block has an Infinite loop with a break condition. The second conditional block has a loop count of 5 with a break condition. The third unconditional block has a loop count of 2 with no condition attached. The lower pane of the screen displays the frames added for the Init block of the traffic flow.

When the stimulus flow is executed as per the displayed traffic flow, the frames in the Init block are the first ones to be sent as per the displayed sequence of frames.

Traffic Templates

You can define the DigRF traffic flow using the traffic templates. DigRF Exerciser provides the following two types of traffic templates in the **Traffic Template** pane of the **Frame Configuration** page in the Protocol Exerciser for DigRF GUI.

- **Default Template with Flow Control** - This is the default traffic template that provides a basic sequence of Init, Main, and Exit blocks with a loop count specified for the Main block. You can use this template to define a simple stimulus flow with these three blocks. However, if required, you can also add more blocks and conditions in this template instances.
- **Template with Conditional Flow Control** - This traffic template provides a sequence of an Init, a conditional block followed by an unconditional block, and an Exit block. The conditional block has an infinite loop and a break condition button to come out of that infinite loop and move to the unconditional block in the flow. The unconditional block has a loop count of 1 which means the frames in this block are sent as stimulus once before moving to the Exit block. If required, you can add more blocks, change loop counts, or add or delete conditions in this traffic template instances.

The following screen displays the two templates in the Traffic Template pane.

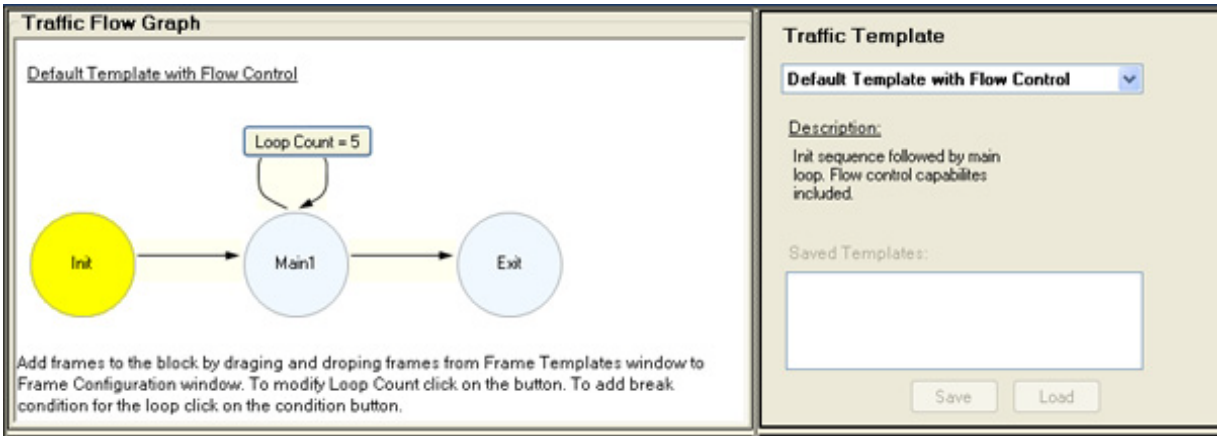


Figure 12 Default Template with Flow Control

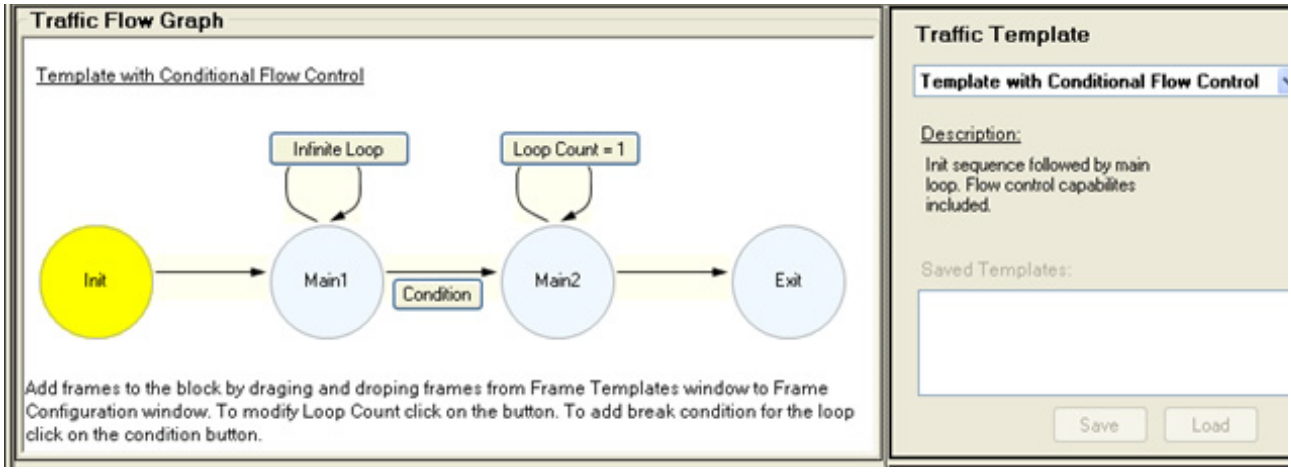


Figure 13 Template with Conditional Flow Control

Any changes that you make to the above-mentioned traffic template instances are not saved to the traffic templates. Also, the user-defined traffic templates are not currently supported.

Adding traffic blocks, loops, and break conditions

To define a traffic flow with blocks, loops, and break conditions:

1 Click the **Frame Configuration** icon from the navigation pane of the Protocol Exerciser for DigRF GUI.

2 Select the appropriate traffic template from the **Traffic Template** listbox.

The traffic flow graph applicable for the selected traffic template is displayed in the Traffic Flow Graph pane.

3 To use the Init block as the control block for sending control information for the initialization of stimulus flow, right-click the **Init** block. Then select the **Use as Control Block** check box. This ensures that the frames added in this block are a part of the control memory of DigRF Exerciser. If this option is not selected, then Init is treated as a data block.

4 To ensure that the transmission mode of the DigRF frames in the Init block is set to SYS-BURST, a low speed (LS) operating mode, right-click the Init block and select the **Transmit in Sys-burst mode** checkbox. This option instructs DigRF Exerciser to transmit frames of the Init block in sys-burst mode. For the rest of the blocks in the stimulus traffic flow, the transmit mode of operation

returns to the mode that you configured for the link in the Link tab of the General Settings page.

5 To add a traffic block after a traffic block, right-click the existing traffic block and click **Add block after**. Then select **Conditional Block** or **Unconditional Block**. You cannot add a block after the Exit block as it represents the end of the stimulus flow.

6 To add a traffic block before a traffic block, right-click the existing traffic block and click **Add block before.** Then select **Conditional Block** or **Unconditional Block**. You cannot add a block before the Init block as it represents the start of the stimulus flow.

7 To modify the default loop count set for a Main traffic block, click the **Loop count** box displayed above that traffic block. The **Behavior Editor** dialog box is displayed.

8 To set an infinite loop for the traffic block, select the **Infinite** check box. Or specify a numeric value (0-255) for the loop count in the **Count** text box and click **OK**. The loop count for the traffic block reflects the changed value.

9 To modify the default loop timings settings for a loop, select the traffic block of that loop and click the **Loop Timing** button.

The **Loop Time Configuration** dialog box is displayed.

a In the **Start Wait Time** text box, specify the time period for which DigRF Exerciser should wait before starting the transmission of DigRF frames in that block. This is applicable for the first round of execution of the loop.

b In the **Iteration time** group box, set the time for which DigRF Exerciser should wait between the loop iterations for that traffic block. You can let DigRF Exerciser calculate this iteration time automatically based on the inter frame gap that you set for the first frame in the sequence using the **Wait time Before Transmission** field in the **Frame Editor** dialog box. You can also explicitly specify the time period for which DigRF Exerciser should wait before starting the next iteration of the loop for the traffic block.

c Click **OK**.

10 To set the break condition for a conditional block:

d Click the **Condition** button attached after that conditional block. The **Break Condition** dialog box is displayed.

a You can specify a combination of **Manual break** as well as pattern matcher(s) for data and control frames. When DigRF Exerciser sends a frame matching any of the patterns specified as conditions, the stimulus flow breaks out of the loop for that block and moves to the next block. To get a description of each field in the Break Condition dialog box, refer to the Break Condition Dialog Box GUI Reference help topic.

11 To add a break condition to an unconditional block, right-click the unconditional block in the graph and select **Add Condition**.

12 To use the **Exit** block as the control block for sending control information for the exit procedure of stimulus flow, right-click the **Exit** block. Then select the **Use as Control Block** check box. This ensures that the frames added in this block are a part of the control memory of DigRF Exerciser.

After defining the traffic flow graph, you can start adding DigRF frame in a sequence in each of the defined traffic blocks. Refer to the topic Creating Data and Control Frame Templates on page 61 to know more.

Traffic flow - Example

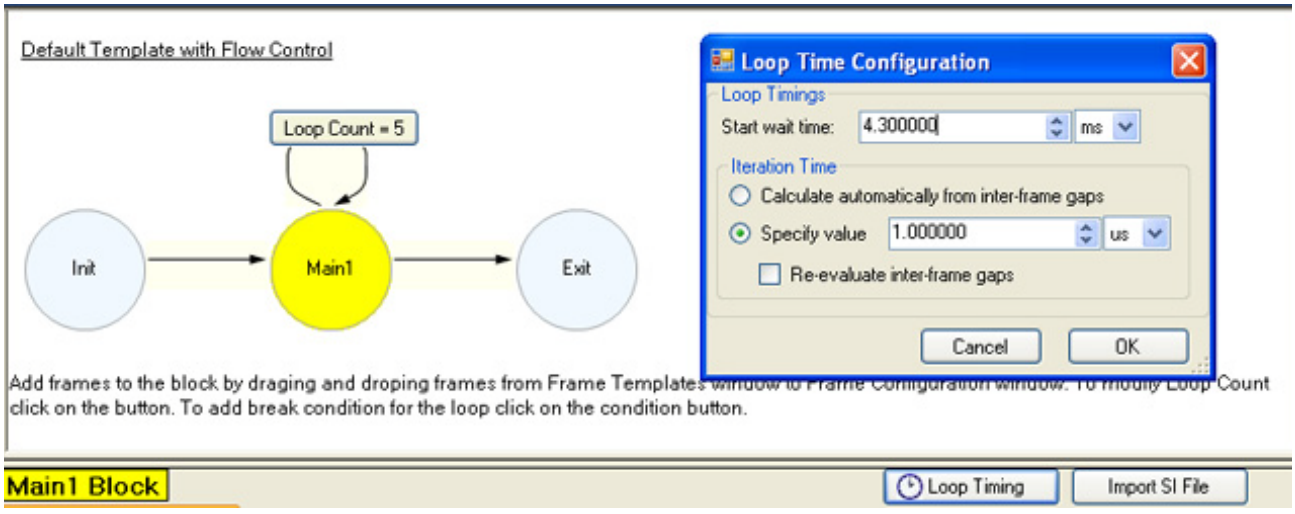


Figure 14 Traffic flow - example

In this example the first block - Init has been defined as a control block. The first iteration of the Main unconditional block starts after a wait of 4.3 ms. The subsequent loop iterations for the Main block are set as 1us apart.

Refer to the topic Example - DigRF Stimulus on page 79 to get a step-by-step example of how to configure and run a DigRF stimulus flow using the Protocol Exerciser for DigRF GUI.

Using Default Set of Data and Control Frame Templates

The Protocol Exerciser for DigRF GUI provides a default set of data and control frame templates. Using this GUI, you can add instances of these frame templates to appropriate traffic blocks, customize these instances, and then send these frames as per the configured sequence to the DUT as stimulus. You can send a single frame or a predefined sequence of frames as stimulus to DUT.

The following screen displays the control and data frame templates available in the Protocol Exerciser for DigRF GUI.

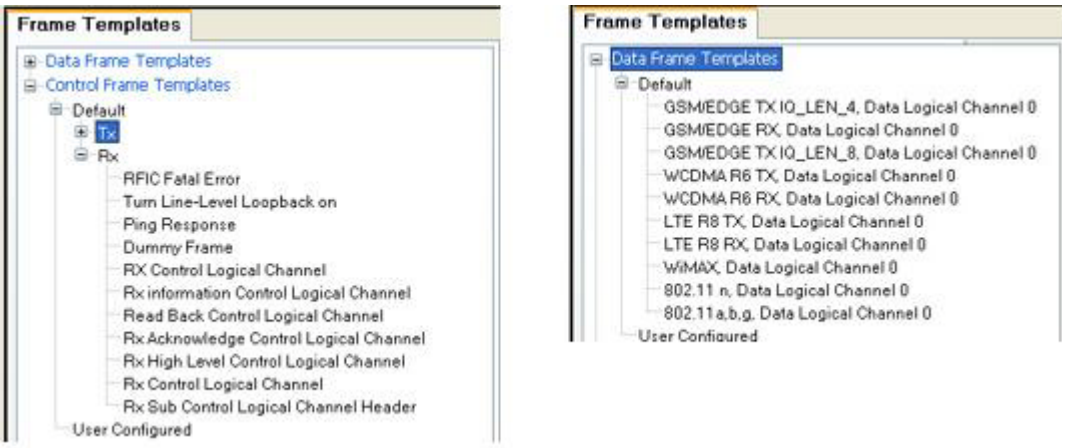


Figure 15 Frame templates

As displayed in the above screen, there are two categories of data and control frame templates - **Default** and **User configured**. The Default category lists the default frame templates available in the GUI. The templates that you create are listed under the User configured category.

Default Data Frame Templates

DigRF Exerciser supports transmission of data frames of various formats such as WCDMA, GSMEDGE, LTE, WiMAX as stimulus. For these data formats, appropriate data frame templates are provided for transmission over the TxData (BBIC to RFIC) and Rxdata (RFIC to BBIC) sublinks. These templates are listed in the Default category under Data frame templates.

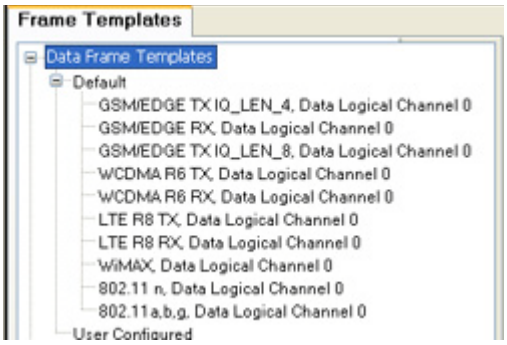


Figure 16 Data frame templates

Default Control Frame Templates

DigRF Exerciser also supports the transmission of control information for various control logical channels including various ICLC messages for the control purpose of the interface. Appropriate control frame templates are provided for the transmission of control information over the TxData (BBIC to RFIC) and RxData (RFIC to BBIC) sublinks.

These templates are listed in the Default category under Control frame templates.

The default control frame templates are further categorized into **Tx** and **Rx**.

- **Tx Control frame templates** - The Tx control frames are applicable for the transmission of control information on the TxData sublink, that is from BBIC (DigRF Exerciser in this case) to RFIC.
- **Rx Control frame templates** - The Rx control frames are applicable for the transmission of control information on the RxData sublink, that is from RFIC (DigRF Exerciser in this case) to BBIC.

The following screen displays control frames under these two categories.

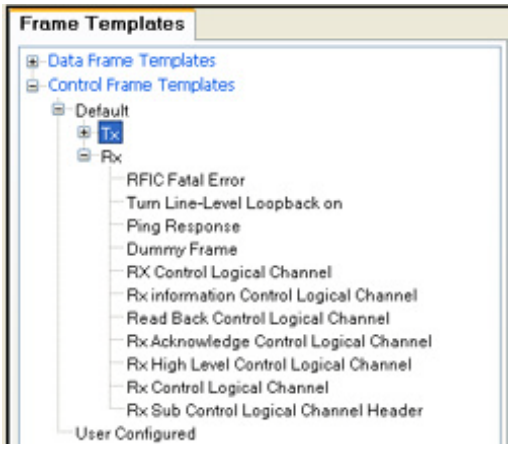


Figure 17 Control frame templates

NOTE

You cannot edit the default data and control frame templates. To edit a default template, you need to add an instance of that template to the list of configured frames and then make relevant changes to this instance. You can also create your own data and control frame templates to suit your specific requirements and then save these for future use. Refer to the topic Creating Data and Control Frame Templates on page 61 to know more.

Adding data and control frames

Before you start adding frames to be sent as stimulus, you need to define the flow of the DigRF stimulus traffic, that is identify the Init, Main, and Exit blocks, the loops associated with the Main blocks and the break conditions for the loops. Refer to the topic Defining a DigRF Traffic Flow on page 47 to know more. Once you have defined the DigRF traffic flow, you can start adding the data and control frames from the available templates to the appropriate blocks in the traffic flow.

To add a frame using the default frame templates:

1. Click the **Frame Configuration** icon from the Navigation pane of the Protocol Exerciser for DigRF GUI.
2. From the Traffic flow graph, select the traffic block for which you want to add the data or control frames.
3. Select the required control or data frame template from the **Frame templates** pane.
4. Drag and drop the selected frame template to the **Configured Frames** list in the **Frame Configuration** tab.

5 If you want to send a frame immediately as stimulus to DUT during an ongoing stimulus flow, then you should add the frame in the **SendImmediate** tab. When you send a frame immediately as stimulus, DigRF Exerciser halts the stimulus flow, sends that frame and then resumes the stimulus flow from the point at which it was halted.

6 Edit the properties of the added frame by right-clicking the frame and selecting **Edit**.

   The **Control Frame Editor** dialog box is displayed if you are editing a control frame and the **Data Frame Editor** dialog box is displayed if you are editing a data frame.

7 Make the required changes to the behavior, payload, and header of the added frame. To get a detailed description of a field in the Control Frame Editor and Data Frame Editor dialog boxes, refer to the GUI reference in this online help.

8 Click **OK**.

NOTE If you want to change the sequence of the data and control frames that you have added for a block, you need to delete the frame instance from the list. Then you re-add the frame instance from the available frame templates in the desired sequence.

The following is an example of a sequence of control and data frames added in the Main block with an infinite loop and a break condition. DigRF Exerciser is emulating a BBIC. Therefore, the data and control frames that are applicable for the TxData sublink have been added as stimulus in the Main block.

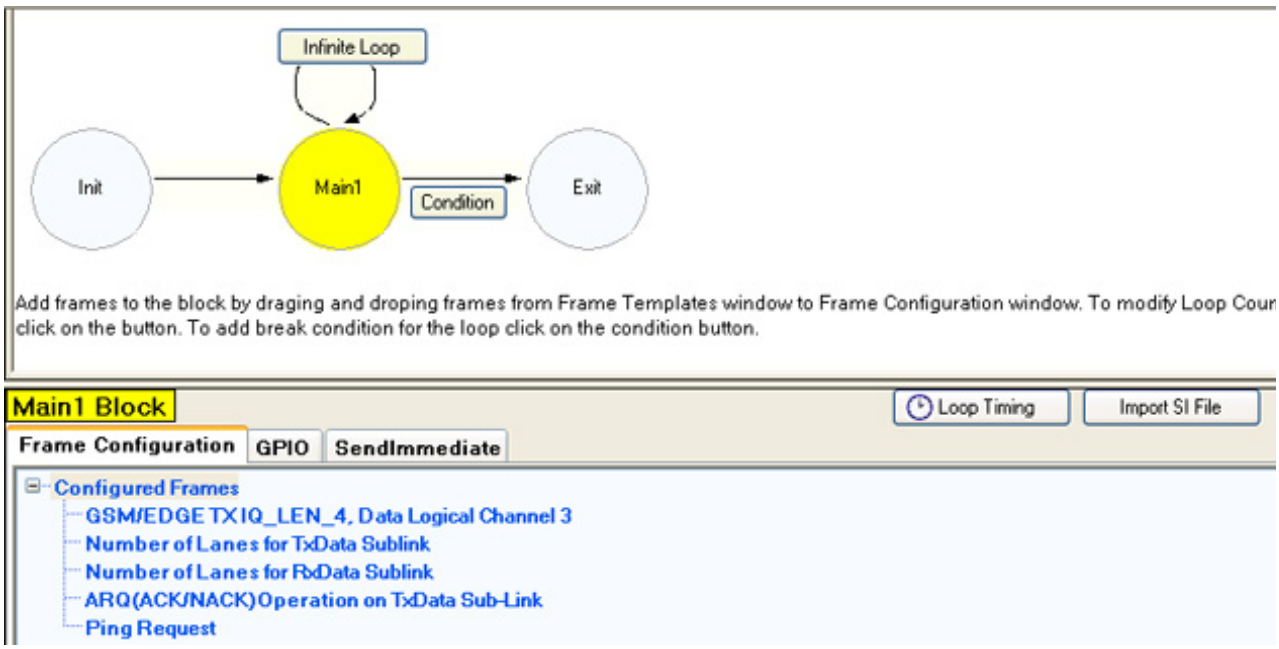


Figure 18 Traffic flow and frames - example

Editing a Frame

Once you have added an instance of a data or a control frame template to the list of frames configured for a block, you can further customize the added template instance to suit your specific stimulus requirements. For instance, you can insert various types of protocol errors in the frame to test how the DUT responds to an errored frame transmission.

To edit a frame template instance:

1 Right-click the added frame from the list of frames added for a traffic block in the **Frame Configuration** page.

2 Click **Edit**.

The **Control Frame Editor** dialog box is displayed if you are editing a control frame and the **Data Frame Editor** dialog box is displayed if you are editing a data frame.

3 Make the required changes to the behavior, payload, and header of the added frame. To get a detailed description of a field in the **Control Frame Editor** and **Data Frame Editor** dialog boxes, refer to the GUI reference in this online help.

4 Click **OK**.

The following screen displays the **Control Frame Editor** dialog box for the **ARQ (ACK/NACK) Operation on TxData sub- link** control frame. The following default settings have been edited for this frame to customize it for the stimulus.

- The wait time before the transmission of this frame as stimulus has been increased to **1 us.**
- The default setting of **ACK/NACK Off** has been changed to **ACK/NACK Complete on** to turn on the ACK/NACK on TxData sublink.

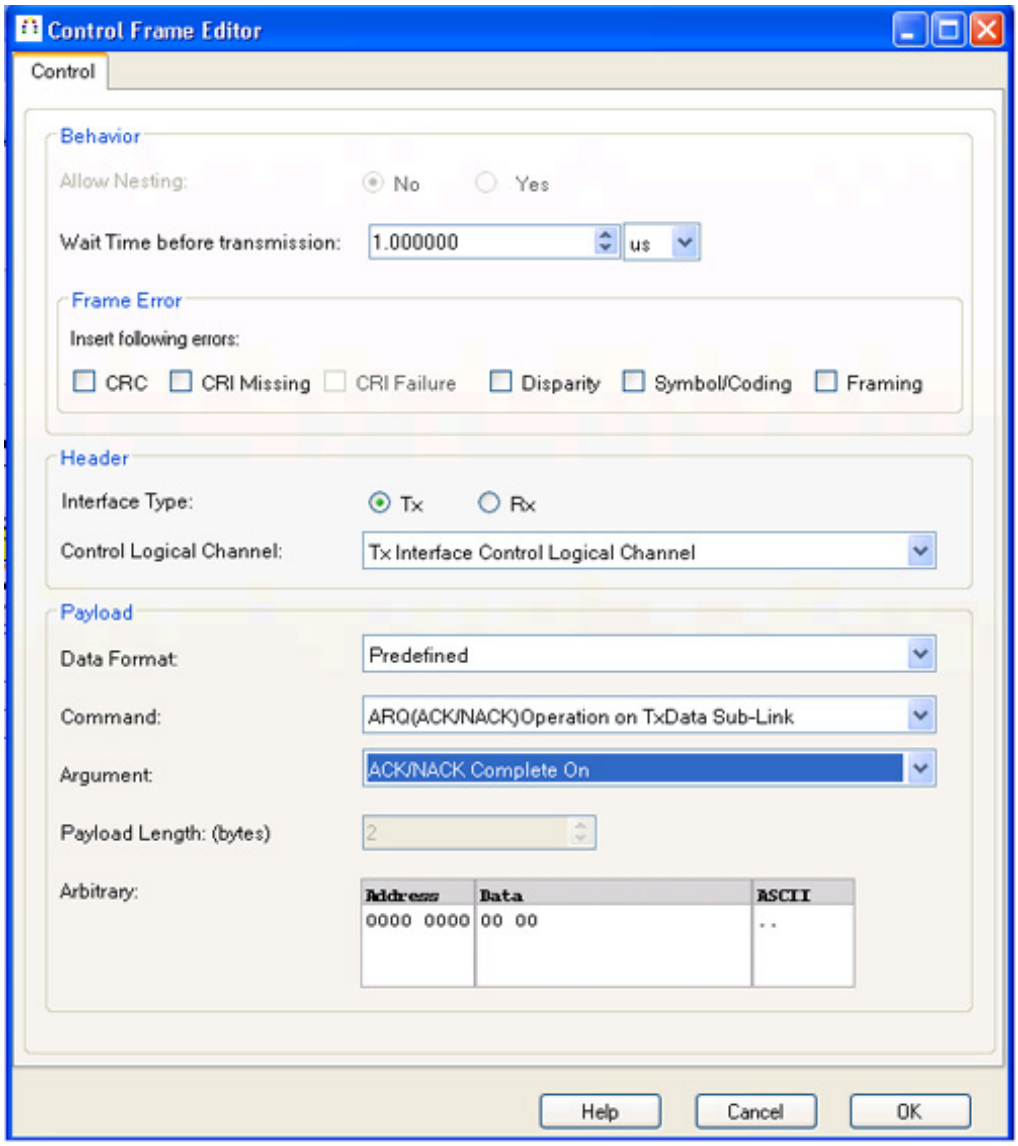


Figure 19 Control Frame Editor

Creating Data and Control Frame Templates

A default set of data and control frame templates is provided in the Frame Configurations pane of the DigRF Exerciser GUI. However, there may be situations when this default set of templates does not serve your specific stimulus requirements. You can create data and control frame templates and save these for future use.

To create a data or a control frame template:

1. Click the **Frame Configuration** icon from the Navigation pane of the Protocol Exerciser for DigRF GUI.
2. Select the **User Configured** option from Data Frame Templates or Control Frame Templates in the **Frame Templates** tab.
3. Click **Add** to add a user configured data or control frame template.

   If you are adding a control frame template, the **Control Frame Editor** dialog box is displayed. For a data frame template, the **Data Frame Editor** dialog box is displayed.
4. Set the behavior, header, and payload properties for the frame template. To get a detailed description of a field in the Control Frame Editor and Data Frame Editor dialog boxes, refer to the GUI reference in this online help.
5. Click **OK**.

The frame template gets added in the **User Configured** option under **Data Frame Templates** or **Control Frame Templates.** You can then add instances of this template to a traffic block by dragging and dropping it at the desired sequence in the list of frames added and configured for a traffic block.

The following is an example of a user-configured control frame to change the TxData Sublink Rate from low speed to High speed.

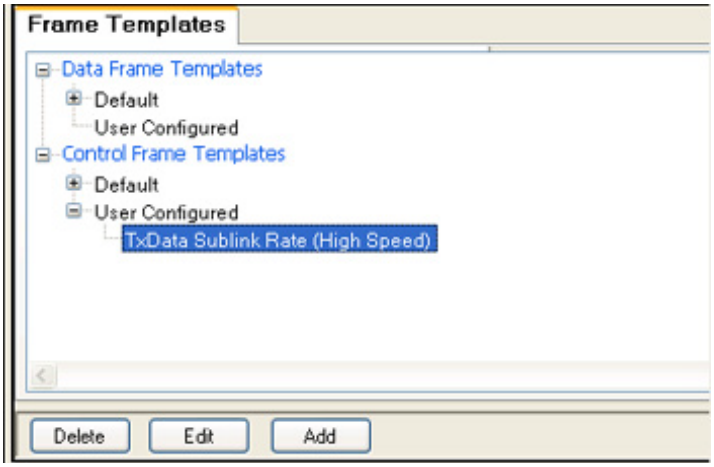


Figure 20 A user configured control frame

You can also make changes to a user configured template by selecting it from the list of User Configured templates in the Frame Templates tab and then clicking **Edit**.

Importing DigRF Frames from a Signal Inserter Stimulus File

Once you have defined the DigRF traffic flow for the stimulus, you need to add appropriate data and control frames to each of the traffic blocks in the required sequence. To do this, you can:

- either use the data and control frame templates available in the Protocol Exerciser for DigRF GUI.
- or import the data and control frames from a stimulus file generated using the Agilent Signal Inserter tool.

This topic describes how to import DigRF frames from a Signal Inserter stimulus file (.ldf or .bdf file) into the Protocol Exerciser for DigRF GUI. To know how to generate such a stimulus file using Signal Inserter, refer to the topic Generating DigRF Stimulus Using the Signal Inserter tool on page 35.

To import DigRF frames from a Signal Inserter stimulus file

1. Click the **Frame Configuration** icon from the Navigation pane of the Protocol Exerciser for DigRF GUI.
2. From the Traffic flow graph, select the traffic block for which you want to import the data or control frames from a stimulus file.

3 Click **Import SI File**. Note: This button appears disabled if you are trying to import frames into the Init block with the **Use as Control block** checkbox selected.

The **Import Signal Inserter File** dialog box

4 Click **Browse** to browse the location where the Signal Inserter stimulus file (.ldf or .bdf) is located.

5 Select the .bdf or .ldf file and click **Open**. Ensure that you have the appropriate license if you are trying to import frames from a Licensed Binary Data File (.ldf file).

6 To provide a prefix for the frames imported from the selected stimulus file, specify the text in the **Prefix Name** field. The specified text is used as a prefix with the frames imported in the Protocol Exerciser for DigRF GUI.

7 In the **Import Frames** group box, the total number of frames that exist in the stimulus file is shown. You can choose to import all the frames by clicking the **All** radio button. Or you can specify a range of frames to be imported by selecting the **Range** radio button and then specifying the frame number from which the import should begin and the total number of frames that should be imported starting from that frame number.

8 Click **OK**.

DigRF frames are imported from the selected stimulus file and added as a list of frames in the Frame configuration tab of the selected traffic block.

The following screen displays a range of frames imported from a .bdf stimulus file in the Exit block of the DigRF stimulus.

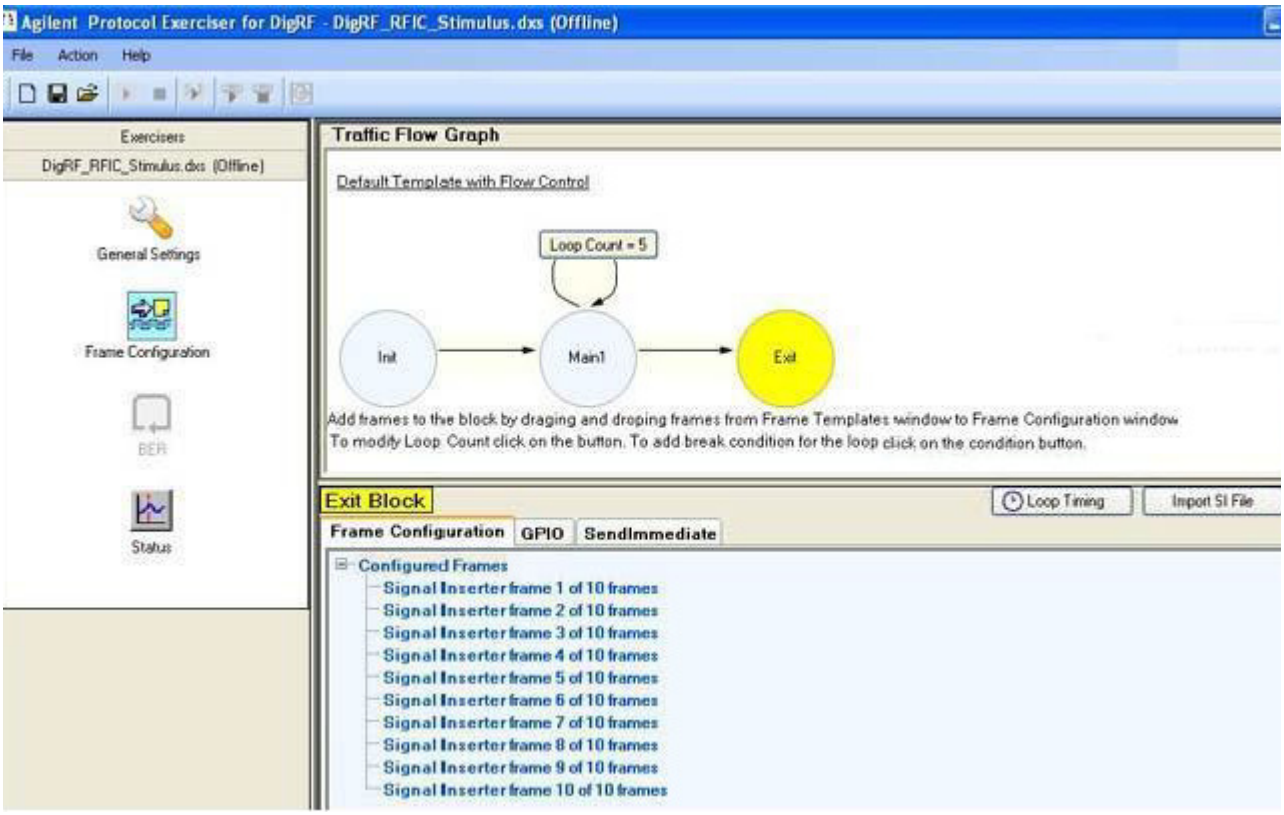


Figure 21 Frames imported from a .bdf file

The following screen displays the data frames imported from a .ldf file (Licensed Binary Data File) created using the Signal Inserter tool.

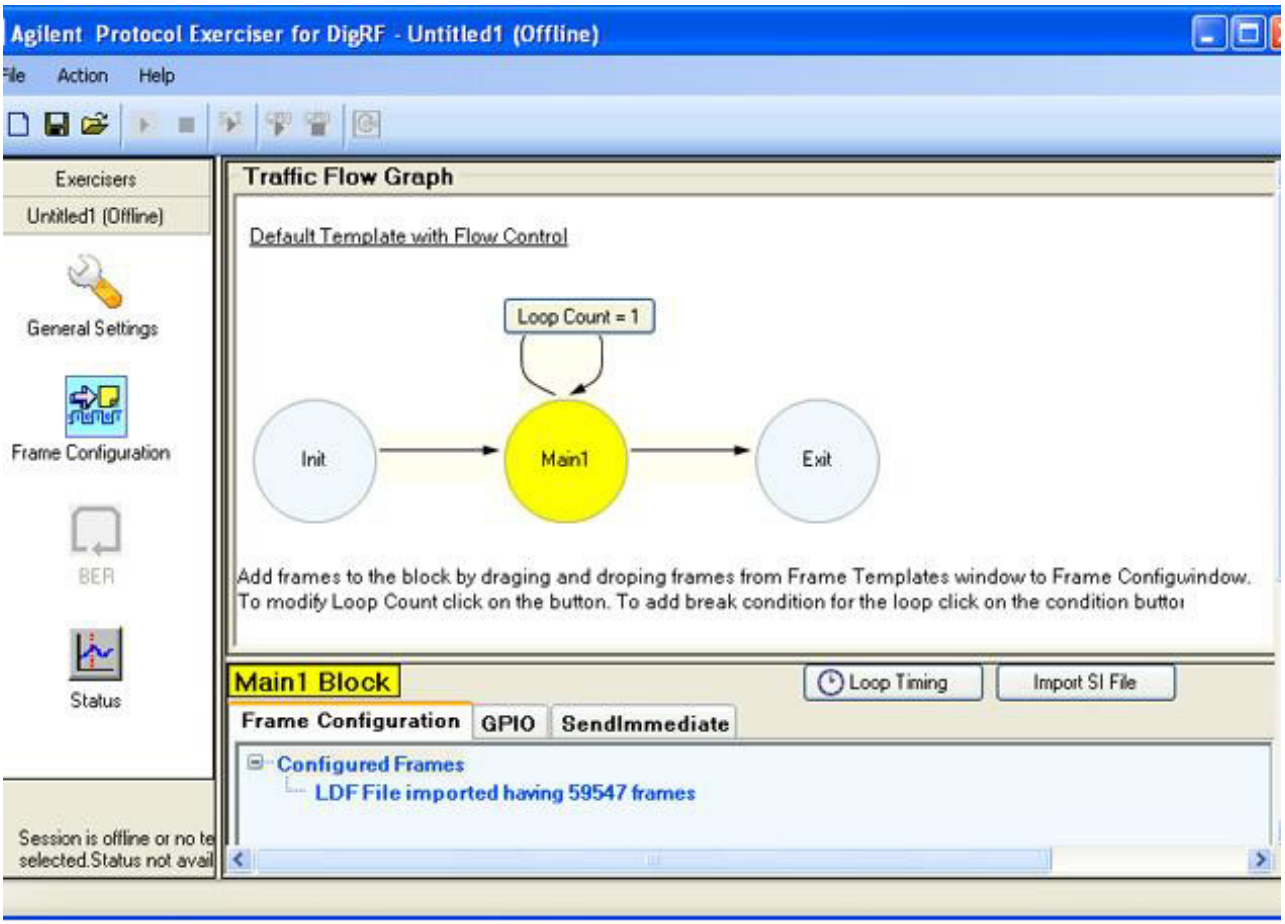


Figure 22 Data frames imported from a .ldf file

If you do not have the appropriate license, you get the following error message when you try to import the frames from a .ldf file as stimulus.

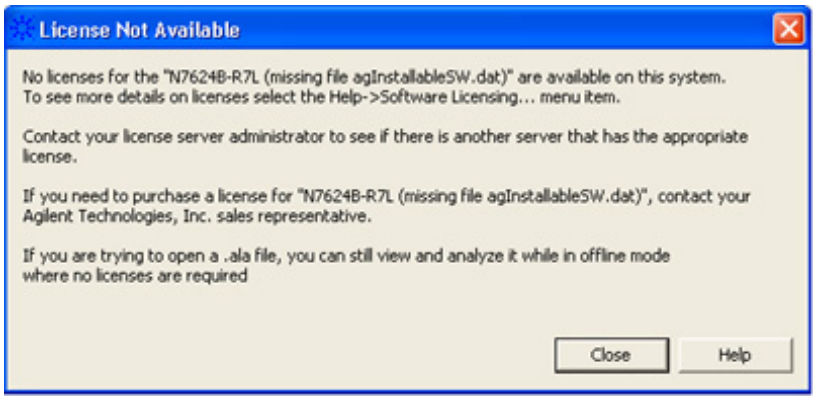


Figure 23 License error message

Configuring Stimulus Using the DigRF Test Wizard

You can configure and start the stimulus from the DigRF Exerciser module using either the Protocol Exerciser for DigRF GUI or DigRF Test Wizard GUI. This topic describes how you can configure the stimulus flow in the DigRF Test Wizard GUI to provide stimulus to a DUT.

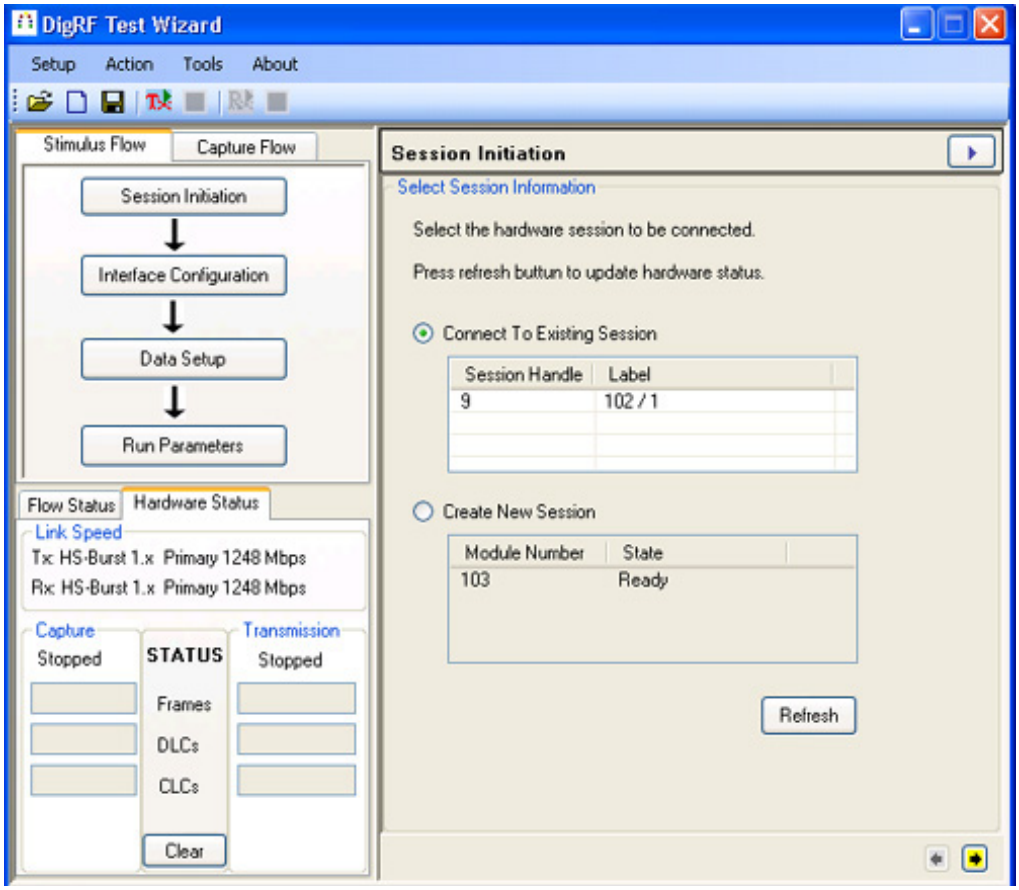
DigRF Test Wizard GUI

The DigRF Test Wizard GUI provides the features to use the stimulus as well as capture capabilities of the DigRF Exerciser module. Thereby it simplifies the procedures of providing stimulus and capturing DigRF data by eliminating the need for invoking multiple GUIs of the RDX test platform in a sequence and configuring these GUIs separately. This wizard has separate tabs namely, **Stimulus flow** and **Capture flow** to configure the DigRF stimulus and capture respectively. This topic describes the Stimulus flow.

To know about the capture flow, refer to the topic Capturing Data Using the DigRF Test Wizard on page 122.

The aim of this wizard is to minimize the complexity and enable you to set up a stimulus scenario with minimum effort. Keeping this in mind, the capabilities of the wizard are limited as compared to the Protocol Exerciser for DigRF GUI that provides extensive features for DigRF stimulus.

Configuring the stimulus flow



To configure DigRF stimulus:

1 Launch the DigRF Test Wizard GUI by clicking **Start > Programs >Agilent RDX for DigRF > DigRF Wizard** option on the Windows task bar.

The **DigRF Test Wizard** GUI is displayed.

2 Click the **Stimulus flow** tab.

The stimulus flow has four blocks that you need to set to complete the flow.

3 In the **Session Initiation** block, the first block in the flow, specify the session information to set a session between the DigRF Test Wizard and the DigRF Exerciser module hardware.

a If a session already exists on the system controller, click the **Connect to Existing Session** radio button.

b If no session exists, create a new session by clicking the **Create New Session** radio button. The DigRF

Exerciser module should be in the **Ready** state to create a new session.

4 In the **Interface Configuration** block, the second block in the flow, specify the settings for the DigRF interface to be used to provide stimulus to DUT. If you want to stimulate an RFIC, then select the **Rx Testing** radio button to test the Rx side of the DigRF link, that is, from RFIC to BBIC (DigRF Exerciser in this case). If you want to stimulate a BBIC, then select the **Tx Testing** radio button to test the Tx side of the DigRF link, that is, from BBIC to RFIC (DigRF Exerciser in this case).

5 In the **Data Setup** block, the third block in the flow, add the sequence of control and data frames that you want to send as stimulus to DUT. The Data Setup page has two sections - Init Data and Main Data Source.

a In **Init Data**, you add the control frames needed to typically initialize the DUT. You use the default control frame templates to add control frames.

b In **Main Data Source**, you add the DigRF data frames:

- either by importing frames from a Signal Inserter stimulus file. Refer to the topic Generating DigRF Stimulus Using the Signal Inserter tool on page 35 to know more.
- or creating data frames from the IQ data stored in an input signal file such as a Signal Studio input file.

6 In the **Run Parameter** block, the last block in the flow, specify the parameters for sending the frames that you added in the Main data source as stimulus. You can specify:

- if the Wizard should send the sequence of frames in the Main data source as an Infinite loop or in the specified number of iterations.
- the time period (in seconds) for which wizard should wait before starting the first iteration of sending the frames added in the Main data source.
- the time period (in seconds) for which wizard should wait before starting the next iteration of sending the frames added in the Main data source.
- the control frames that you want to send immediately to DUT in between the stimulus flow usually to change the behavior of DUT at runtime.

NOTE To get a detailed description of each field in the DigRF Test Wizard GUI, refer to the GUI Reference help topics in this online help.

After configuring the stimulus flow, you can start the stimulus flow and view the status of the flow in the DigRF Test Wizard GUI.

Starting the DigRF Stimulus as per the Configured Settings

Once you have configured the DigRF Exerciser's stimulus flow, you can start the DigRF stimulus for the DUT. This topic describes how to start the DigRF stimulus as per the configured stimulus settings.

To start the DigRF stimulus from the **Protocol Exerciser for DigRF GUI**

1 Click the **Run** toolbar button to start the stimulus.

DigRF Exerciser starts sending the configured frames in the specified sequence as per the defined traffic flow.

NOTE If you are using both the stimulus and capture capabilities of DigRF Exerciser, then ensure that you start the data capture in Logic Analyzer GUI before starting the stimulus in the Protocol Exerciser for DigRF GUI. If this sequence is not followed, the number of frames captured is displayed as 0. Refer to Starting the Data Capture on page 106 to know more about data capture.

Refer to the topic Viewing the DigRF Stimulus Results on page 75 to know how to view the stimulus results.

Start the DigRF stimulus from the DigRF Test Wizard GUI

If you have configured the stimulus flow in the DigRF Test Wizard GUI, you can start the DigRF stimulus from the DigRF Test Wizard GUI by:

1 Clicking the **Start Stimulus** toolbar button. This starts the execution of the configured stimulus flow.

The wizard creates the connection to the DigRF Exerciser hardware, configures the DigRF interface, and configures the control and data frames for stimulus. Refer to the topic Viewing the DigRF Stimulus Results on page 75 to know how to view the stimulus results.

NOTE If you are using both the stimulus and capture flows in DigRF Test Wizard, then ensure that you start the data capture in the Capture flow tab before starting the stimulus in the Stimulus flow tab. If this sequence is not followed, the number of frames captured is displayed as 0.

Sending Frames Immediately as Stimulus

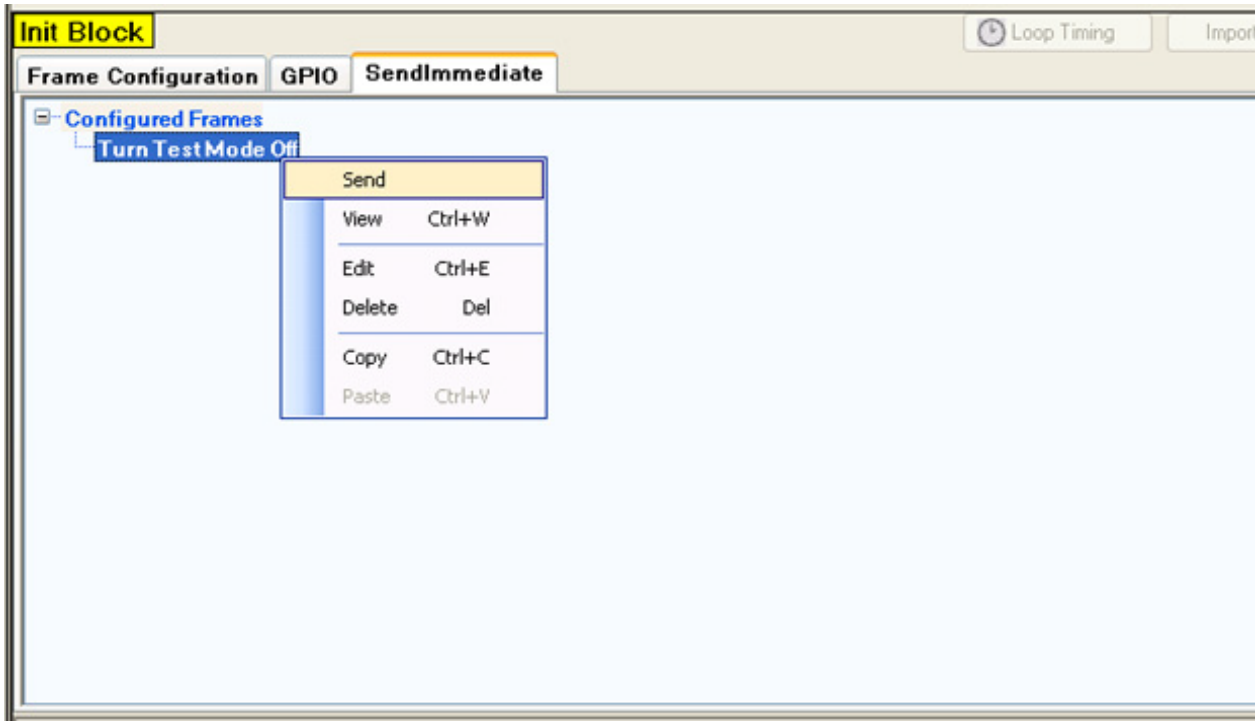
DigRF Exerciser allows you to send a control or a data frame immediately as stimulus to DUT during an ongoing stimulus flow using the DigRF Exerciser module. By sending a frame immediately, you can change the behavior of DUT at runtime or perform runtime debug as well while stimulating the DUT. For instance, you can inject a control frame at runtime in between the stimulus flow to change the speed of the RxData sublink or to turn on ACK/NACK operation on a sublink or turn off the clock test mode.

You can send a single or multiple frames immediately while running the stimulus flow using Protocol Exerciser for DigRF GUI or DigRF Test Wizard GUI. When you send a frame immediately as stimulus, DigRF Exerciser halts the stimulus flow, sends that frame and then resumes the stimulus flow from the point at which it was halted.

Sending frames immediately when running stimulus from the Protocol Exerciser for DigRF GUI:

1. From the **Frame Configuration** page, select the stimulus traffic block in which you want to add the frame to be sent immediately.
2. Drag and drop the required frame template from the **Frame Templates** pane to the **SendImmediate** tab of the traffic block.
3. Right-click the added frame and click **Send**. This sends only the selected frame immediately.
4. If you have added multiple frames in a block to be sent immediately, then click the **Send Immediate** toolbar button. This sends all the frames in the configured sequence from the SendImmediate tab as stimulus.

The following screen displays the Turn Test Mode Off control frame sent immediately as stimulus to RFIC.



Sending frames immediately when running stimulus from the DigRF Test Wizard GUI:

NOTE You can send only control frames immediately as stimulus when using DigRF Test Wizard.

1. In the **Stimulus flow** of wizard, access the **Run Parameters** block.
2. In the **Send Immediate** tab, select the **CLC** type of the control frame that you want to send immediately to DUT.
3. Click **<<Add**.

   The **Control Frame Editor** dialog box is displayed.
4. Based on whether you selected DigRF Exerciser to emulate a BBIC or an RFIC, the Tx or Rx CLCs are displayed with the commands and arguments. Select the **Command**, **Argument**, and **Payload length** (if applicable) for the control frame. You can also specify any **Transmission Delay** for this control frame.
5. Click **OK**.
6. Click **Send** displayed with the added control frame.

The frame is sent immediately to DUT while the stimulus flow is running.

The following screen displays the TxData Sublionk Rate control frame sent immediately as stimulus to RFIC.

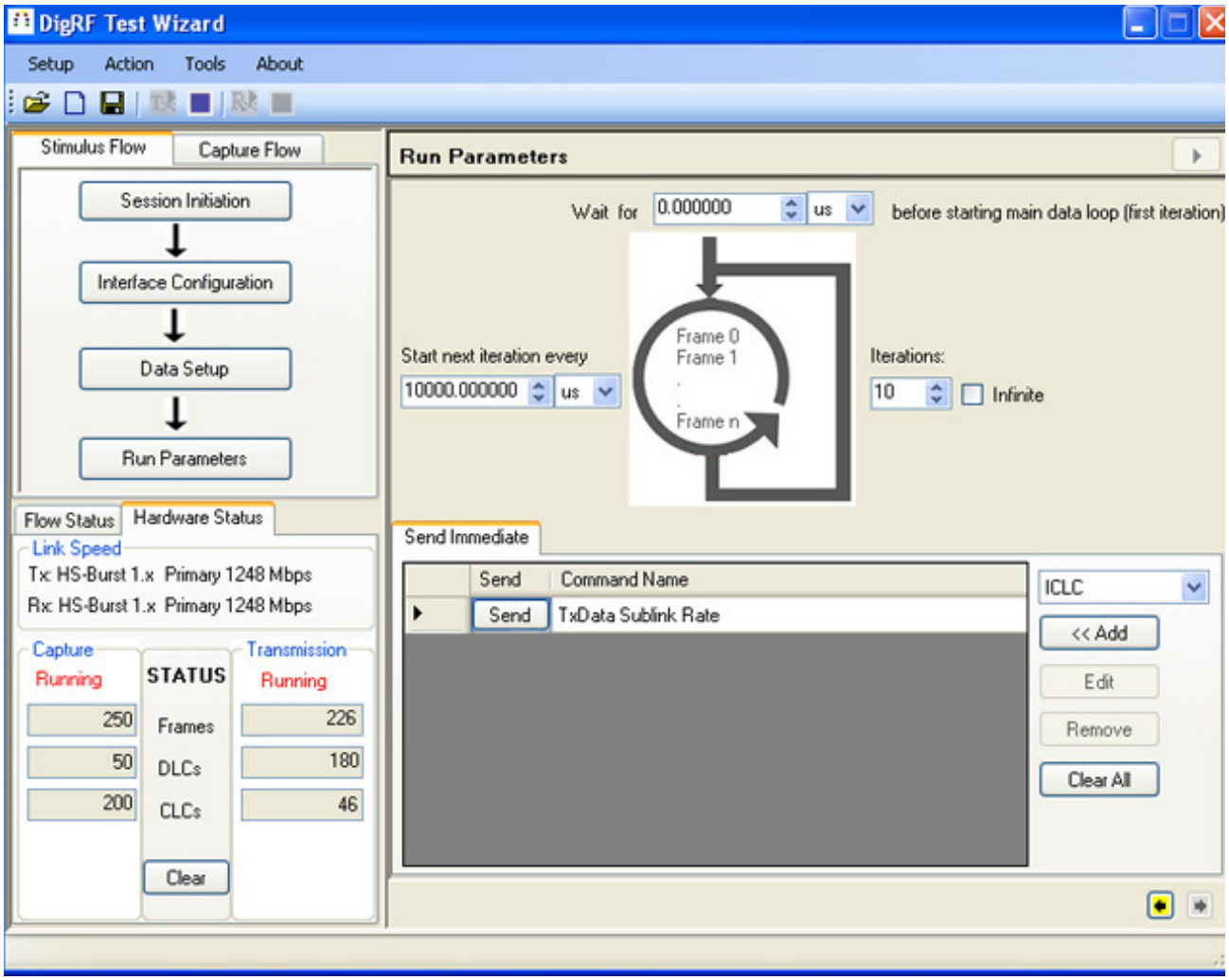


Figure 24 Frame sent immediately

Viewing the DigRF Stimulus Results

You can view the stimulus results from the GUI you used to configure and start stimulus that is, Protocol Exerciser for DigRF GUI or the DigRF Test Wizard GUI.

If you have used the Protocol Exerciser for DigRF GUI, you can view the results of the DigRF stimulus in the Status page of this GUI.

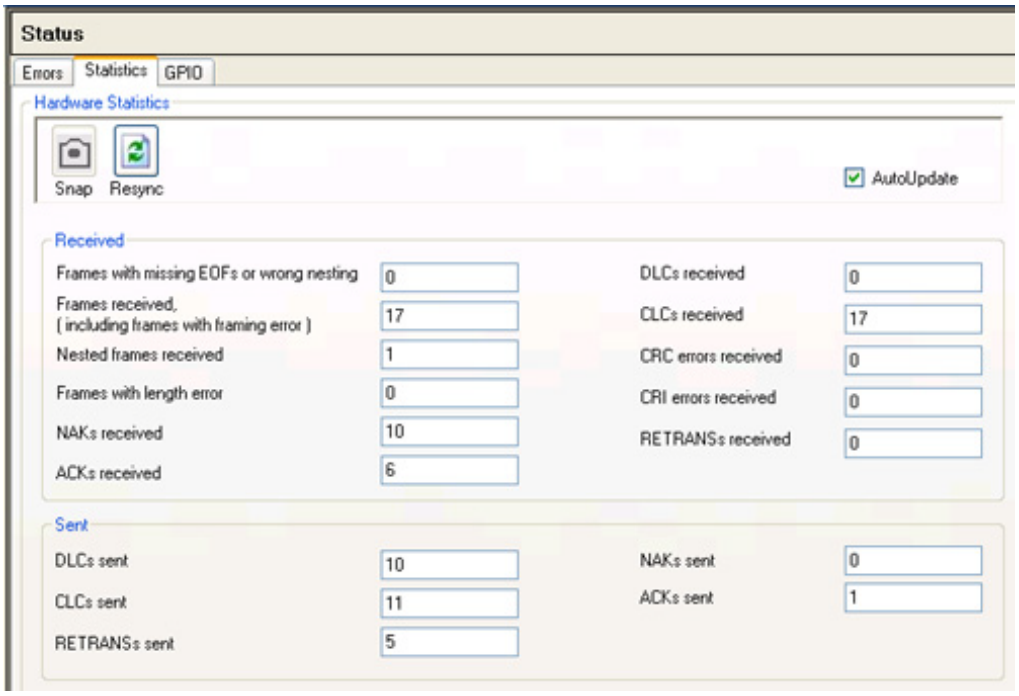


Figure 25 Stimulus results

The page has the following three tabs:

- **Errors** - Displays the categorized protocol errors encountered in the frames received from DUT during the stimulus flow. For this release, the Errors tab in the Status page is not functional.
- **Statistics** - Displays the statistics for the stimulus frames sent from DigRF Exerciser and frames received from DUT in the **Sent** and **Received** group boxes respectively. The statistics is displayed based on the settings you have configured in the stimulus flow. For instance, if you disabled the retransmission of packets from DigRF Exerciser in the Transmission tab of General Settings page, then the **RETRANSs sent** counter is displayed as 0 in Statistics tab.

In the Statistics page:

- Select the **AutoUpdate** checkbox to ensure that the statistics is automatically updated with the stimulus results every 1 second.
- Click **Snap** to update all the received and sent frame counters in the Statistics tab with the current stimulus results. This option is enabled if the AutoUpdate checkbox is not selected.
- Click **Resynch** to reset all the received and sent frame counters in the Statistics tab.

- **GPIO** - Displays the output of the pins that you configured in Bank A to F for the transmission on the GPIO interface. DigRF Exerciser module provides a General Purpose Input Output (GPIO) Bus interface besides the DigRF interface for stimulus. On starting the GPIO transmission, this tab displays the results of the GPIO interface transmission. To know how to configure and use this interface, refer to the topic Configuring and Using GPIO Interface for Transmission on page 179.

If you have used the DigRF Test Wizard GUI, you can view the results of the DigRF stimulus in the **Flow Status** and **Hardware Status** tabs of this GUI. The **Flow status** tab displays the status of the stimulus flow reflecting the steps that wizard is currently performing as per the configured stimulus blocks. If the stimulus flow fails, you can view the step at which it failed and the reason of failure.

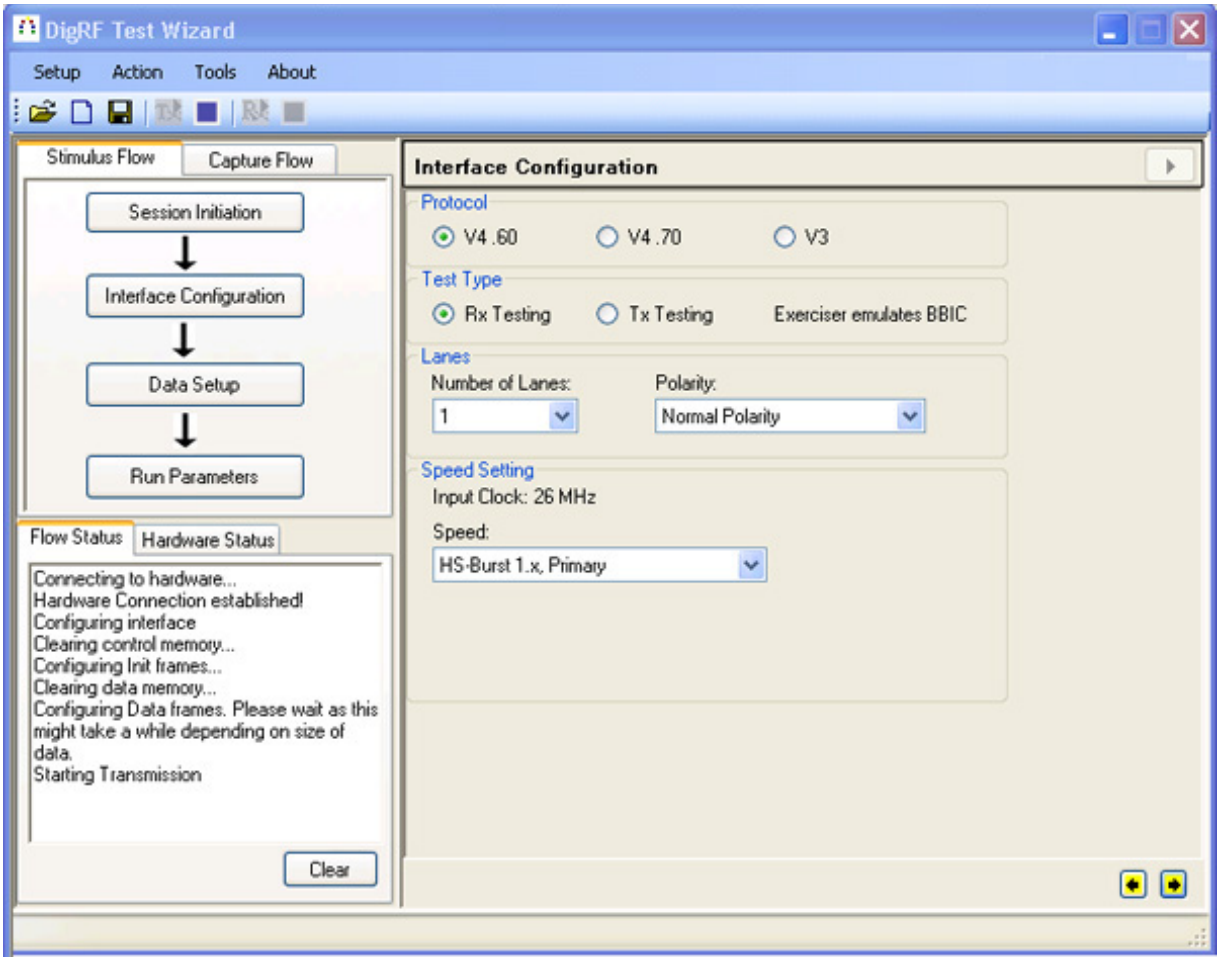


Figure 26 Flow status in Wizard

The following screen displays the stimulus results in the Hardware Status tab of the wizard.

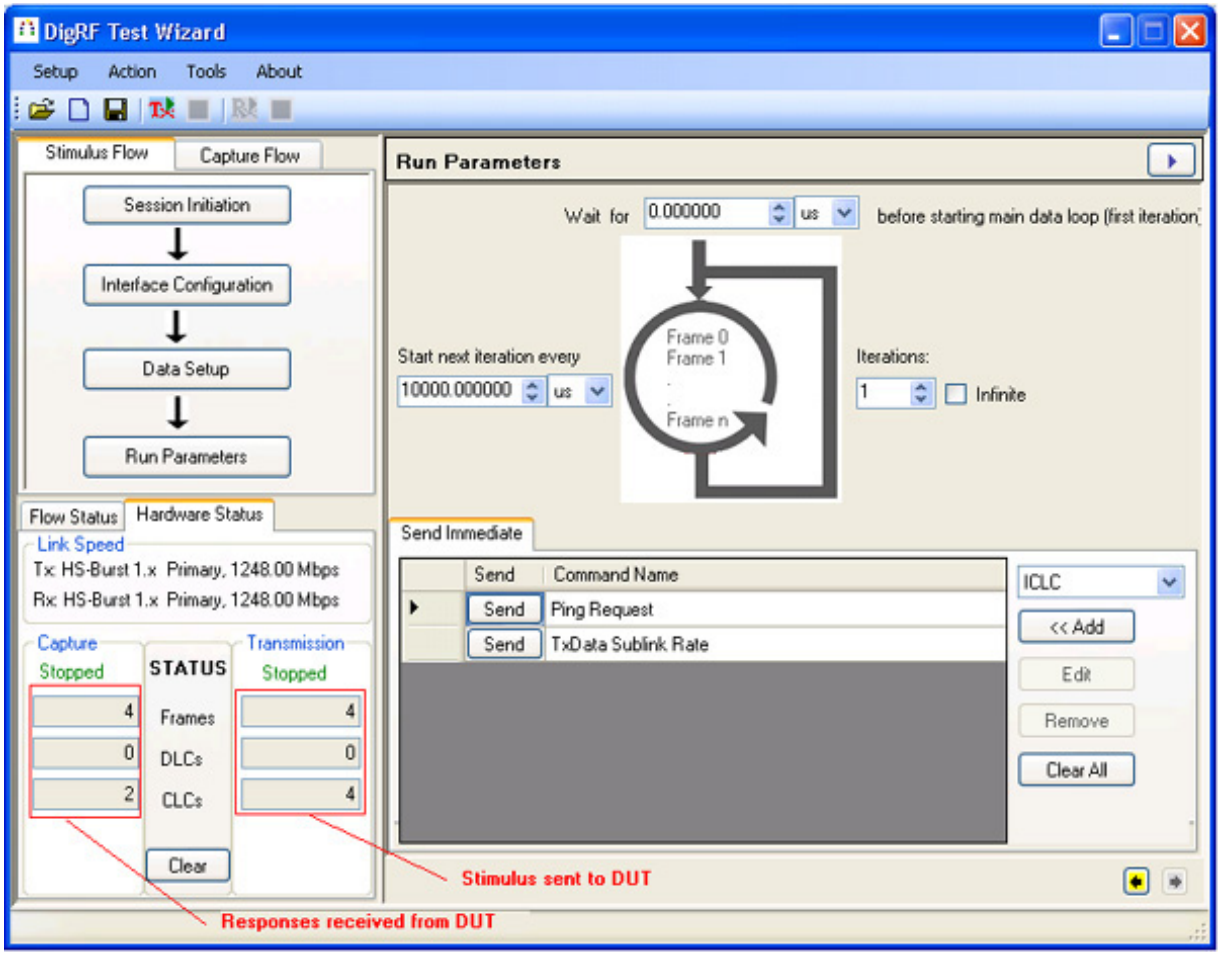


Figure 27 Hardware status in wizard

The Hardware Status tab displays:

- the total number of frames that DigRF Exerciser transmitted as stimulus to DUT. The number of frames are also categorized based on the data and control frames sent as stimulus.
- the total number of frames that DigRF Exerciser received from DUT as a response to the stimulus. The number of frames are also categorized based on the data and control frames received as response from DUT.

You can click **Clear** to reset the stimulus result counters in the Hardware status tab.

Example - DigRF Stimulus

This topic provides an example of DigRF stimulus flow over a DigRF v4 .60 link.

DigRF Stimulus using the Protocol Exerciser for DigRF GUI

Scenario - Testing an RFIC over the DigRF link for the LTE R8 data format.

Link configuration for the stimulus

Link configuration consists of the DigRF Exerciser emulating a BBIC. A high-speed rate of HS Burst 1x is used on both Transmitter and Receiver sides of the Exerciser to support the exchange of ACK/NACK between DigRF Exerciser and RFIC.

Transmission settings for the stimulus

The ARQ protocol is enabled to transmit ACK/NACK from DigRF Exerciser. Retransmission of packets in case of NACK received from DUT is also enabled.

Receive settings for the stimulus

Frame length and CRI checking is enabled for the frames received from RFIC.

Setting Transmission trigger for the stimulus

Requirement - Trigger out pulse should be generated when the **Turn Test Mode Off** control frame is transmitted as stimulus to RFIC.

Configuration - To accomplish this, a Transmission trigger is set in the **Trigger** tab of the Protocol Exerciser for DigRF GUI. When the **Turn Test Mode Off** control frame is sent as stimulus, a trigger out pulse is sent to another test equipment connected to DigRF Exerciser through Trigger out connector component.

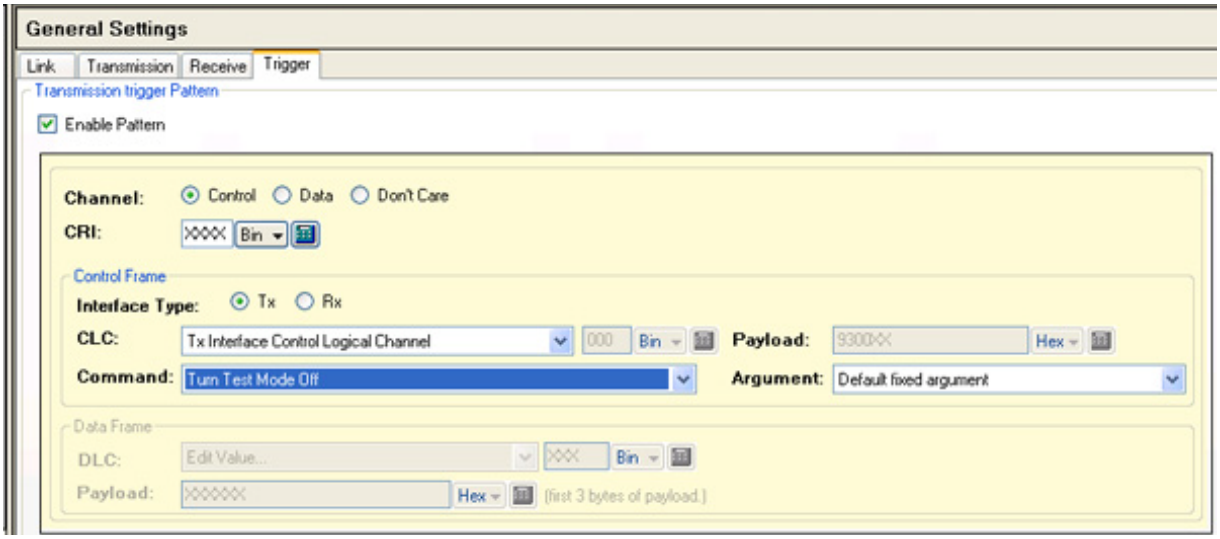
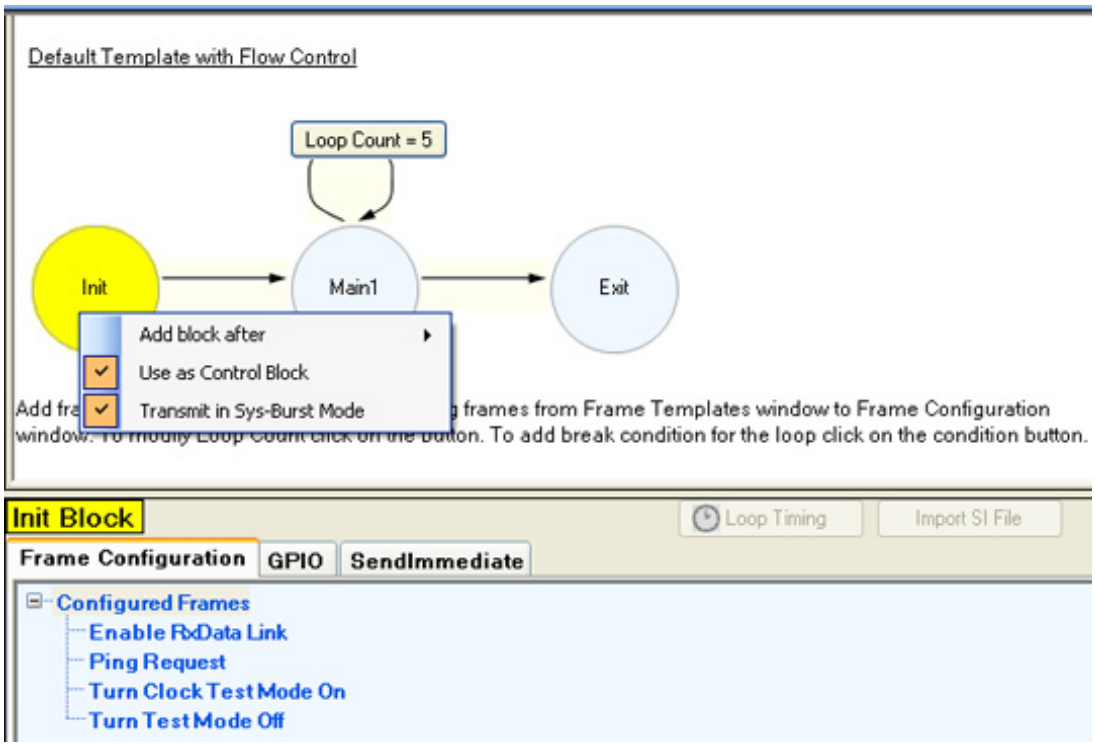


Figure 28 Transmission trigger example

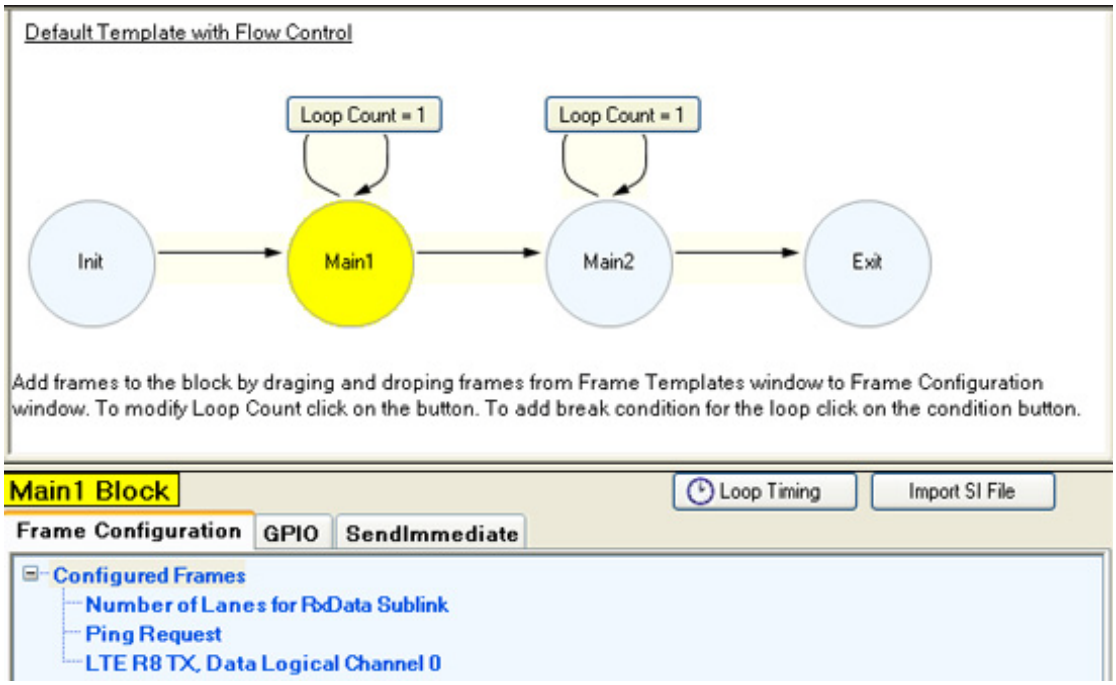
Traffic flow defined for the stimulus

The following traffic flow has been defined to stimulate the RFIC.

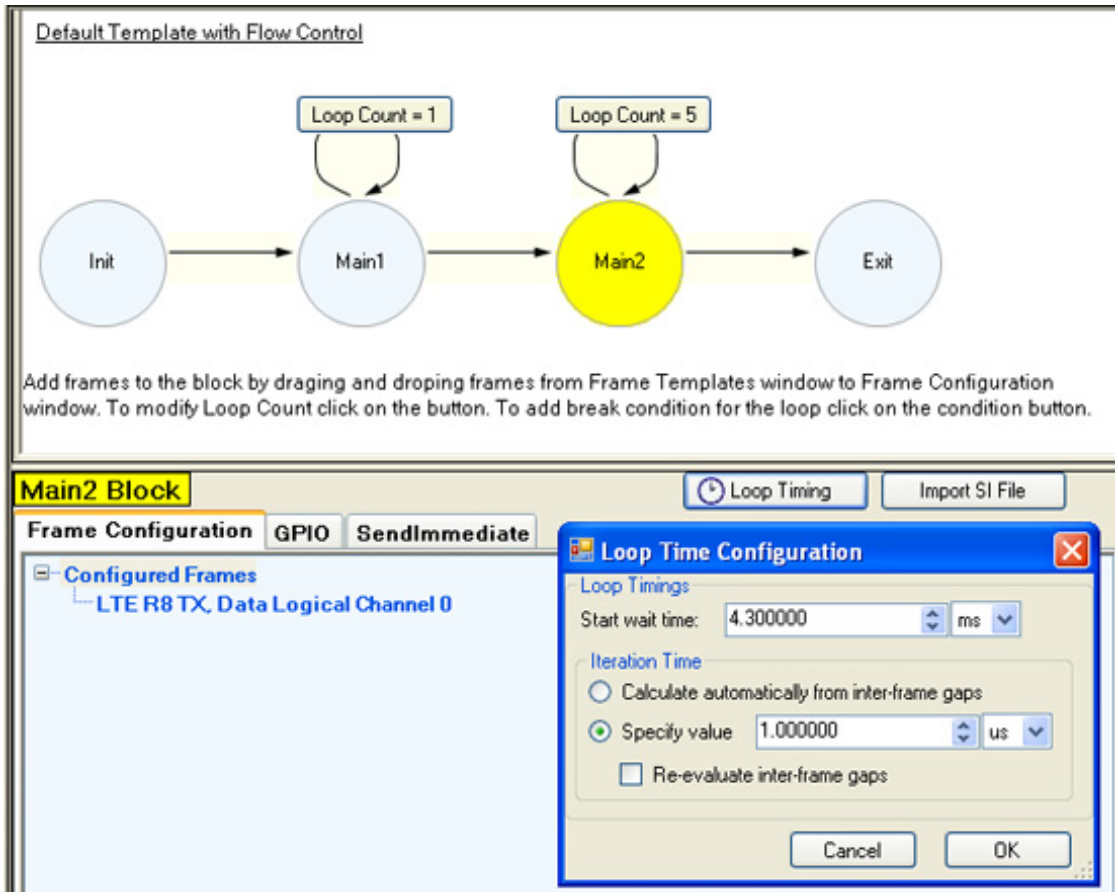
Init block - This block has been set as a control block with transmission in sys-burst mode. For the rest of the blocks in the stimulus traffic flow, the transmit mode of DigRF Exerciser returns to the HS-Burst mode set for the link.



Main blocks - In the first Main block, the RxData sublink is changed from a single lane to dual lanes to address the transmission of LTE R8 Tx data frames. After this, an LTE Tx frame is added with a CRI error to test how RFIC responds to the errored frame.

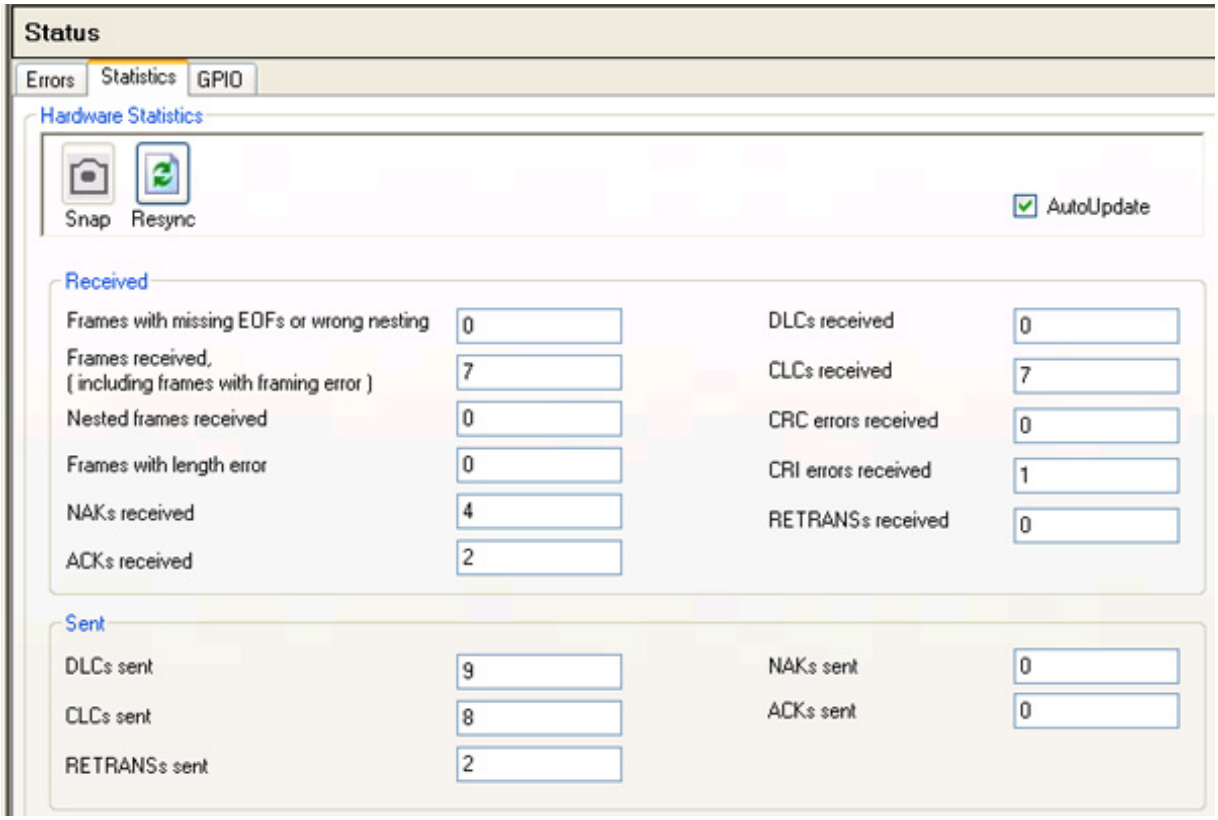


In the next Main block, **LTE R8 Tx** data frame has been added with a loop count set to 5. In this loop, the first LTE frame sequence will start after waiting for 4.3ms and the iterations will be 1us apart.



Stimulus results

The stimulus results are displayed when the above flow is executed by clicking the **Run** toolbar button. The results display some frames retransmitted from Exerciser for which Exerciser received a NACK from DUT. The frame that DigRF Exerciser received from RFIC with CRI error is also reported.


Status
Errors
Statistics
GPIO
Hardware Statistics
Snap
Resync
AutoUpdate
Received
Frames with missing EOFs or wrong nesting
0
Frames received,
(including frames with framing error)
7
Nested frames received
0
Frames with length error
0
NAKs received
4
ACKs received
2
DLCs received
0
CLCs received
7
CRC errors received
0
CRI errors received
1
RETRANSs received
0
Sent
DLCs sent
9
CLCs sent
8
RETRANSs sent
2
NAKs sent
0
ACKs sent
0

Capturing and Obtaining the DigRF Data for Analysis

Overview

Besides providing stimulus capabilities to test an RFIC or a BBIC, RDX Test Platform also includes capture capabilities to capture the DigRF data exchanged over a DigRF link between an RFIC and a BBIC.

The following diagram illustrates the basic sequence of the capture flow in RDX test platform followed by a brief description of this flow.

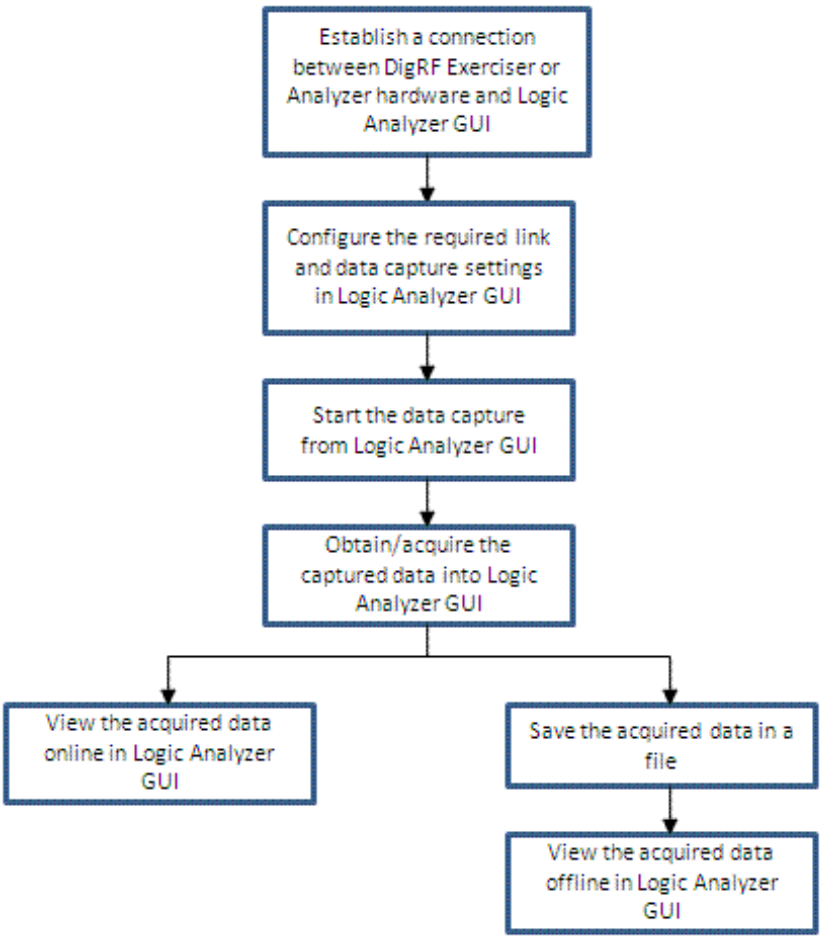


Figure 29 Capture flow

Capturing DigRF data

In RDX Test platform, you can use the following modules to capture DigRF data for validation and analysis:

- **DigRF Exerciser module (N5343A)**: You should use this module when you want to test and analyze an RFIC or a BBIC independent of the other link partner. DigRF Exerciser emulates the other link partner in this case. Using this module, you can capture either the TxData or RxData or the traffic flowing both ways, that is from the DUT to DigRF Exerciser and vice versa.
- **DigRF Analyzer module (N5344A)**: You should use this module when you want to capture the data exchanged between the integrated RFIC and BBIC to analyze and resolve the integration issues. Using this module, you can capture either the TxData or RxData or the traffic flowing both ways between the RFIC and BBIC.

For data capture, a session is needed with the DigRF Exerciser or Analyzer module to establish a connection between the module and the Logic Analyzer GUI. Then, you need to configure the link and data capture settings based on which the data capture is done.

Obtaining DigRF data

After capturing, you need to obtain/acquire the DigRF data captured using either DigRF Exerciser or Analyzer module into the Logic Analyzer GUI for viewing and analyzing it.

Viewing the captured DigRF data

You can use various DigRF Analysis tools to view and analyze the DigRF data obtained in the Logic Analyzer GUI. There are two ways to view the obtained data in Logic Analyzer GUI:

- **Online** - This method requires a connection between the Logic Analyzer GUI and the DigRF Exerciser / Analyzer hardware.
- **Offline** - This method does not require a connection between the Logic Analyzer GUI and DigRF Exerciser/Analyzer hardware used for capturing data. While obtaining the captured data from the module, you can save the data in a file and later view it offline in the Logic Analyzer GUI.

VSA integration capability

You can choose to integrate the run routines of Agilent's 89601A VSA and Agilent Logic Analyzer software so that VSA can draw real-time graphs from the data captured using the DigRF Exerciser/Analyzer module.

The topics that follow describe how to capture the TxData, RxData, or both sides data, how to obtain this data in Logic Analyzer GUI, and how to view it in online and offline modes.

Establishing a Connection with DigRF Exerciser/Analyzer Module

To capture Tx or Rx DigRF data, you first need to establish a connection between the Logic Analyzer GUI and the DigRF Exerciser or Analyzer module that you have decided to use for the data capture. By establishing this connection, you can control, configure, and use the data capture capabilities of the DigRF Exerciser or DigRF Analyzer module through the Logic Analyzer GUI.

You establish this connection by creating a session or using an existing session on the system controller PC that hosts the Logic Analyzer GUI. Before establishing the connection, ensure that the system controller PC is connected to the chassis that has the DigRF Exerciser or Analyzer module hardware.

To establish a connection

1 Launch the Logic Analyzer GUI by clicking **Start > Programs > Agilent Logic Analyzer > Agilent Logic Analyzer** option on the Windows task bar.

   The **Offline Startup Options** dialog box is displayed.

2 Click **Continue Offline** to start the Logic Analyzer application in offline mode, that is, not connected to the Logic Analyzer hardware. To perform DigRF data capture or analysis, you do not need connectivity to the Logic Analyzer hardware.

   The **Agilent Logic Analyzer** GUI is displayed.

3 Click **Setup > Add External Protocol Analyzer....** from the main menu of Logic Analyzer GUI.

   The **External Protocol Analyzer** dialog box is displayed. You use this dialog box to create a session, use an existing session, and setup and control the data capture.

4 Depending on whether you are using DigRF Exerciser or Analyzer module for data capture, select **DigRFv4Exerciser** or **DigRFv4Analyzer** as the session type from the **Select Session Type** listbox.

5 If a session already exists with **DigRFv4Exerciser** or **DigRFv4Analyzer**, use that session by:

   a Clicking **Get Session List** to display a list of available sessions of the selected session type in the open list.

   b From the list of sessions available on the server, selecting a session and then clicking **Connect to a Session**.

Connected appears in the **Connected** column for the selected session which indicates that a connection has been created with DigRF Exerciser/Analyzer module.

6 If a session does not exists, you can create a new session with **DigRFv4Exerciser** or **DigRFv4Analyzer**:

a Click **Create New Session**.

The **Create New Session** dialog box is displayed.

b The module number for the DigRF Exerciser or the Analyzer module connected to the system controller are displayed along with the status of the module. Select the module with which you want to create a session for data capture.

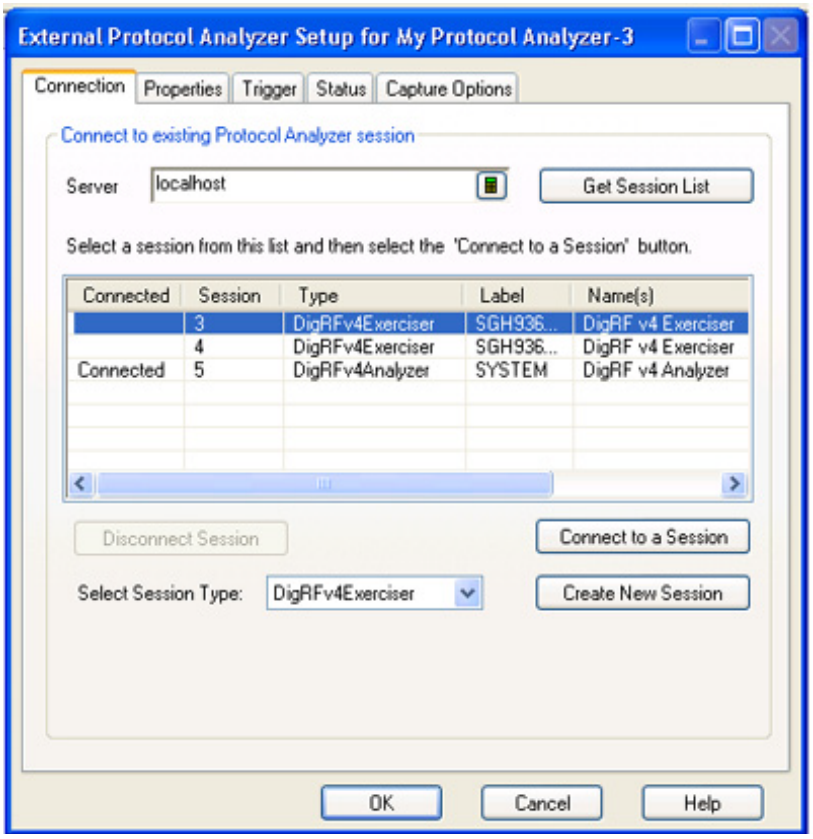
c Click **OK**.

A new session is created with the selected module. The session details are displayed in the Session list.

7 Select this newly created session from the list and click **Connect to a Session**.

Connected appears in the Connected column for the selected session which indicates that a connection has been created with DigRF Exerciser/Analyzer module.

Once a connection is successfully established through a session, the following additional tabs (besides the Connection tab) are added in the External Protocol Analyzer dialog box.



You can then use these additional tabs to configure and control the data capture with the selected DigRF Exerciser or Analyzer module with which the session has been created.

Configuring a Tx or Rx Data Capture Setup

When a session is created between the DigRF Exerciser / Analyzer module and the Logic Analyzer GUI, you can configure the data capture settings for the DigRF Exerciser/ Analyzer module. For instance, you can configure the DigRF link direction for which data capture should be done, a trigger condition that should start the data capture, and the frames that you want the module to capture.

To configure these settings for data capture, you use various tabs in the External Protocol Analyzer Setup dialog box in Logic Analyzer GUI. This is the same dialog box using which you created a connection between the DigRF Exerciser / Analyzer module and the Logic Analyzer GUI. After creating a connection, the relevant tabs are automatically added in this dialog box for configuring the data capture.

This topic describes how to configure the data capture settings to capture data over either a TxData or an RxData sublink using DigRF Exerciser / Analyzer module. To know how to perform dual capture on a DigRF link, refer to the topic Configuring a Dual Capture Setup on page 98.

To configure a Tx or Rx data capture setup, you need to set:

- a connection with DigRF Exerciser/Analyzer module
- link and data capture properties
- trigger condition(s) if you want to start capture on a trigger
- checks to be performed on the frames received in capture memory of DigRF Exerciser/Analyzer

Connection with DigRF Exerciser/Analyzer module

1. In the Logic Analyzer GUI, access the External Protocol Analyzer Setup dialog box for the module that you added with the connection to the DigRF Exerciser or Analyzer hardware. To do this, click the Connection Setup icon displayed in the module that you added for data capture in the Overview tab of the Logic Analyzer GUI. To know how to create a connection, refer to the topic Establishing a Connection with DigRF Exerciser/Analyzer Module on page 88.
2. Ensure that a session is created in the Connection tab with the DigRF Exerciser / Analyzer module.

Set link and data capture properties

1 Click the **Properties** tab in the **External Protocol Analyzer Setup** dialog box.

2 Select the link direction in which you want to do data capture.

If you are using DigRF Exerciser for data capture:

- **Tx** means the data transmitted by DigRF Exerciser will be captured.
- **Rx** means the data received by DigRF Exerciser will be captured.

If you are using DigRF Analyzer for data capture:

- **Tx** means data transmitted on the TxData sublink (BBIC to RFIC) will be captured.
- **Rx** means data transmitted on the RxData sublink (RFIC to BBIC) will be captured.

3 Select the DigRF protocol applicable for the DigRF link on which you want to perform data capture. There are two options, V4 which means DigRFv4 0.60 and V3 which means DigRFv3. If you select the REV 70 checkbox, it means the DigRFV4 0.70 protocol.

4 From the **RX Lanes** group box, select the number of lanes on which data is received in the capture memory of DigRF Exerciser or Analyzer module. For instance, if you are capturing the data transmitted by Exerciser (Tx data), then number of lanes are applicable for the Tx lanes of Exerciser. If you are using DigRF Exerciser to provide stimulus for this data capture, then the number of lanes should not clash with the number of lanes set for the stimulus in the Protocol Exerciser for DigRF GUI. If it clashes, then the data is not captured. By default, the number of lanes match the number of lanes set in the stimulus settings.

5 In the **RX Polarity** group box, set the polarity for the lanes on which data is received in the capture memory of DigRF Exerciser or Analyzer module. If you are using DigRF Exerciser to provide stimulus for this data capture, then the polarity of lanes should not clash with the polarity of lanes set for the stimulus in the Protocol Exerciser for DigRF GUI. If it clashes, then the data is not captured. By default, the polarity of lanes match the polarity set in the stimulus settings.

6 From the **Clock Source** group box, select the source for the reference clock if you are using DigRF Exerciser module for data capture. You can choose from the following options:

- **Internal**: Select if you want to use DigRF Exerciser's internal or onboard oscillator clock as the source.
- **External**: Select if you want to use an external clock source, such as a DUT clock source, for DigRF Exerciser.

7 Currently, only 26 MHZ is supported as the clock speed in a capture setup.

8 From the **Mode** group box, select the speed mode for the data capture. If you are using DigRF Exerciser to provide stimulus for this data capture, then the speed mode should not clash with the speed mode set for the stimulus in the Protocol Exerciser for DigRF GUI. If it clashes, then the data is not captured. This is applicable only for a DigRF v4 link.

9 From the **Rate** group box, select the DigRF interface line rate. This is applicable only for a DigRF v4 link. The effective Tx or Rx link speed is also displayed based on the **Mode** and **Rate** combination selected.

10 In the **Capture Setup** group box, choose which frames you want to store in the capture memory of DigRF Exerciser/Analyzer. You can store:

- either all the frames in the configured link direction.
- only those frames in the configured link direction whose first four bytes match the specified pattern.

11 From the **Maximum Capture memory** percentage slider, select the percentage of the capture memory of DigRF Exerciser module that you want to allocate for the storage of data captured in the configured link direction. This lets you divide the capture memory between Tx and Rx data captured using the DigRF Exerciser module. This step is not applicable if you are using the DigRF Analyzer module for data capture. Unlike the DigRF Exerciser module, the capture memory of DigRF Analyzer module is not divided between the Tx and Rx data capture.

NOTE The DigRF Exerciser and Analyzer modules have 512 MB of capture memory to store the captured data. Out of this 512 MB of memory, the captured data is stored in 380 MB. The rest of memory (approximately 132 MB) is consumed by internal bookkeeping logic. If you are capturing data using the DigRF Exerciser module, you can divide this 380 MB between the Tx and Rx data captured.

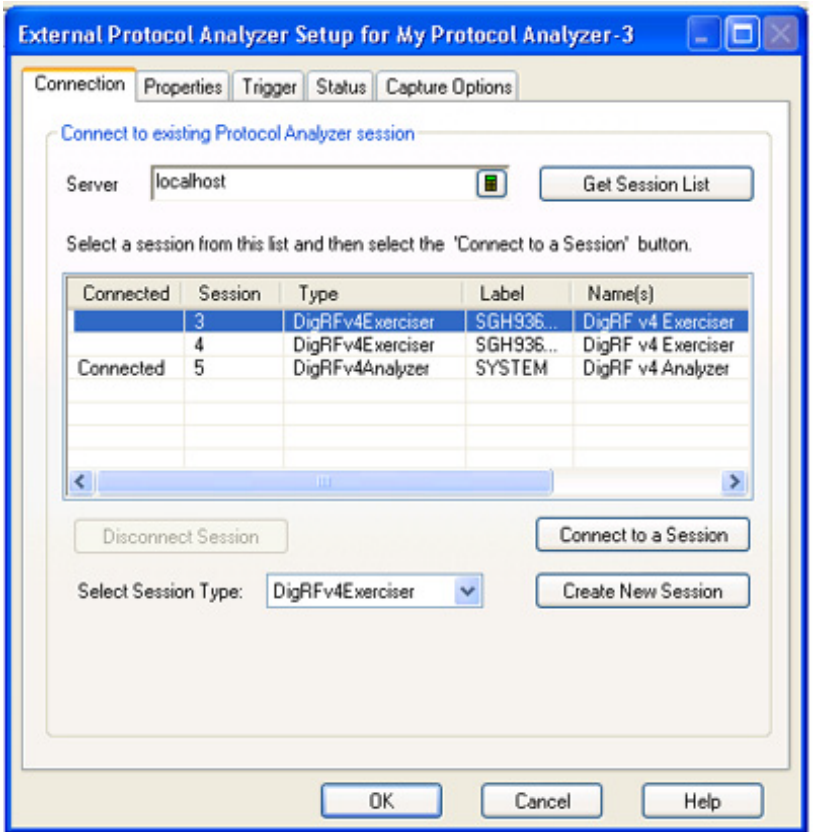
12 In the **Maximum Trace Size (%)** field, specify the percentage of the maximum capture memory of Exerciser/Analyzer module to be used for storing the total (pre and post trigger) capture trace.

13 In the **Maximum Pre trigger trace size (%),** specify the percentage of the maximum trace size to be used for storing the captured data before the capture trigger condition specified in the Trigger tab is met. The remainder of the memory allocated for the maximum trace size is used for storing post trigger data capture.

14 Select the **Go Online** checkbox to ensure that clicking the  **Run** toolbar button starts the data capture as well as uploads the captured data from the memory of DigRF Exerciser/Analyzer into Logic Analyzer GUI for display and analysis. If this checkbox is not selected, then you first need to start the data capture using the **Start** button in the Status tab of this dialog box. Then, you need to click the  **Run** toolbar button to upload the captured data from the memory of DigRF Exerciser/Analyzer into Logic Analyzer GUI. Selecting this checkbox eliminates the need for explicitly clicking the Start button to start the data capture. Refer to the topics Starting the Data Capture on page 106 and Obtaining/Acquiring the Captured Data on page 109 to know more.

15 Select the **Auto Probe Configuration** check box to ensure that the probe used with the DigRF Analyzer module to passively probe the link is automatically configured as per the data capture settings. This option is disabled if you use DigRF Exerciser for data capture.

The module that you added for data capture in the Overview tab of the Logic Analyzer GUI now contains the link and data capture settings. The following screen displays a module that has the settings for capturing the data transmitted from the DigRF Exerciser module.



Set trigger condition(s) to start capture on a trigger

In this tab, you can enable the data capture to start only when a specified trigger condition is met. The data captured when the trigger condition is met is stored in the post trigger capture memory of DigRF Exerciser/Analyzer module. The maximum size of the post trigger capture trace is determined by the capture memory settings that you configured in the Properties tab. The capture stops automatically when the allocated post trigger capture memory is full.

1 Click the **Trigger** tab in the **External Protocol Analyzer Setup** dialog box.

2 Select the **Enable capture on trigger** checkbox to ensure that the data capture starts only when the trigger condition(s) that you specify in this tab are met.

3 Specify the patterns that serve as the conditions to start data capture. You can specify upto four patterns, each comprising of four bytes with the first byte to match the header and the next three bytes to match the payload of a captured frame. During the data capture flow, the

header and payload of the frames in the configured link direction are checked against these patterns. If the first four bytes of a frame (first byte for header and the next three bytes for payload) match with one of these patterns, the trigger condition is met and the data is stored in the post trigger capture memory. You can also use a value of XX in a pattern to indicate that this byte in the pattern can match any value in the corresponding byte in the frame. Also, if you specify a pattern value with less than four bytes, the remaining bytes in the pattern are automatically filled by XX to match any value for these bytes in the frame. For instance, if you specify the pattern as XX55FF55 Hex, then the frames with any value in the header and 55FF55 pattern for the first three bytes of payload will trigger the data capture. To get an example of trigger patterns, refer to the topic Example - DigRF Data Capture on page 130.

4 You can select the **Trigger out** checkbox displayed with each pattern field to send a trigger out pulse when a frame in the configured link direction matches the pattern. The trigger out pulse is sent from the DigRF Exerciser/Analyzer module that you used for data capture to the test equipment connected to its Trigger Out Connector pin.

5 Besides specifying patterns as the trigger conditions, you can also specify an external trigger in signal as the trigger condition to start data capture. If you select the **External trigger in** checkbox, the data capture starts when a trigger in signal is received by DigRF Exerciser/Analyzer module on its Trigger in connector pin from another test equipment.

To get an example of trigger conditions set for the data capture, refer to the topic Example - DigRF Data Capture on page 130.

Set checks to be performed on the captured frames

1 Click the **Capture Options** tab in the **External Protocol Analyzer Setup** dialog box.

2 Deselect the checkboxes in the **Receive frame checks** group to enable the frame level checks to be performed on the captured frames. You can deselect the Disable CRI checking checkbox to ensure that the captured frames are checked for the missing or incorrect CRI number. Based on the checks that you select here, the Error counters in

the Status tab are updated for the errors encountered in the captured frames.

3 In the **Expected length of DLC frames** group box, set the expected length of the captured data frames. DigRF Exerciser uses this length to check A captured data frame is checked to match the expected length specified for that DLC type. A **Frame with length error** is reported in the Status page if length checking is enabled and a captured data frame crosses the expected length.

4 The **Probe Configuration** group box is enabled if you are using the DigRF Analyzer module for data capture. You can select the type of configurations that you want to use for the probe connected with the DigRF Analyzer module to passively probe the link. If you want to capture high speed DigRFv4 data with lower Sync and Prep values (preferred values - Sync=5 and Prep=4) using the DigRF Analyzer module, then select the V4 Dual Probing configurations for the probe. If dual probing configurations are not used, then in HS-BURST non-continuous mode, DigRF Analyzer can capture data correctly only with higher values of Sync (>10) and Prep (>4).

NOTE You can save the data capture configurations done in the Logic Analyzer GUI in a .ala configuration file. To save the configurations, click File -> Save in the Logic Analyzer GUI.

You can change the link or data capture settings for a module by clicking the 

icons displayed on the module.

Once the module is ready with the data capture settings, you can start capturing the data.

Configuring a Dual Capture Setup

This topic describes how you can configure the data capture settings in the Logic Analyzer GUI to capture the bidirectional data (Tx as well as Rx) over a DigRF link. The usage of both DigRF Exerciser and Analyzer module is described to perform dual capture.

Using DigRF Exerciser module

When you perform dual capture using the DigRF Exerciser module, it captures the data that it transmits to the DUT (Tx data) as well as the data that it receives from the DUT (Rx data) over the DigRF link. Both the Tx and Rx data are stored in the Capture memory of the DigRF Exerciser module. You can configure how the total capture memory size of the DigRF Exerciser module should be divided to store the captured Tx and Rx data. The total size of the capture memory of the DigRF Exerciser module is 512 MB. Out of the total 512 MB of memory, the captured data is stored in 380 MB. The rest of memory (approximately 132 MB) is used by internal bookkeeping logic. You can divide this 380 MB of memory between the Tx (data transmitted by DigRF Exerciser) and Rx (data received from DUT) storage.

NOTE To perform dual capture using the DigRF Exerciser module, you should have the required license of the DigRF Exerciser module with the dual capture capabilities. You can add this license using the License Programmer tool. Refer to the topic Adding and Viewing Available Licenses on page 31 to know more.

To configure dual capture setup using the DigRF Exerciser module:

1. Configure the data capture setup for Tx data capture (data transmitted from DigRF Exerciser). To do this:
   a. Access the **External Protocol Analyzer Setup** dialog box in the Logic Analyzer GUI.
   b. Ensure that a session is created between the DigRF Exerciser module and Logic Analyzer GUI. Refer to the topic Establishing a Connection with DigRF Exerciser/Analyzer Module on page 88 to know more.
   c. Follow the steps mentioned in the topic Configuring a Tx or Rx Data Capture Setup on page 91 to create a setup for the Tx data capture. Ensure that:

- the **Link** direction is set to **Tx** in the **Properties** tab to make these settings applicable for Tx data capture, that is capturing the data transmitted by DigRF Exerciser.
- the percentage of total memory that you want to allocate to the Tx data storage is set in the **Maximum Capture Memory (Tx)** field in the **Properties** tab.

2 Configure the data capture setup for Rx data capture (data received by DigRF Exerciser). To do this:

a Access the **External Protocol Analyzer Setup** dialog box in the Logic Analyzer GUI.

b Connect to the DigRF Exerciser module using the same session as used in step 1 (Tx data capture). Refer to the topic Establishing a Connection with DigRF Exerciser/Analyzer Module on page 88 to know more.

c Follow the steps mentioned in the topic Configuring a Tx or Rx Data Capture Setup on page 91 to create a setup for the Rx data capture. Ensure that:

- the **Link** direction is set to **Rx** in the **Properties** tab to make these settings applicable for Rx data capture, that is capturing the data received by DigRF Exerciser.
- the percentage of total memory that you want to allocate to the Rx data storage is automatically set in the **Maximum Capture Memory (Rx)** field in the Properties tab. This setting is calculated based on the memory that you allocated for the Tx data storage in Step 1.

The following screens display a Tx (data transmitted by DigRF Exerciser) and then an Rx (data received by DigRF Exerciser) data capture module.

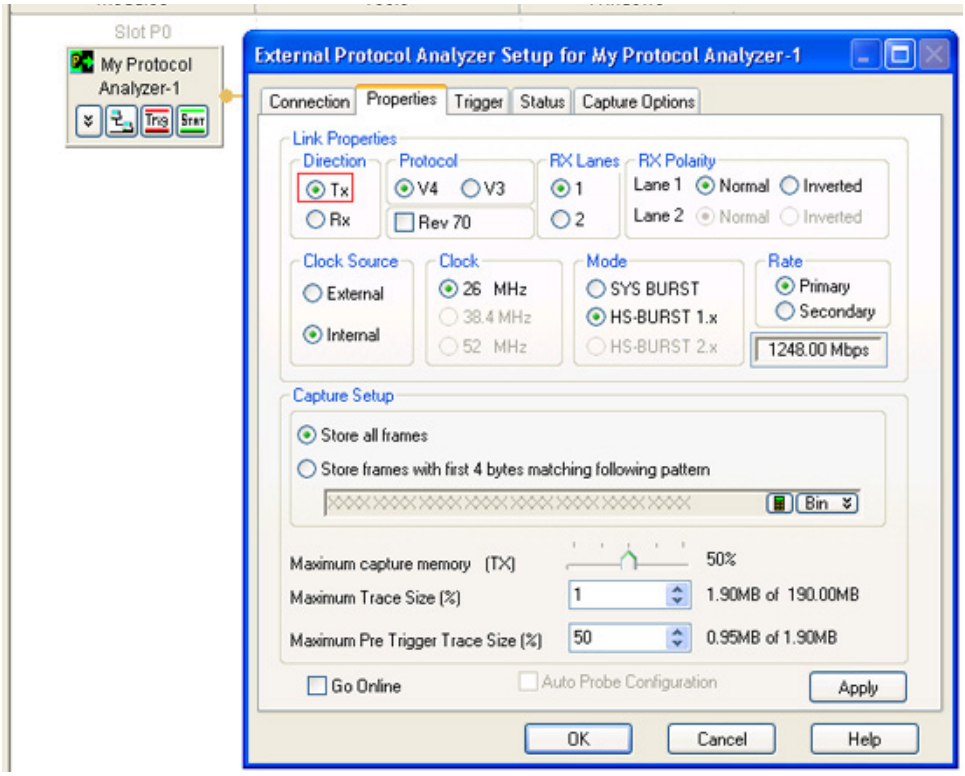


Figure 30 Tx data capture module

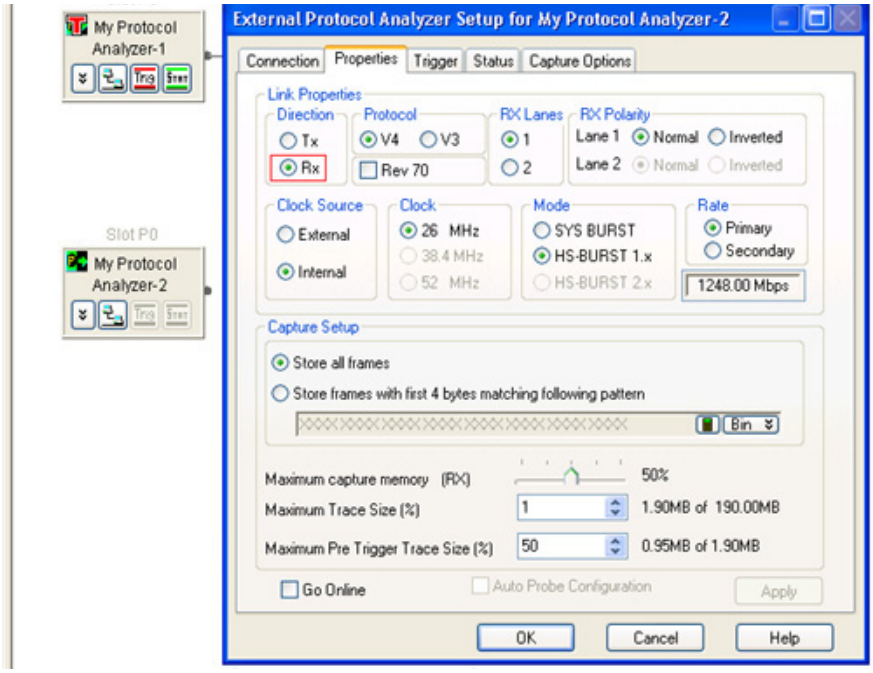
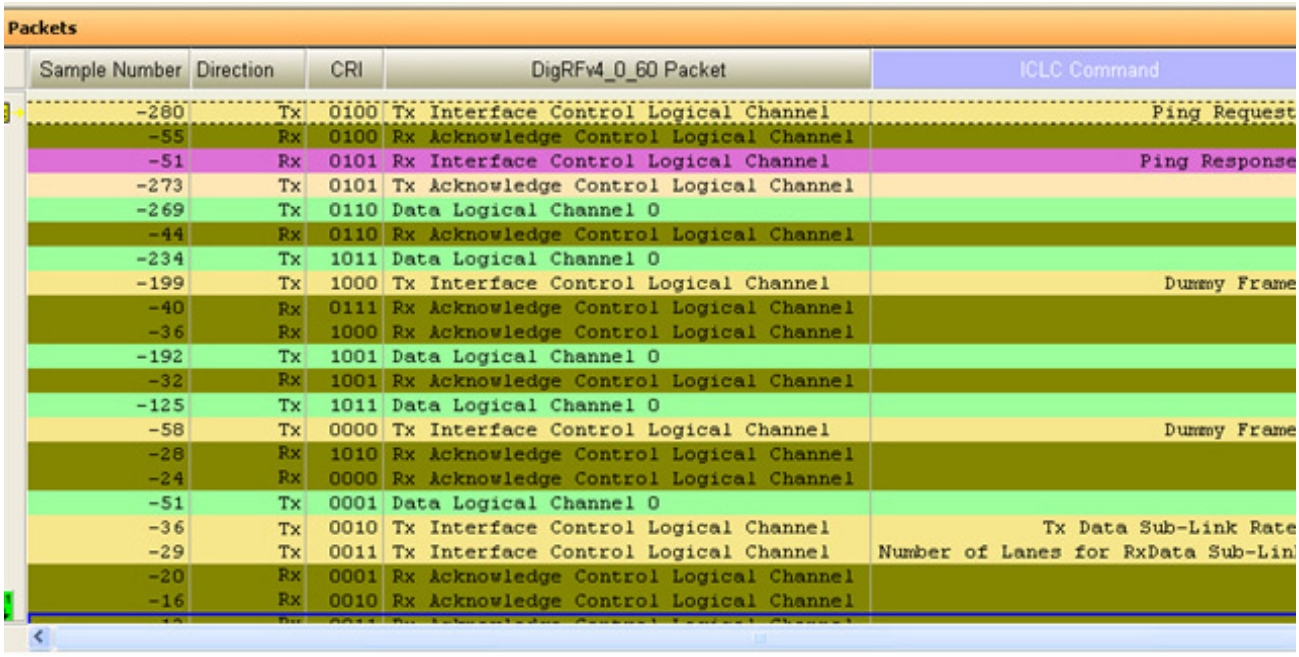


Figure 31 Rx data capture module

Once the data capture module setups are added in Logic Analyzer, you can add the Packet Decoder and Packet Viewer tools to complete the configuration of data capture.

When you start dual capture as per the configured settings, DigRF Exerciser captures the Rx data in relation to the Tx data, that is, it captures the stimulus transmission and the response to the transmission. The following screen displays a sample output of the dual data capture in the Logic Analyzer GUI. To get a detailed example of how to view dual capture data, refer to the topic Viewing the Captured DigRF Data Online on page 112.



Packets

Sample Number	Direction	CRI	DigRFv4_0_60 Packet	ICLC Command
-280	Tx	0100	Tx Interface Control Logical Channel	Ping Request
-55	Rx	0100	Rx Acknowledge Control Logical Channel	
-51	Rx	0101	Rx Interface Control Logical Channel	Ping Response
-273	Tx	0101	Tx Acknowledge Control Logical Channel	
-269	Tx	0110	Data Logical Channel 0	
-44	Rx	0110	Rx Acknowledge Control Logical Channel	
-234	Tx	1011	Data Logical Channel 0	
-199	Tx	1000	Tx Interface Control Logical Channel	Dummy Frame
-40	Rx	0111	Rx Acknowledge Control Logical Channel	
-36	Rx	1000	Rx Acknowledge Control Logical Channel	
-192	Tx	1001	Data Logical Channel 0	
-32	Rx	1001	Rx Acknowledge Control Logical Channel	
-125	Tx	1011	Data Logical Channel 0	
-58	Tx	0000	Tx Interface Control Logical Channel	Dummy Frame
-28	Rx	1010	Rx Acknowledge Control Logical Channel	
-24	Rx	0000	Rx Acknowledge Control Logical Channel	
-51	Tx	0001	Data Logical Channel 0	
-36	Tx	0010	Tx Interface Control Logical Channel	Tx Data Sub-Link Rate
-29	Tx	0011	Tx Interface Control Logical Channel	Number of Lanes for RxData Sub-Lin
-20	Rx	0001	Rx Acknowledge Control Logical Channel	
-16	Rx	0010	Rx Acknowledge Control Logical Channel	

Figure 32 Dual data capture results

NOTE

To get co-related data from the dual capture setup, ensure that you use the same Packet Viewer window in Logic Analyzer GUI to view the packets captured in Tx as well as the Rx direction. Refer to the topic Viewing the Captured DigRF Data Online on page 112 to know how you can view the bidirectional data captured over a DigRF link.

Using DigRF Analyzer module

You can perform dual capture using the DigRF Analyzer module by monitoring a DigRF link between two DUTs (BBIC and RFIC) and capturing the DigRF data flowing both ways with the help of a flying lead or a midbus probe.

To accomplish dual capture, you need to configure two data capture setups in Logic Analyzer GUI, one for Tx data capture and another for Rx data capture. Here, Tx data capture means capturing data on the TxData sublink that is, BBIC to RFIC. Rx data capture means capturing data on the RxData sublink, that is, from RFIC to BBIC.

Unlike the DigRF Exerciser module, you do not divide the capture memory (380 MB) of DigRF Analyzer into Tx and Rx capture memory.

Once the data capture module setups are added in Logic Analyzer, you can add the Packet Decoder and Packet Viewer tools to complete the configuration of data capture.

NOTE

To get co-related data from the dual capture setup, ensure that you use the same Packet Viewer window in Logic Analyzer GUI to view the packets captured in Tx as well as the Rx direction. Refer to the topic Viewing the Captured DigRF Data Online on page 112 to know how you can view the bidirectional data captured over a DigRF link.

Configuring Data Capture with VSA Integration

This topic describes how you can configure the data capture setup to ensure that the captured data is simultaneously sent from Logic Analyzer to the VSA GUI for further RF analysis. The VSA integration with the data capture enables VSA to generate real time graphs from the captured data received from the Logic Analyzer GUI. This topic describes the configurations that you need to perform on the Logic Analyzer GUI and the VSA GUI to enable integration of VSA while data capture for online analysis of the captured data.

When integrated with data capture, VSA runs to the end of the current Logic Analyzer data capture buffer and instructs or triggers the Logic Analyzer to run again for recapture.

Configuring Logic Analyzer GUI for online analysis using VSA

1. Configure the Tx or Rx data capture setup as stated in the topic Configuring a Tx or Rx Data Capture Setup on page 91. In this capture setup configuration, select the Go online checkbox to ensure that you do not have to manually start and stop data captures in the Logic Analyzer GUI when VSA triggers the Logic Analyzer GUI for recapture.
2. Ensure that the post trigger capture memory of the DigRF Exerciser/Analyzer module is set to 100%. This is necessary so that pre trigger memory is not utilized at all and all the captured data gets filled in the post trigger memory. Refer to the topic Configuring a Tx or Rx Data Capture Setup on page 91 to know how to set this memory.
3. Ensure that the data capture on trigger is enabled with all XX masking as the trigger pattern. This step ensures that the trigger condition is met immediately when the data capture starts and the post trigger memory starts filling. When the VSA trigger type is free-run, it ignores any trigger setup on the Logic Analyzer. VSA then processes the input data as quickly as possible, without waiting for any kind of triggering signal.

Configuring the VSA GUI for online analysis of captured data

1. Start the VSA GUI.
2. Link the VSA GUI to the Logic Analyzer application.
   a. VSA gets the Logic Analyzer address using the 89600 IO Connections software utility. The 89600 IO

Connections software utility is installed with the VSA software and is located at **Start** > (All) **Programs** > **Agilent 89600 VSA** > **Logic Analyzer** > **IO Connections**. If the Logic Analyzer application resides on the same PC as the VSA, then use the name "localhost."

b In the **VSA** GUI, click **Utilities** > **Hardware** > **ADC 1**. Clear **Simulate Hardware** if currently selected and select **Agilent VSA Logic Analyzer Input**. VSA will then link to the Logic Analyzer application.

To get detailed information on configurations in the VSA GUI, refer to the VSA online help.

You also have the option to analyze the captured data in VSA in offline mode, that is no connection is needed with the DigRF Exerciser/Analyzer for analysis. Refer to the topic, Analyzing Captured Data using VSA on page 175 to know more.

Starting the Data Capture

After you have added the required modules with the data capture settings in the Overview tab of the Logic Analyzer GUI, you can start the data capture. On starting the data capture, the hardware (DigRF Exerciser or Analyzer module) that you have selected for data capture, starts capturing the data as per your configured settings. This captured data is stored in the memory of the DigRF Exerciser / Analyzer module as per the maximum capture memory that you specified in the data capture setup. The statistics for data capture are updated simultaneously in the Logic Analyzer GUI to help you ascertain whether or not the frames are getting captured.

NOTE If you are using both the stimulus and capture capabilities of DigRF Exerciser, then ensure that you start the data capture in Logic Analyzer GUI before starting the stimulus in the Protocol Exerciser for DigRF GUI. If this sequence is not followed, the number of frames captured is displayed as 0 in Logic Analyzer GUI.

To start the data capture:

If the Go Online checkbox is not selected in the Properties tab of the External Protocol Analyzer Setup dialog box:

1 In the Logic Analyzer GUI, access the External Protocol Analyzer Setup dialog box for the module that you added with the required data capture settings. To do this, click the  **Status** icon displayed in the module in the Overview tab of the Logic Analyzer GUI.

   The **Status** tab of the External Protocol Analyzer Setup dialog box is displayed.

2 Click the **Start** button in the **Status** tab.

On starting the data capture, the DigRF Exerciser or Analyzer module with which the session is created starts capturing data in the configured link direction (Tx or Rx). The Capture State is displayed as **Running** in the Status tab. The Statistics and error counters for the data capture are simultaneously updated during the capture. However, the total number of frames captured is updated when the data capture stops automatically or you stop it manually.

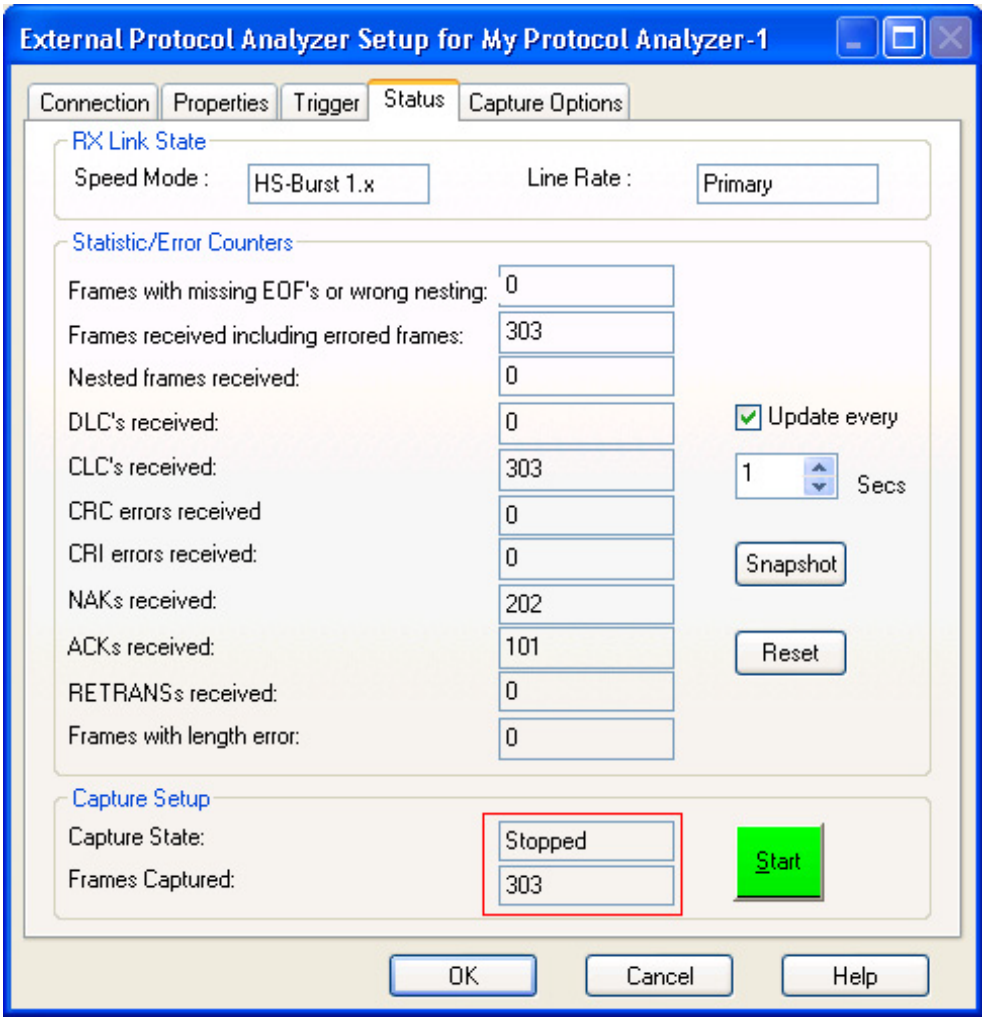


Figure 33 Data capture status

The capture stops:

- automatically when the capture memory of the module that you specified to store the captured data is full.
- if you manually stop the capture by clicking **Stop** in the Status tab of the External Protocol Analyzer Setup dialog box for the module.

NOTE Once the data capture has stopped, you need to obtain/acquire the captured data from the DigRF Exerciser/Analyzer module's memory into the Logic Analyzer GUI by clicking the toolbar button. Once the captured data is obtained in the Logic Analyzer GUI, you can decode the packets and view it using Packet Viewer.

If the Go Online checkbox is selected in the Properties tab of the External Protocol Analyzer Setup dialog box:

1 Click the **Run** toolbar button in Logic Analyzer GUI. Clicking this button starts the data capture as well as uploads the captured data into the Logic Analyzer GUI for display and analysis. In this case, you need not start the data capture using the **Start** button in the **Status** tab of the External Protocol Analyzer Setup dialog box.

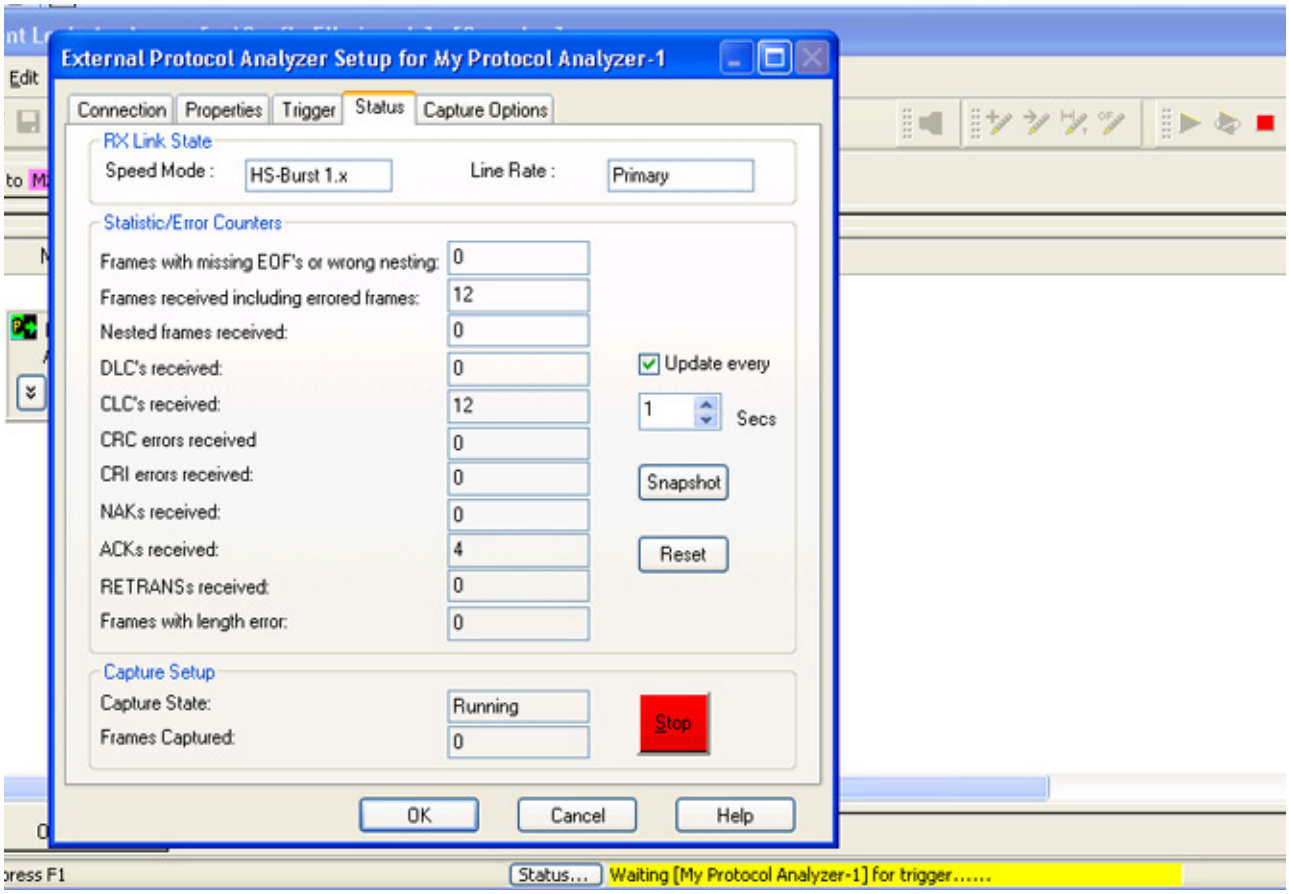


Figure 34 Data capture with ***Go Online*** selected

The Capture State is displayed as Running in the Status tab. The Statistics and error counters for the data capture are simultaneously updated during the capture. However, the total number of frames captured is updated when the data capture stops automatically or you stop it manually. When the data capture stops automatically or manually by either clicking Stop in the Status tab or clicking the **Stop** toolbar button, the data is available in the GUI for display and analysis.

Obtaining/Acquiring the Captured Data

Once the data capture starts using the **Start** button in the **Status** tab, the DigRF Exerciser/ Analyzer module stores the captured data in its memory as per the memory allocation that you configured for the data capture.

To view and analyze the captured data, you need to obtain/acquire the captured data from the DigRF Exerciser / Analyzer memory into Logic Analyzer GUI.

NOTE To obtain/acquire the captured data from the DigRF Exerciser / Analyzer module, a connection (session) is required with the DigRF Exerciser / Analyzer hardware while obtaining the captured data into Logic Analyzer GUI. In the absence of this session, the captured data is not acquired.

To obtain the captured data:

1 Click the **Run** toolbar button from the **Run/Stop** toolbar of the Logic Analyzer GUI. Alternatively, you can also click the **Run Repetitive** toolbar button. Both these buttons perform the same function in case of captured data acquisition from the DigRF Exerciser/Analyzer module.

The **Status** page is displayed with the acquisition details of the captured data. This page is displayed to show the status of acquisition if the data capture is in progress and you have started data acquisition simultaneously or if the data acquisition is in progress.

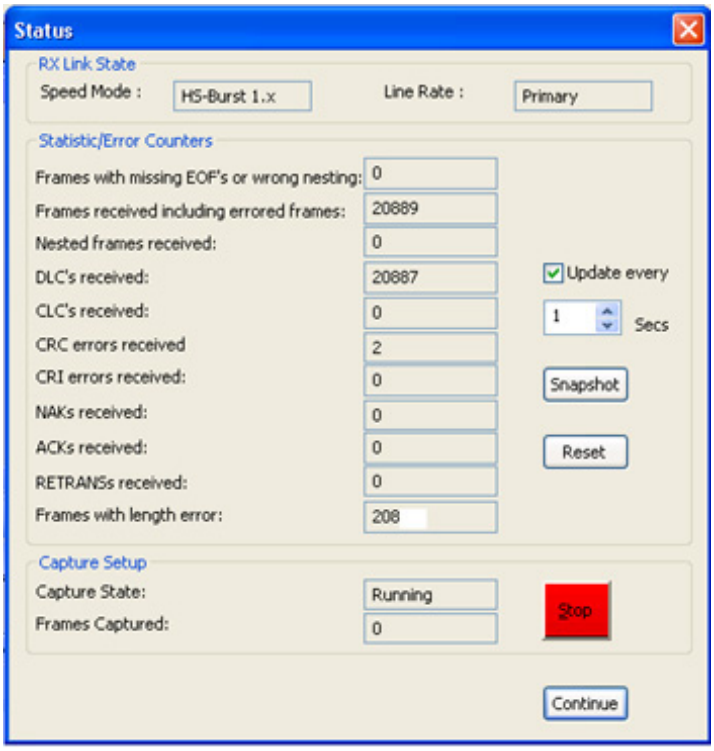


Figure 35 Data acquisition status

All the data captured in the configured direction is acquired from the connected DigRF Exerciser or Analyzer module after which the acquisition stops automatically. Or else, you can also stop the acquisition manually by clicking the Stop button in Status page. The total number of frames acquired is displayed in the **Frames Captured** field after you click Stop to stop the data acquisition process.

Once the data is acquired, you can view it using DigRF tools such as Packet Viewer. Refer to the topic Viewing the Captured DigRF Data Online on page 112 to know more.

NOTE

The acquired data is not displayed for viewing in tools such as Packet Viewer until:

- either the data capture has completed.
- or the data capture/acquisition is manually stopped.

Data Capture and acquisition with the Run toolbar button

The **Run** toolbar button only acquires the already captured data from the connected DigRF Exerciser or Analyzer module. However, you can also use it to perform both the tasks of starting the data capture as well as acquiring the captured data with a single click of this button. To do this, you need to select the **Go online** check box in the **Properties** tab of the External Protocol Analyzer Setup dialog box while configuring the data capture settings.

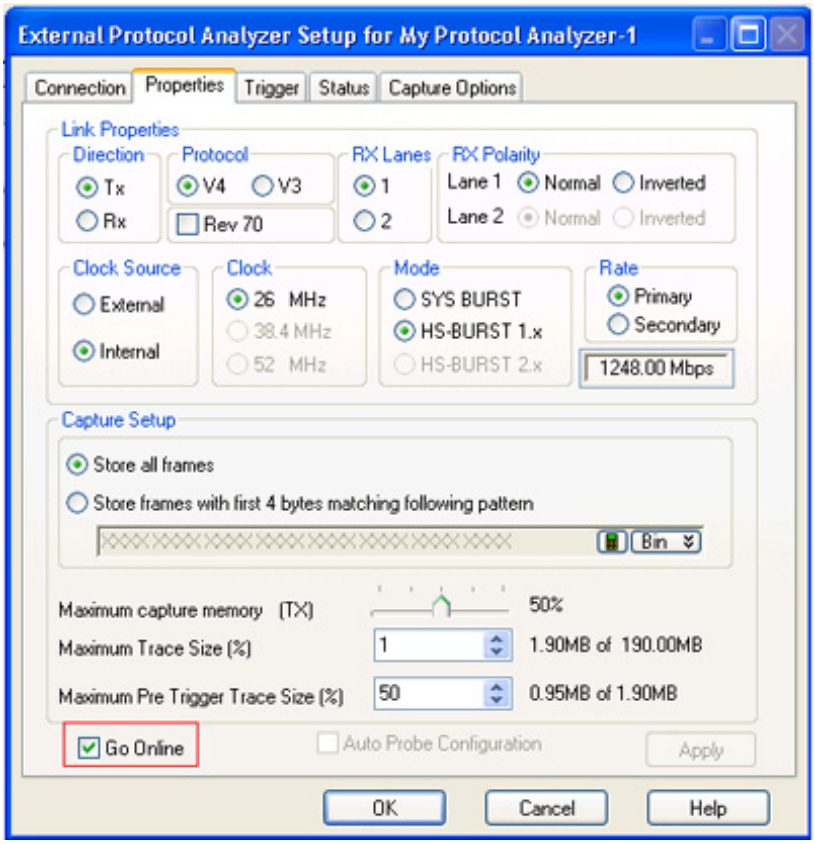


Figure 36 Data capture with the Go online option

Viewing the Captured DigRF Data Online

This topic describes how you can view the data that you captured using either DigRF Exerciser or Analyzer module. Once a session is created and the data is captured and obtained in the Logic Analyzer GUI, you can view this data in the Logic Analyzer GUI. You use the DigRF Analysis tools such as Packet Viewer and Packet Decoder to view the captured data. This data is available for viewing till you do not start the acquisitions of another data capture using the data capture module.

Viewing the unidirectional (Tx or Rx) data capture

In the following example, data sent from BBIC to RFIC (DigRF Exerciser in this case) on the TxData sublink has been captured by adding a data capture module for the Rx side of the DigRF Exerciser.

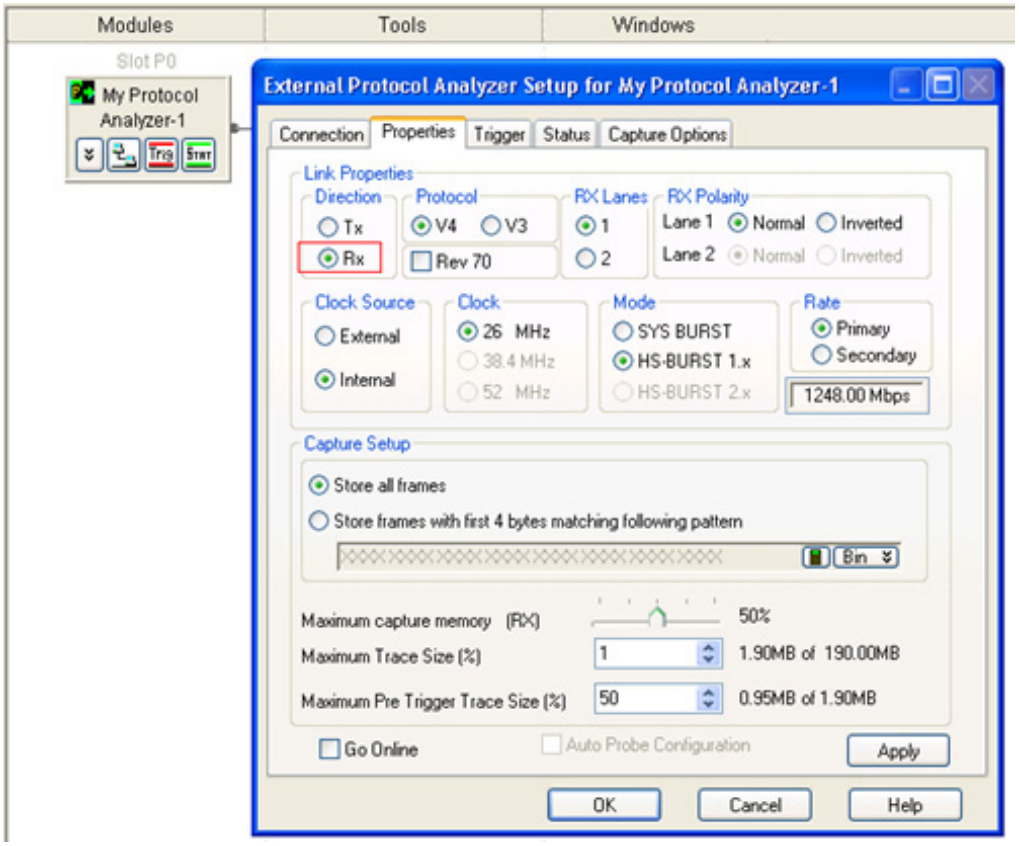


Figure 37 Rx data capture module setup

Using the **Run** toolbar button, the captured data has already been acquired into Logic Analyzer GUI.

To view this acquired data, a Packet Decoder instance is added with the following settings to decode the captured Tx packets that is, packets sent from BBIC to DigRF Exerciser on the TxData sublink. Notice that the Decode bus has been selected as Tx.

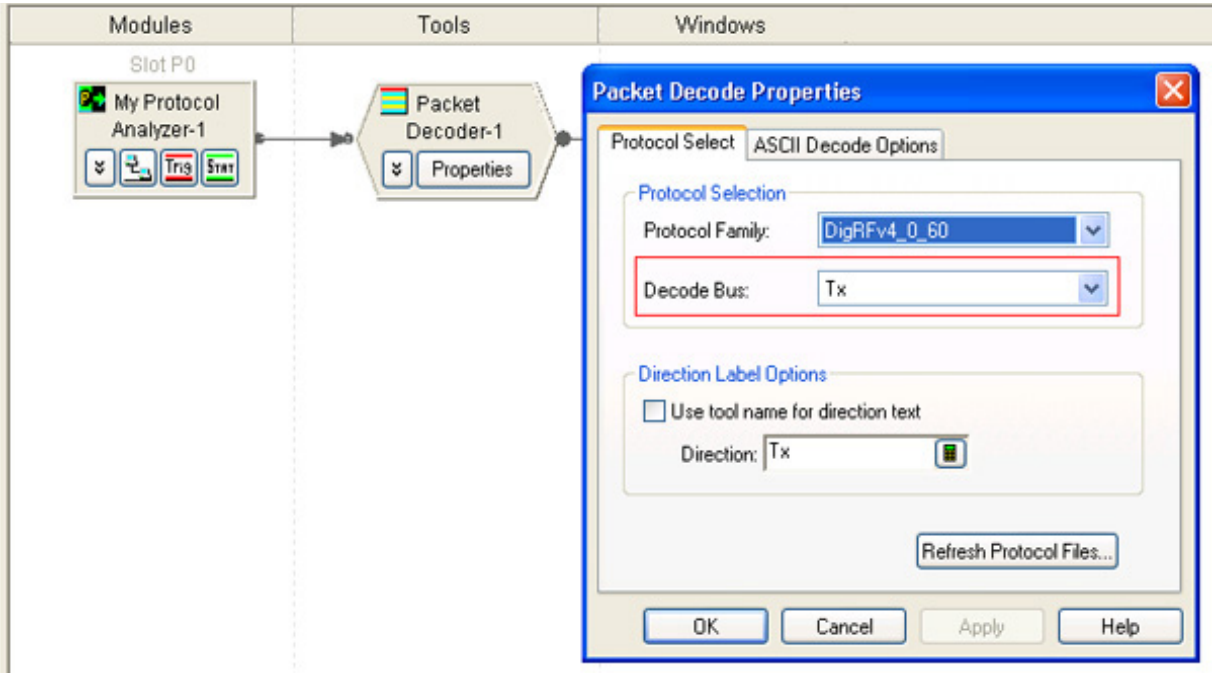


Figure 38 Packet Decoder for the captured Tx packets

To view the decoded Tx packets, a Packet Viewer instance has been added to the Packet Decoder instance. To view the decoded Rx packets as waveforms, the waveform view has been added to the Packet Decoder instance.

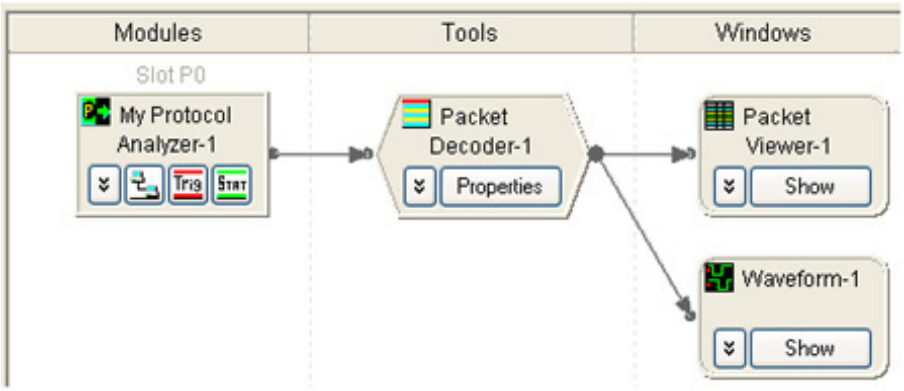


Figure 39 Waveform and Packet Viewer for viewing captured data

The captured Tx packets are displayed in the following screen using Packet Viewer.

Packets

Sample Number	Direction	CRI	DigRFv4_0_60 Packet	ICLC Command	ICL
-106	Tx	0101	Tx Interface Control Logical Channel	Ping Request	
-99	Tx	0110	Tx Interface Control Logical Channel	Tx Data Sub-Link Rate	
-92	Tx	0111	Tx Interface Control Logical Channel	Rx Data Sub-Link Rate	
-85	Tx	1000	Tx Acknowledge Control Logical Channel		
-81	Tx	1001	Data Logical Channel 0		
-46	Tx	1011	Data Logical Channel 0		
-11	Tx	0000	Tx Interface Control Logical Channel	Dummy Frame	
-4	Tx	0001	Tx Acknowledge Control Logical Channel		

Figure 40 Captured data displayed in Packet Viewer

Viewing the bidirectional data capture

The following is an example of how you can view the data captured in both Tx and Rx directions (dual capture).

In this example, the following data capture module has been added to capture the data sent from the BBIC (DigRF Exerciser in this case) to RFIC. This data capture module captures the Tx side of DigRF Exerciser.

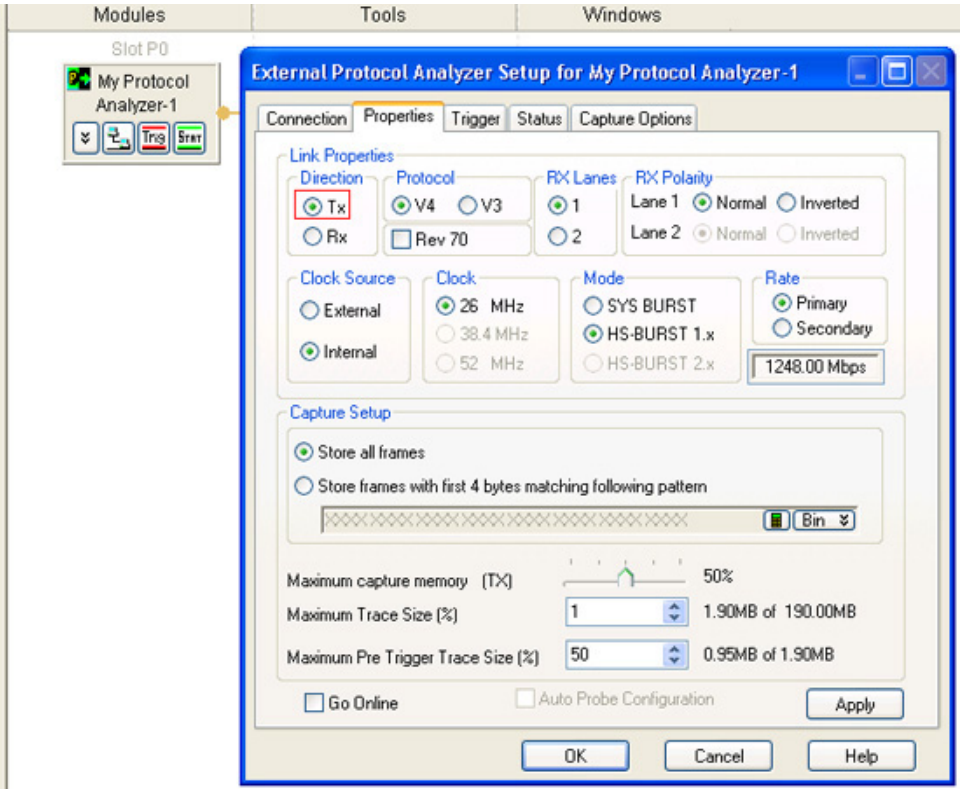


Figure 41 Tx data capture module setup

Another data capture module has been added to capture the data sent from RFIC to BBIC (DigRF Exerciser in this case). This data capture module captures the Rx side of DigRF Exerciser.

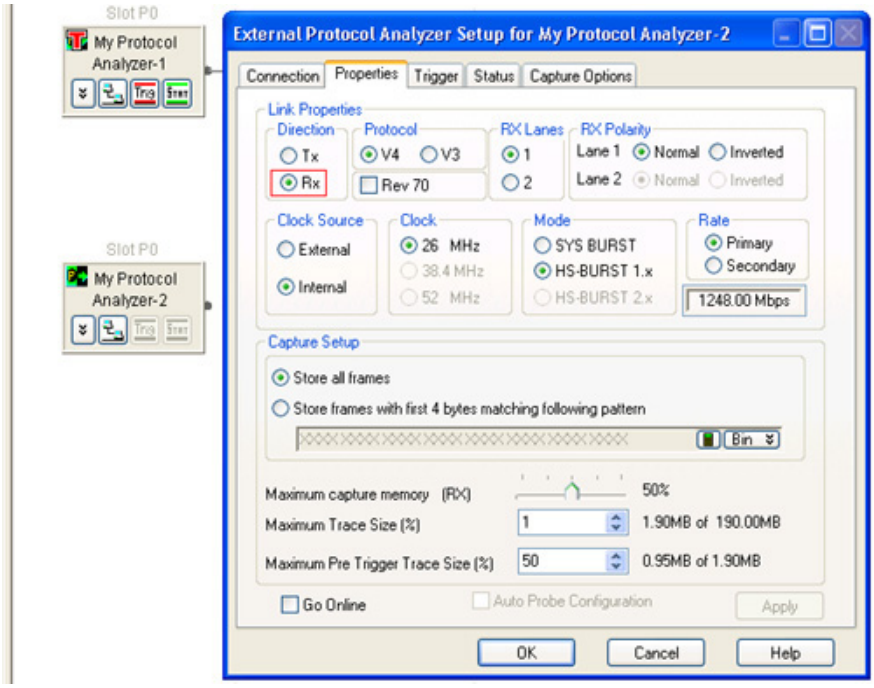


Figure 42 Rx data capture module

Using the **Run** toolbar button, the Tx and Rx data have already been acquired into Logic Analyzer GUI.

To view the acquired Tx and Rx data, two Packet Decoder instances are added to decode the data captured in the Tx and Rx directions of DigRF Exerciser. The Decode bus has been selected as Tx for the Packet Decoder instance that decodes the Tx packets, that is, packets sent on the TxData sublink from DigRF Exerciser to RFIC. For the other Packet Decoder instance, the Decode bus has been selected as Rx to decode the Rx packets that is, packets sent on the RxData sublink from RFIC to DigRF Exerciser.

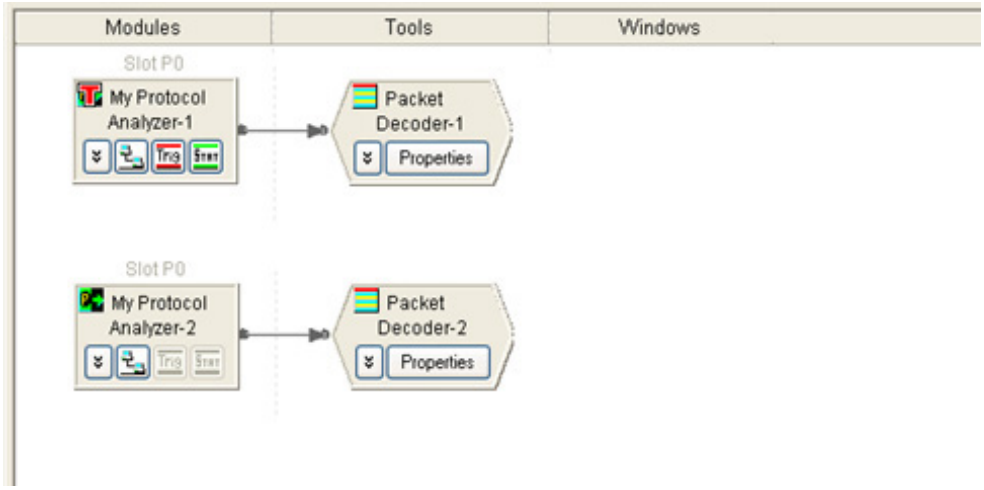


Figure 43 Packet Decoders to decode the captured Tx and Rx packets

To view the decoded Tx and Rx data in co-relation to each other, both the Rx and Tx Packet Decoder instances are pointed to the same Packet Viewer window.

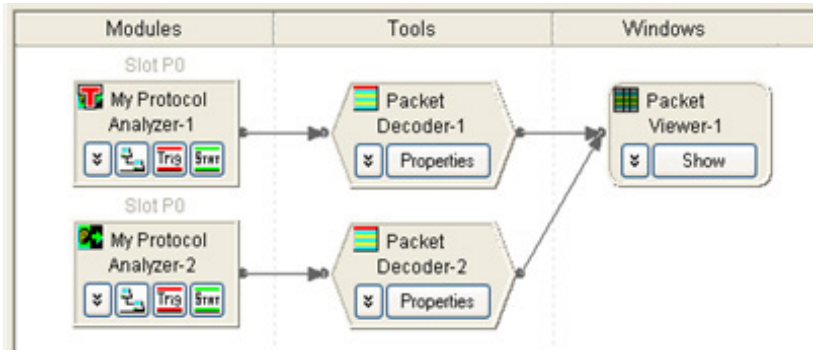


Figure 44 Single Packet Viewer for both Tx and Rx packets

The Packet Viewer window displays the decoded Rx packets in relation to the Tx packets exchanged over the link.

Packets

Sample Number	Direction	CRI	DigRFv4_0_60 Packet	ICLC C
-280	Tx	0100	Tx Interface Control Logical Channel	
-55	Rx	0100	Rx Acknowledge Control Logical Channel	
-51	Rx	0101	Rx Interface Control Logical Channel	
-273	Tx	0101	Tx Acknowledge Control Logical Channel	
-269	Tx	0110	Data Logical Channel 0	
-44	Rx	0110	Rx Acknowledge Control Logical Channel	
-234	Tx	1011	Data Logical Channel 0	
-199	Tx	1000	Tx Interface Control Logical Channel	
-40	Rx	0111	Rx Acknowledge Control Logical Channel	
-36	Rx	1000	Rx Acknowledge Control Logical Channel	
-192	Tx	1001	Data Logical Channel 0	
-32	Rx	1001	Rx Acknowledge Control Logical Channel	
-125	Tx	1011	Data Logical Channel 0	
-58	Tx	0000	Tx Interface Control Logical Channel	
-28	Rx	1010	Rx Acknowledge Control Logical Channel	
-24	Rx	0000	Rx Acknowledge Control Logical Channel	
-51	Tx	0001	Data Logical Channel 0	

Figure 45 Correlated bi-directional data

Viewing the Captured Data Offline

In RDX test platform, the Logic Analyzer GUI is used to configure the link and data capture setup and to start the data capture using either DigRF Exerciser or Analyzer module. In this mode, a connection is needed between the Logic Analyzer GUI and the DigRF Exerciser or Analyzer hardware to control the capture and then obtain the captured data for viewing in Logic Analyzer GUI.

However, once you have obtained the captured data from the DigRF Exerciser or Analyzer module into the Logic Analyzer GUI, you can view this data offline. Offline here means no connection is needed between the Logic Analyzer GUI and the DigRF Exerciser or Analyzer hardware to view the captured data. To accomplish this:

1 Configure the settings to save the captured data in a file while acquiring it into Logic Analyzer GUI.

2 Import the saved file in the Logic Analyzer GUI.

3 View and analyze it offline using the DigRF Analysis tools.

Saving the captured data

You can perform the following steps to ensure that the data acquired from the DigRF Exerciser/Analyzer module is saved automatically in the specified file after the data acquisition is complete.

1 Select **Run/Stop > Run Properties** menu option from the Logic Analyzer GUI main menu.

The **Run Properties** dialog box is displayed.

2 Select the **Save after every acquisition** check box.

3 In the **Base file name** field, specify the full path and name of the file in which you want to save the acquired data.

4 Select the **Module CSV text file (*.csv)** option from the **Save as type** listbox.

5 Click **Settings** and then select the source from which the captured data should be saved. For instance, if you have added a Tx and Rx module for data capture in Logic Analyzer GUI, then you can select the source as one of these modules to save the data captured using the selected module.

6 Click **OK**.

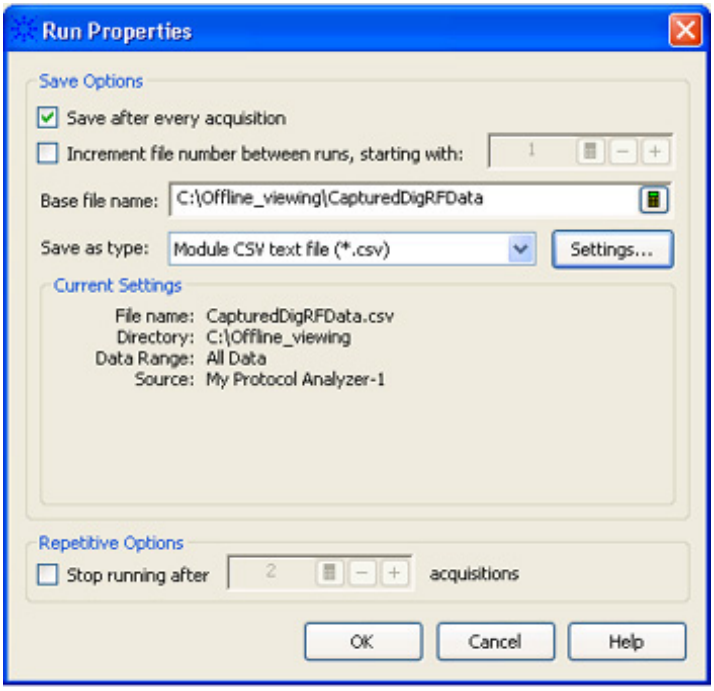


Figure 46 Settings for saving the captured data

After configuring these settings, the captured data from the specified source will automatically be saved at the specified path and file when you obtain the captured data using the **Run** button in Logic Analyzer.

Importing the saved file

NOTE To import the captured data from the saved module CSV text file into Logic Analyzer GUI, you need the Data_Import license.

You can import the saved module CSV text file into the Logic Analyzer GUI to view the data offline. To do this:

1. Launch the Logic Analyzer GUI.
2. Click **File -> Import**.

   The **Import** dialog box is displayed.
3. Select **Module CSV Text File** as the file type to be imported and click **OK**.
4. Browse and select the module CSV text file that you want to import and click **Import**.

The file is imported as a Data Import module in the Overview tab of the Logic Analyzer GUI. You can then add the required tools and windows to this module to view and analyze the imported data offline. To know about the tools, refer to Introduction to DigRF Analysis Tools on page 165.

The following screen displays a module CSV text file imported as a Data Import module in Logic Analyzer GUI. Packet Decoder and Packet Viewer have been added to decode and view the imported data.

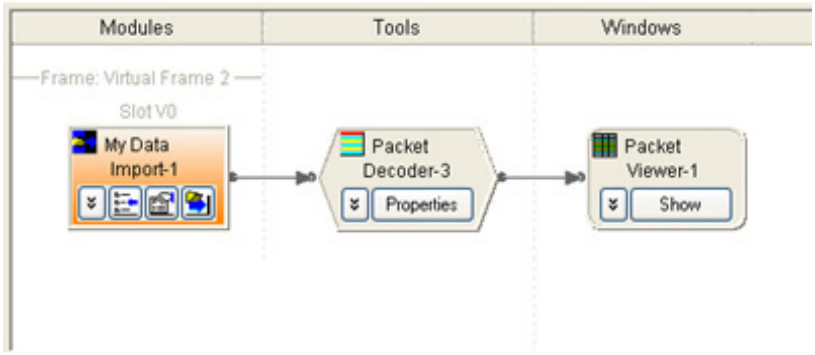
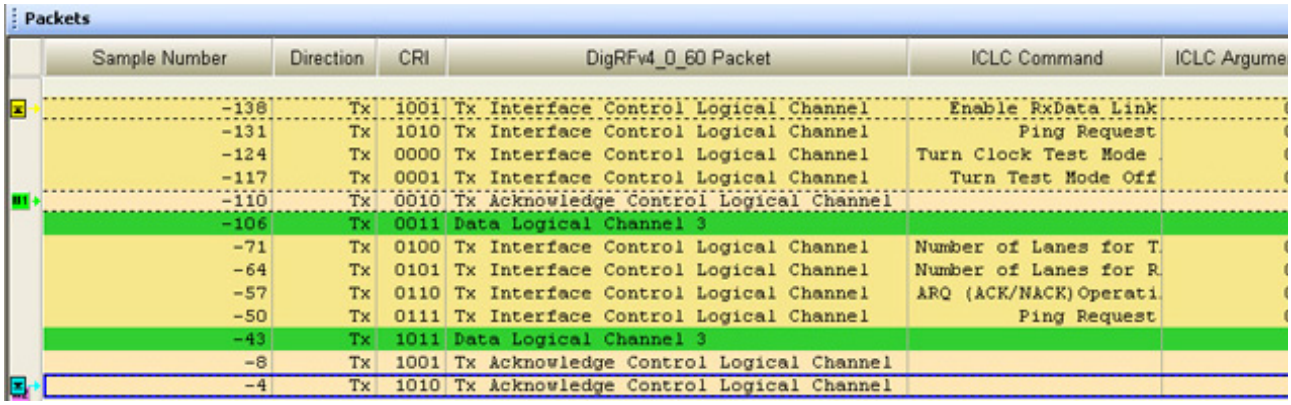


Figure 47 Imported data module

The following screen displays the DigRF data from this data import module in Packet Viewer for offline viewing and analysis.



Sample Number	Direction	CRI	DigRFv4_0_60 Packet	ICLC Command	ICLC Argume
-138	Tx	1001	Tx Interface Control Logical Channel	Enable RxData Link	
-131	Tx	1010	Tx Interface Control Logical Channel	Ping Request	
-124	Tx	0000	Tx Interface Control Logical Channel	Turn Clock Test Mode	
-117	Tx	0001	Tx Interface Control Logical Channel	Turn Test Mode Off	
-110	Tx	0010	Tx Acknowledge Control Logical Channel		
-106	Tx	0011	Data Logical Channel 3		
-71	Tx	0100	Tx Interface Control Logical Channel	Number of Lanes for T	
-64	Tx	0101	Tx Interface Control Logical Channel	Number of Lanes for R	
-57	Tx	0110	Tx Interface Control Logical Channel	ARQ (ACK/NACK) Operati	
-50	Tx	0111	Tx Interface Control Logical Channel	Ping Request	
-43	Tx	1011	Data Logical Channel 3		
-8	Tx	1001	Tx Acknowledge Control Logical Channel		
-4	Tx	1010	Tx Acknowledge Control Logical Channel		

Figure 48 Viewing data offline

You can also perform offline RF analysis of the saved data using VSA. Refer to the topic Analyzing Captured Data using VSA on page 175 to know more.

Capturing Data Using the DigRF Test Wizard

You can configure and use the data capture capabilities of the DigRF Exerciser module using either the Protocol Exerciser for DigRF GUI or DigRF Test Wizard GUI. This topic describes how you can configure and start the capture flow using the DigRF Test Wizard GUI to capture the data that DigRF Exerciser receives as stimulus responses from DUT.

DigRF Test Wizard GUI

The DigRF Test Wizard GUI provides the features to use the stimulus as well as capture capabilities of the DigRF Exerciser module. Thereby it simplifies the procedures of providing stimulus and capturing DigRF data by eliminating the need for invoking multiple GUIs of the RDX test platform in a sequence and configuring these GUIs separately. This wizard has separate tabs namely, **Stimulus flow** and **Capture flow** to configure the DigRF stimulus and capture respectively. This topic describes the Capture flow. To know about the stimulus flow, refer to the topic Configuring Stimulus Using the DigRF Test Wizard on page 67.

The aim of this wizard is to minimize the complexity and enable you to set up a capture scenario with minimum effort. Keeping this in mind, the capabilities of the wizard are limited as compared to the Agilent Logic Analyzer GUI that provides extensive features for DigRF data capture.

While running the capture flow, the wizard launches different applications such as Signal Inserter, Logic Analyzer, VSA, and Protocol Exerciser for DigRF GUI as required and as per the settings you specified in the capture flow.

NOTE In this release, you cannot configure dual capture (Tx and Rx) using the DigRF Test Wizard GUI. To configure dual capture, you need to use the Logic Analyzer GUI. Refer to the topic Configuring a Dual Capture Setup to know more.

Configuring a data capture flow

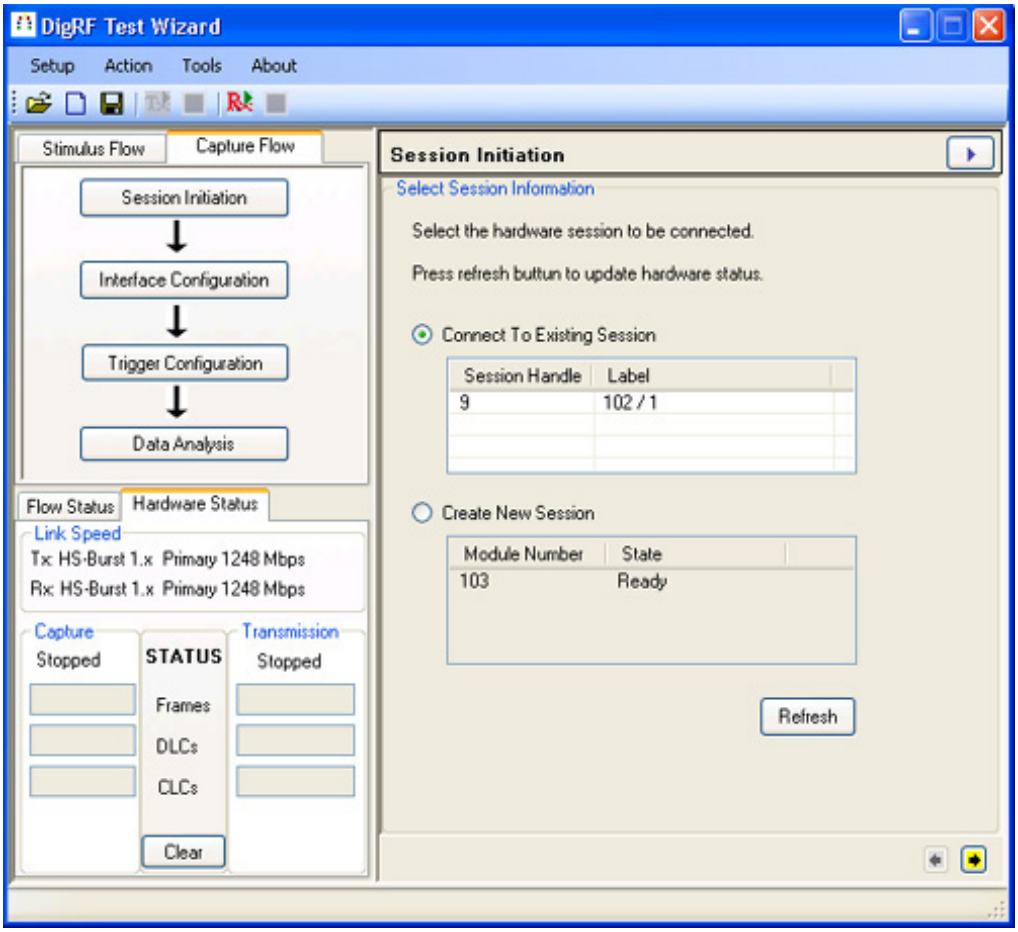


Figure 49 Capture flow in wizard

To configure DigRF capture:

1 Launch the DigRF Test Wizard GUI by clicking **Start** > **Programs** > **Agilent RDX for DigRF** > **DigRF Wizard** option on the Windows task bar.

The **DigRF Test Wizard** GUI is displayed.

2 Click the **Capture flow** tab.

The capture flow has four blocks that you need to set to complete the flow.

NOTE The first two blocks, Session Initiation and Interface Configuration are common to both stimulus and capture flows. Therefore, if you have already set these two blocks for the stimulus flow, then you need not set these for the capture flow.

3 In the **Session Initiation** block, the first block in the flow, specify the session information to set a session between the DigRF Test Wizard and the DigRF Exerciser module hardware.

   a If a session already exists on the system controller, click the **Connect to Existing Session** radio button.

   b If no session exists, create a new session by clicking the **Create New Session** radio button. The DigRF Exerciser module should be in the **Ready** state to create a new session.

4 In the **Interface Configuration** block, the second block in the flow, specify the settings to be used for configuring the DigRF interface between DigRF Exerciser and DUT. If you select the **Rx Testing** radio button, DigRF Exerciser emulates a BBIC and the data received from DUT (RFIC in this case) is captured. If you select the **Tx Testing** radio button, DigRF Exerciser emulates an RFIC and the data received from DUT (BBIC in this case) is captured.

5 In the **Trigger Configuration** block, the third block in the flow, you can specify:

   - the percentage of the total capture memory of the DigRF Exerciser module that should be used to store the captured data. The total size of the capture memory of the DigRF Exerciser module is 512 MB. Out of the total 512 MB of memory, the captured data can be stored in 384 MB. The rest of memory is used by internal bookkeeping logic. You can allocate a percentage of this memory for storing Rx data received from DUT. You can divide this allocated memory for pre trigger and post trigger data storage.
   - the trigger condition(s) to start the data capture. The wizard starts data capture when any of these conditions is met. Data capture can start either when a trigger in signal is received on the DigRF Exerciser's Trigger In Connector component from another test equipment. Or when a DigRF frame received from DUT matches the pattern that you specified as the trigger condition.

6 In the **Data Analysis** block, the last block in the flow, specify what needs to be done once the data is captured. You can either:

- View the captured data in one of the DigRF Analysis tools such as Packet Viewer, Signal Extractor, or VSA. Depending on which tool you select in this block for viewing the data, the wizard configures and launches the tool automatically when the flow is executed.
- Save the IQ data from the captured data in a specified txt file and view it later.

NOTE To get a detailed description of each field in the DigRF Test Wizard GUI, refer to the GUI Reference help topics in this online help.

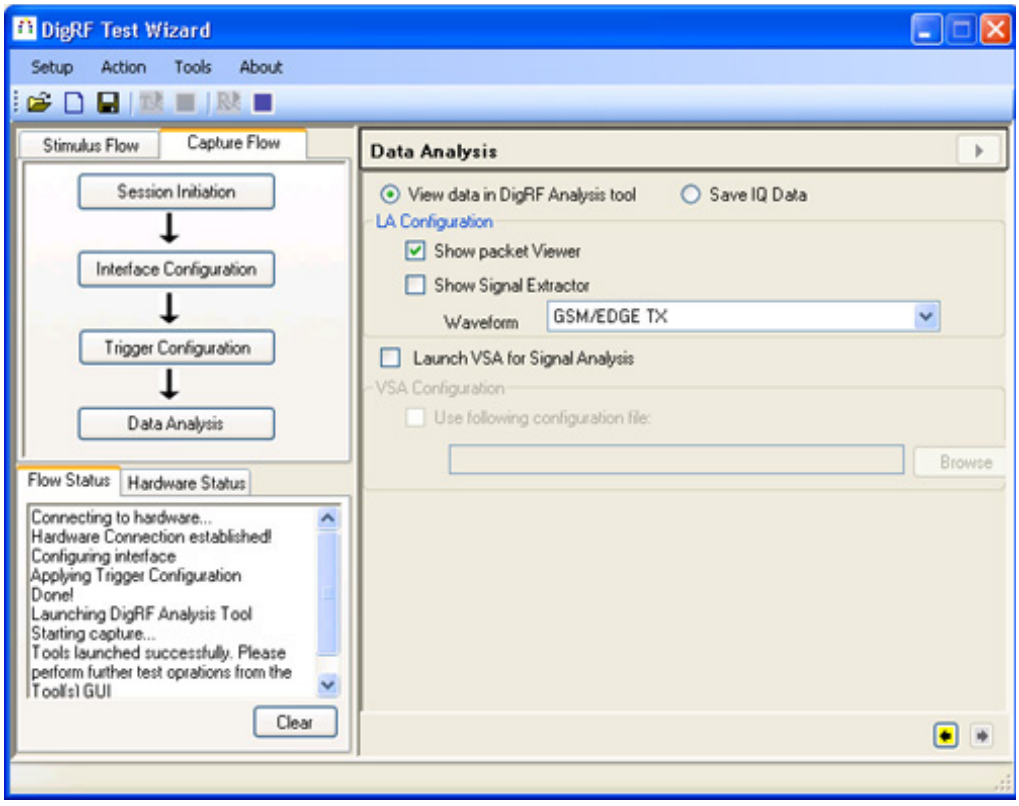
After configuring the capture flow, you can start the capture flow and view the status of the flow in the DigRF Test Wizard GUI.

Starting the data capture

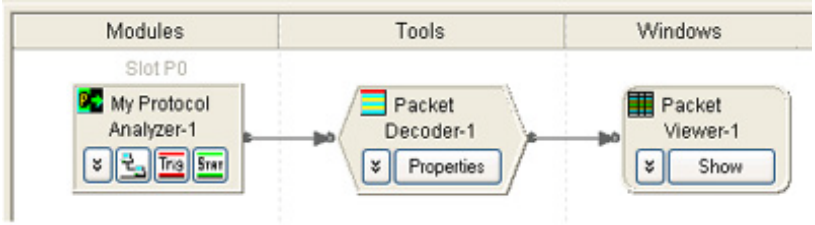
NOTE When you are running both the stimulus and capture flows in the DigRF Test Wizard, then ensure that you start the data capture flow before starting the stimulus flow in this GUI. If this sequence is not followed, the capture flow does not produce any capture results.

To start the data capture:

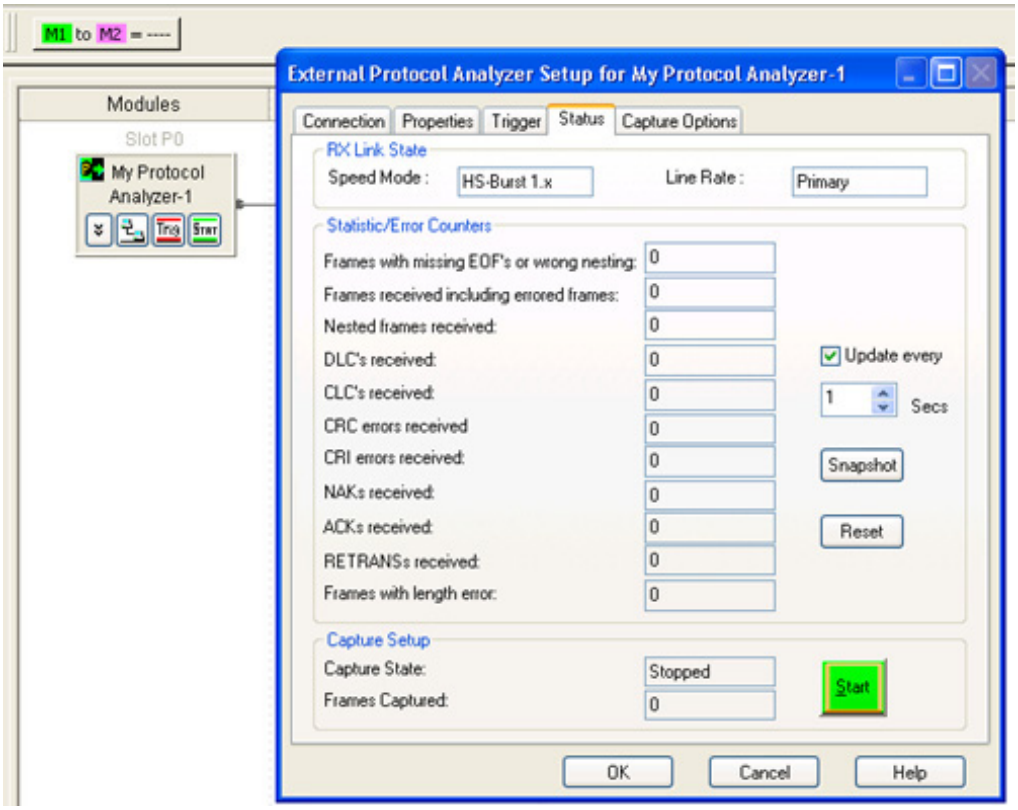
1 Start the data capture flow using the  toolbar button. The status of the capture flow is updated in the Flow Status tab.



The wizard automatically launches the required GUIs and creates the required data capture setup as per the settings you specified in the capture flow. Once these applications are launched, you need to use these applications for further actions such as starting the capture changing capture settings, or uploading captured data. After launching the required applications, the wizard does not control the functioning of these applications.

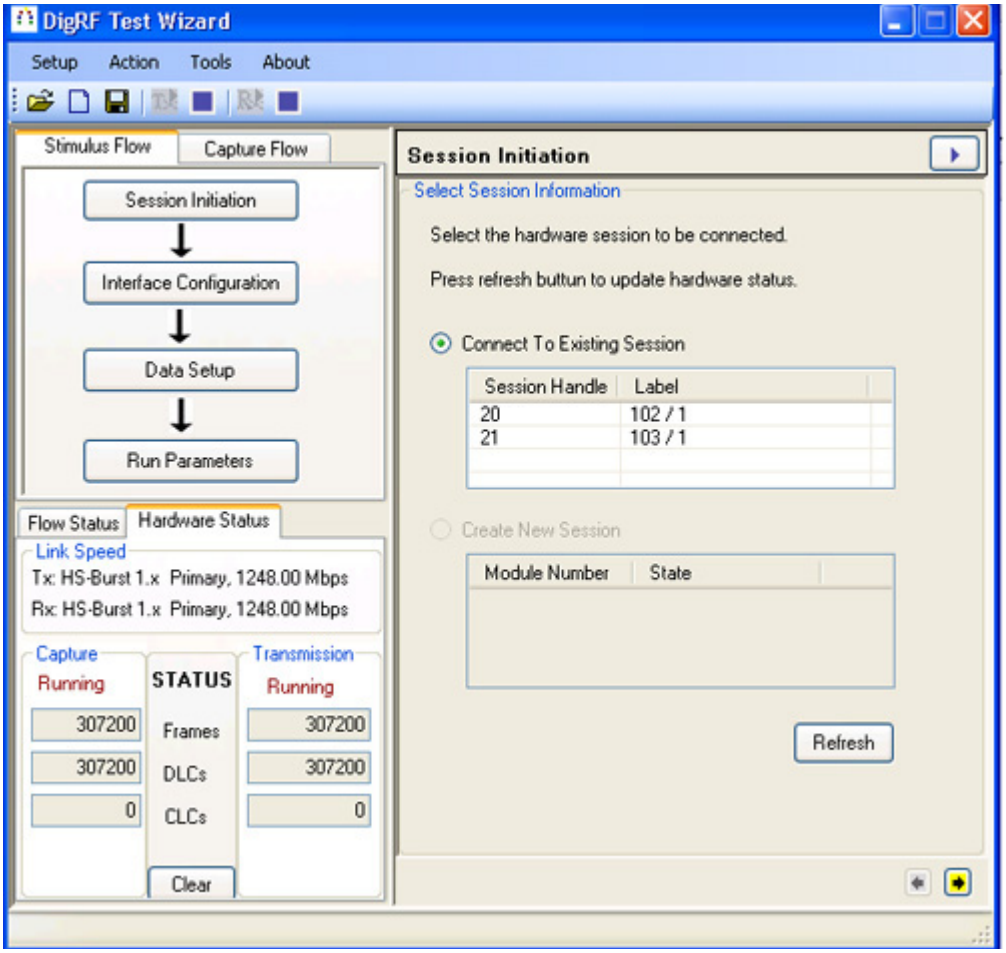


2 Start the data capture by clicking the **Start** button in the Status tab of the External Protocol Analyzer Setup dialog box added by the capture flow in Logic Analyzer GUI.



3 Start the stimulus using the  toolbar button in the **Stimulus Flow** tab of the wizard.

DigRF Exerciser starts sending the stimulus to DUT as per the stimulus flow. The capture flow is already running. Therefore, the responses received from DUT starts getting captured.



4 When the data capture in Logic Analyzer GUI stops automatically or after you stop it manually, access the Logic Analyzer GUI that the wizard opened to view the captured data. Else, if you configured to save the IQ data, access the saved txt file to view the captured data. The wizard tries to close the applications when the capture is stopped from the Wizard GUI.

Viewing the captured data

1 If you configured to save the IQ data, access the saved txt file from the location you specified in the capture flow to view the captured data.

2 If you configured to view the captured data in DigRF Analysis tools:

   a Access the Logic Analyzer GUI that the wizard opened while running the capture flow.

   b Check if the data capture has completed by viewing the state of capture in the Status tab.

   c Click the  **Run** toolbar button in the Logic Analyzer GUI to obtain the captured data in this GUI for viewing.

   d View the data in the Packet Viewer or Signal Extractor tool that the wizard added in Logic Analyzer GUI.

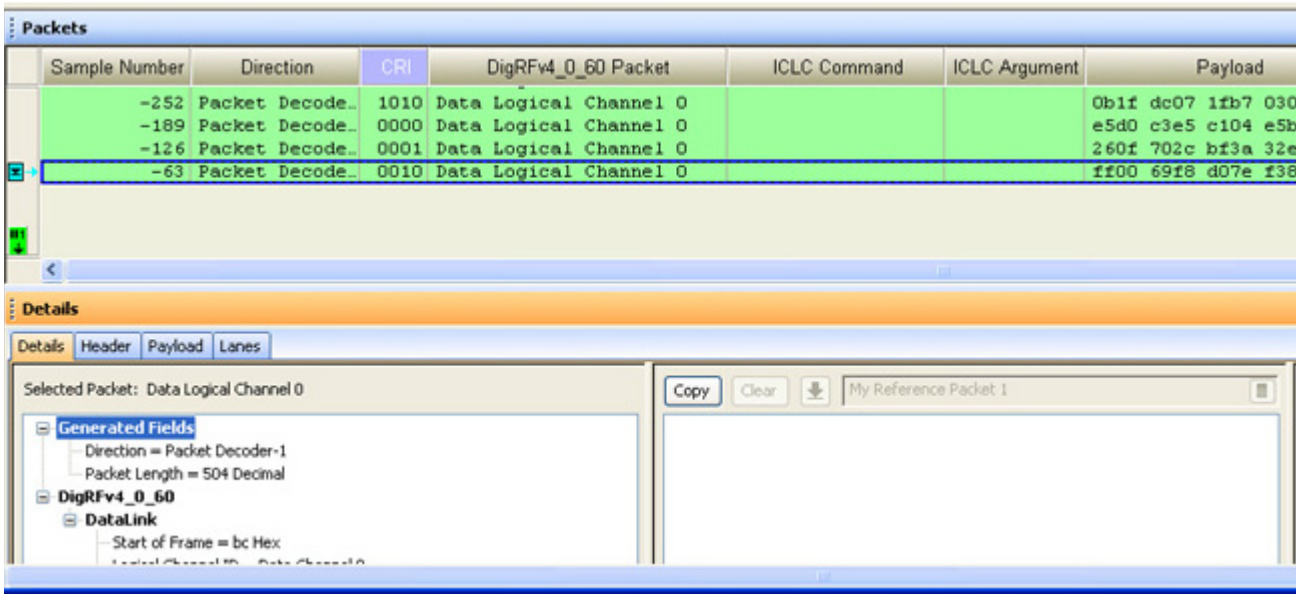


Figure 50 Data captured using wizard

Example - DigRF Data Capture

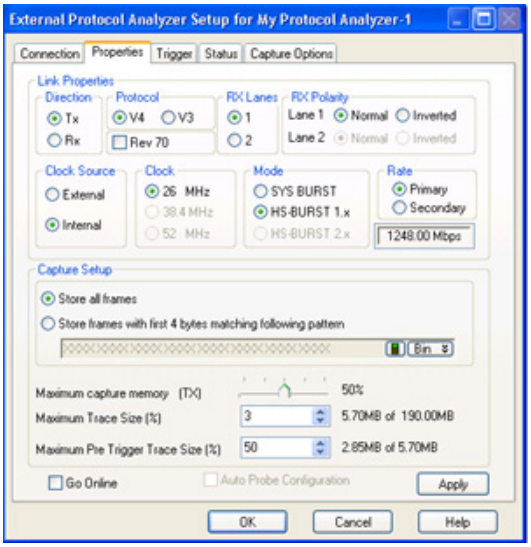
This topic provides an example of a DigRF data capture flow created and executed using the Logic Analyzer GUI. The data capture is done using the DigRF Exerciser module in this example.

DigRF Data Capture using the Logic Analyzer GUI

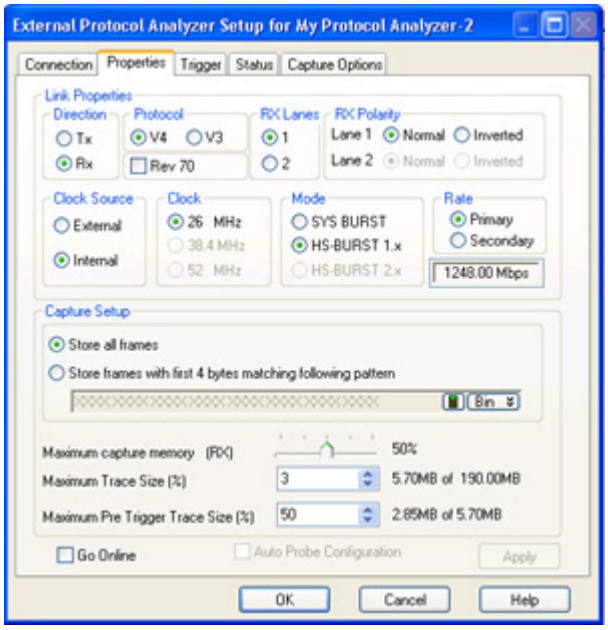
This example focuses on the testing of a BBIC independent of an RFIC. DigRF Exerciser is emulating the missing link partner - RFIC and is used for sending stimulus to BBIC (DUT). The stimulus flow is already set using the Protocol Exerciser for DigRF GUI. In the following sections, the data capture flow is set to capture the Tx and Rx data exchanged between BBIC and DigRF Exerciser over the configured DigRF link. The data received from BBIC (DUT) should start getting captured when it sends a **Number of Lanes for TxData sublink** frame to DigRF Exerciser emulating an RFIC.

Link configuration for the data capture

To capture data both ways, the following two modules have been set up in Logic Analyzer GUI. The Tx module captures the data transmitted by DigRF Exerciser, that is, RFIC in this case, it captures the data sent by DigRF Exerciser (RFIC) on the RxData sublink. Notice the link direction has been set to Tx.

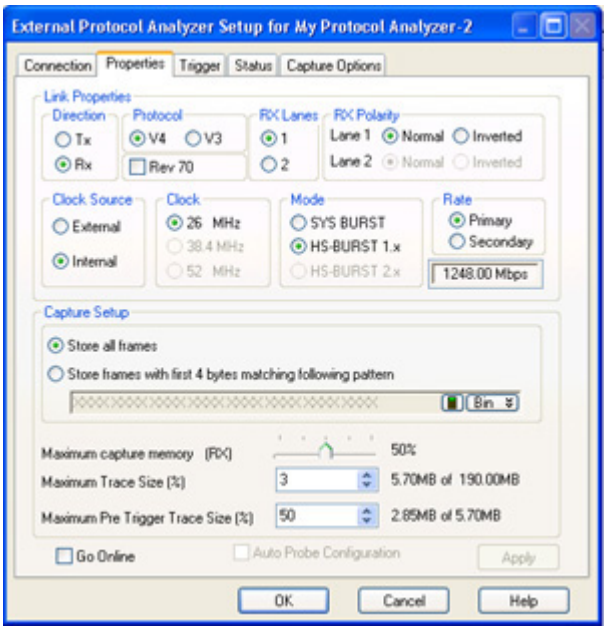


The Rx module captures the data received by DigRF Exerciser, that is, in this case, it captures the data received by DigRF Exerciser (RFIC) on the TxData sublink. Notice the link direction has been set to Rx.



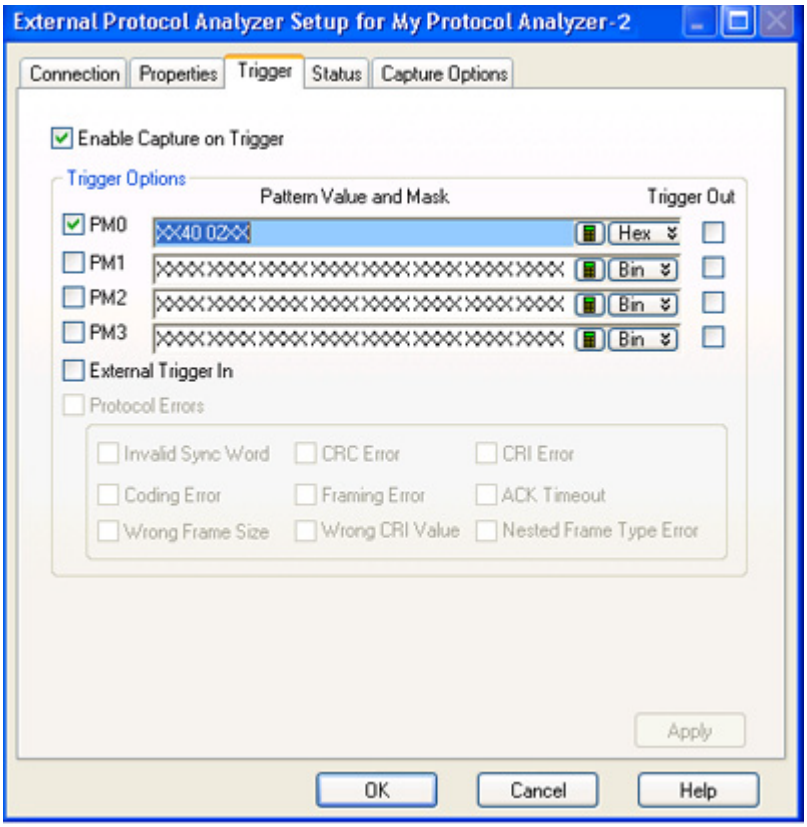
DigRF Exerciser Capture Setup

The DigRF Exerciser module is capturing data both ways. Therefore, the capture memory is divided equally between the Tx and Rx captures. The allocated capture memory for Rx is further divided into pre trigger and post trigger capture memory.



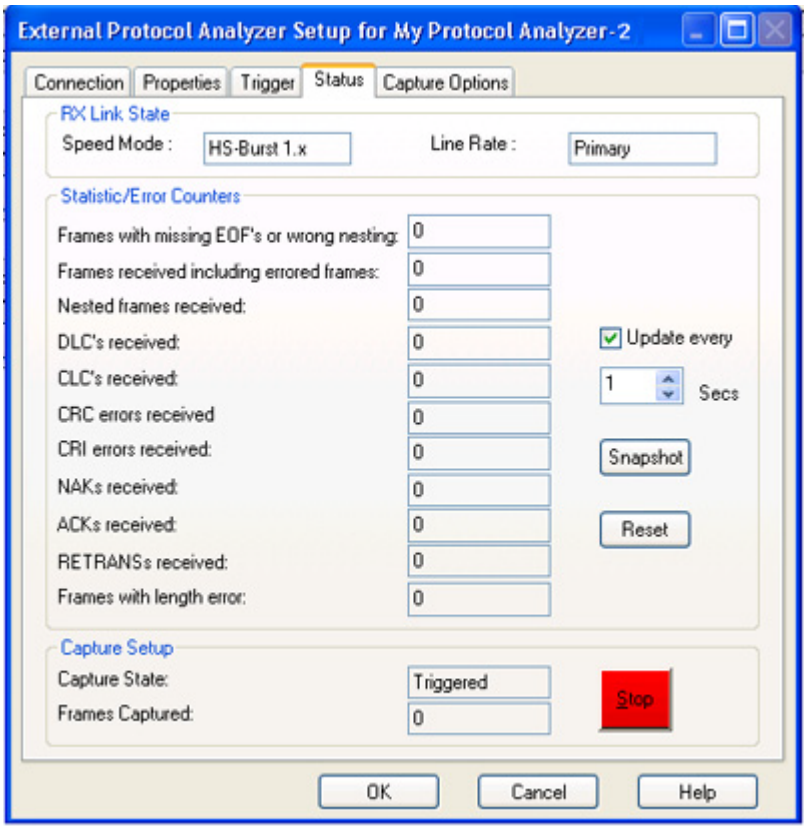
Setting Trigger to start capture on the Rx side of DigRF Exerciser

The data received from BBIC (DUT) should start getting captured when it sends the **Number of Lanes on the TxData sublink** frame to DigRF Exerciser emulating an RFIC. To accomplish this, a capture trigger is enabled on the Rx data capture, that is the data received by DigRF Exerciser from BBIC. The following screen displays the pattern value **XX4002XX** Hex specified for this trigger. The value has been specified matching the payload of the Number of Lanes on the TxData sublink frame. The first byte, **XX** is for the header of the frame and **4002XX** are for the payload of the frame. On encountering a frame matching this pattern, the data capture should start.



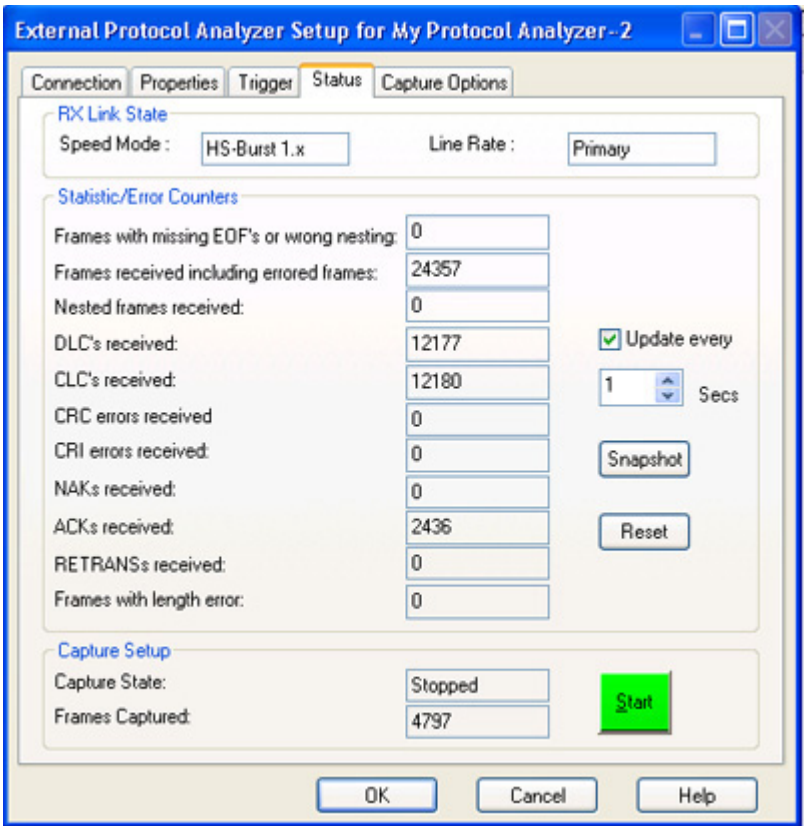
Starting the capture and stimulus

First, data capture is started as per the capture settings by clicking the **Start** button in the External Protocol Analyzer Setup dialog box. The capture state is displayed as **Triggered** representing that a trigger condition has been set for the data capture.



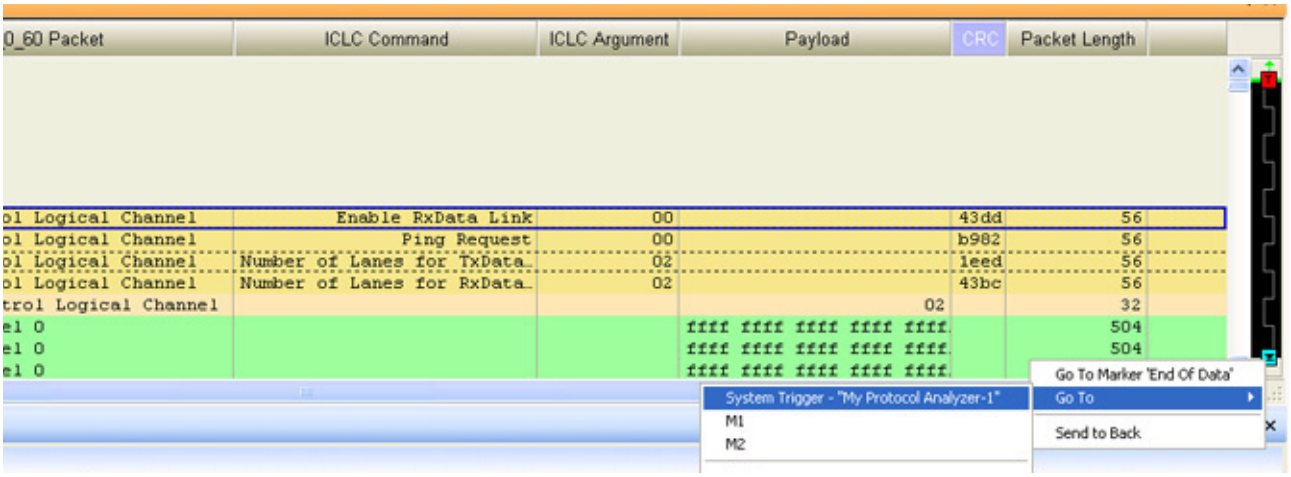
Next, the stimulus flow is started in the Protocol Exerciser for DigRF GUI as per the configured stimulus flow. On starting the stimulus, the capture state is displayed as **Running**. The frames received from BBIC are checked against the trigger conditions. When a Number of Lanes on the TxData sublink frame is received from DUT, the frames are captured in the post trigger memory of DigRF Exerciser.

The capture stops automatically when the allocated post trigger capture memory is full. The total number of frames captured is also displayed.

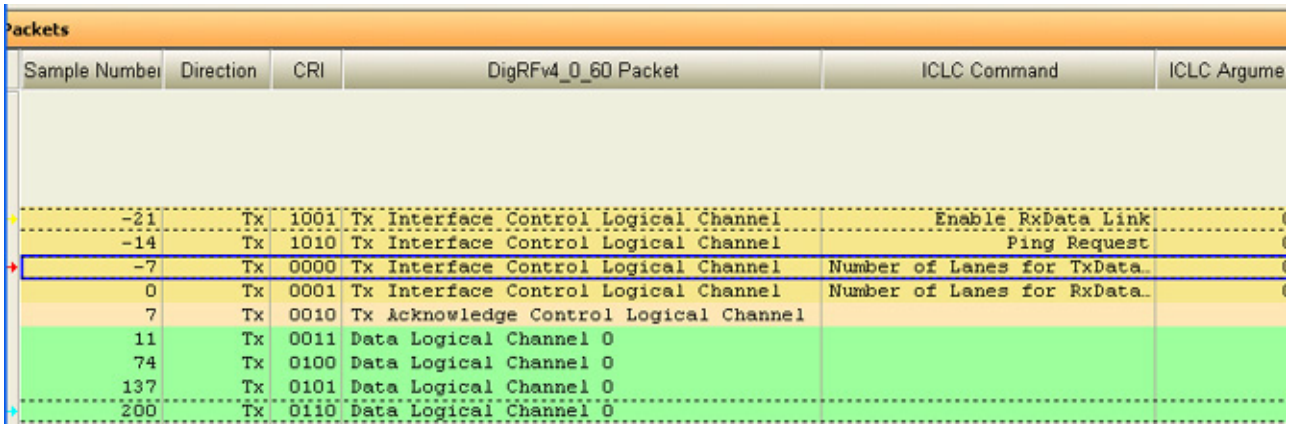


Viewing the captured data

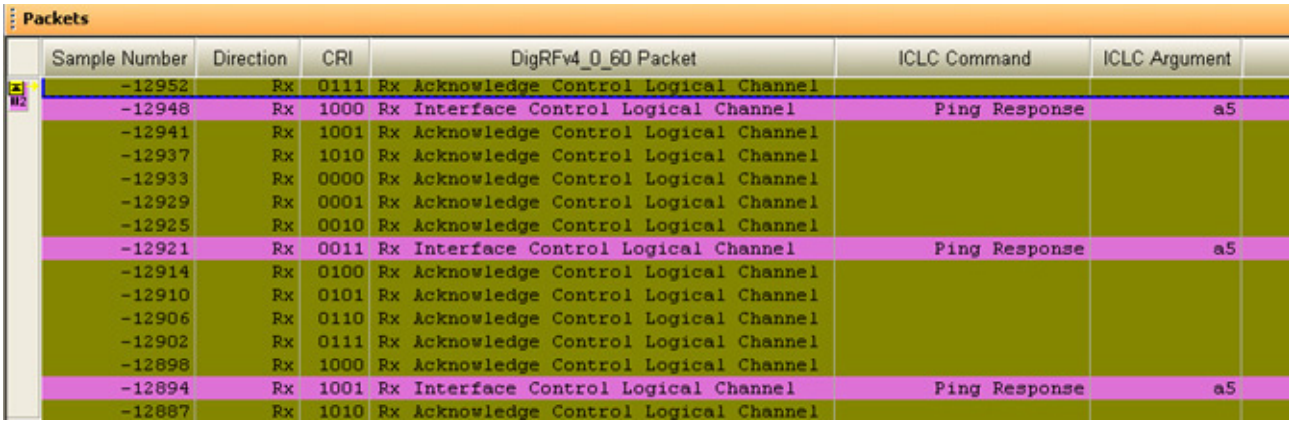
The captured Tx and Rx data is obtained in the Logic Analyzer GUI by clicking the **Run** toolbar button. The Packet Viewer displays both the pre trigger and post trigger data captured on the receiver side of DigRF Exerciser. To view the frame from which the trigger condition is met and data started getting captured in post trigger memory, right-click the Trigger marker in the upper pane of Packet Viewer. Then select **Go To** and then select **System Trigger**.



Clicking the System trigger option highlights the frame that triggered the data capture. Notice that the **Number of Lanes on the TxData sublink** frame is highlighted as the frame that triggered the data capture.



For the data captured on the Transmitter side of Exerciser, no trigger condition was set. Therefore, all the captured data is displayed in the Packet Viewer without the trigger position.



Packets

Sample Number	Direction	CRI	DigRFv4_0_60 Packet	ICLC Command	ICLC Argument
-12952	Rx	0111	Rx Acknowledge Control Logical Channel		
-12948	Rx	1000	Rx Interface Control Logical Channel	Ping Response	a5
-12941	Rx	1001	Rx Acknowledge Control Logical Channel		
-12937	Rx	1010	Rx Acknowledge Control Logical Channel		
-12933	Rx	0000	Rx Acknowledge Control Logical Channel		
-12929	Rx	0001	Rx Acknowledge Control Logical Channel		
-12925	Rx	0010	Rx Acknowledge Control Logical Channel		
-12921	Rx	0011	Rx Interface Control Logical Channel	Ping Response	a5
-12914	Rx	0100	Rx Acknowledge Control Logical Channel		
-12910	Rx	0101	Rx Acknowledge Control Logical Channel		
-12906	Rx	0110	Rx Acknowledge Control Logical Channel		
-12902	Rx	0111	Rx Acknowledge Control Logical Channel		
-12898	Rx	1000	Rx Acknowledge Control Logical Channel		
-12894	Rx	1001	Rx Interface Control Logical Channel	Ping Response	a5
-12887	Rx	1010	Rx Acknowledge Control Logical Channel		

Performing DigRF Protocol Level Testing

Testing a DigRF Link

This topic provides some examples of how you can use the stimulus and capture roles of DigRF Exerciser to perform link testing in different modes. For instance, you can test if the DigRF link between the DigRF Exerciser and DUT is configured correctly and is functional before transmitting data frames as stimulus.

DigRF Exerciser provides control frame templates that you can send for testing the link in various test modes such as Ping mode and Loopback mode. You can transmit these control frames as stimulus to DUT to test and verify if the DigRF link and the sublinks (TxData and RxData) are functional and capable of responding to the requests.

You can test the configured DigRF link between the DigRF Exerciser and DUT in the following modes using the control frame templates:

- Ping mode
- Clock Test Mode
- Line and Logic Loopback mode

Testing the link in Ping mode

You can test the link in Ping mode by:

- sending a Ping request in case DigRF Exerciser is emulating a BBIC.
- responding to a Ping request from BBIC in case DigRF Exerciser is emulating an RFIC.

To send a Ping request over a DigRF v4 0.60 link from DigRF Exerciser (emulating a BBIC):

1 In the **Stimulus flow** of DigRF Test Wizard,

   a Initiate a stimulus session with DigRF Exerciser module using the **Session Initiation** block.

   b In the **Interface Configuration** block, select the **Rx Testing** radio button to ensure that DigRF Exerciser emulates a BBIC.

   c In the **Data Setup** block, select **ICLC** from the listbox displayed in the **Init Data** groupbox.

   d Click **Add** displayed in the **Init Data** groupbox to add the required ICLC message as stimulus.

   e Select **Ping Request** as the **ICLC command** from the **Command** listbox.

   f Click **OK**.

   g For the data frames to be sent as stimulus, import frames by specifying a Signal Inserter stimulus file in the Main Data Source group box.

2 In the **Capture flow** of DigRF Test Wizard,

   a Retain the settings in the **Session Initiation** and **Interface Configuration** blocks.

   b In the **Data Analysis** block, specify how you want to analyze the captured Rx data, that is the response of RFIC to the Ping request. Select the **View data in DigRF Analysis Tools** radio button and then the **Show Packet Viewer** check box to display the captured responses in Packet Viewer tool.

3 Click the  **Start Capture flow** and  **Start Stimulus** toolbar buttons from the Capture flow and Stimulus flow tabs respectively to start capture and then stimulus as per the configured settings for these flows.

On execution of the stimulus flow, DigRF Exerciser sends a Ping Request control frame as stimulus to RFIC and also starts capturing RFIC's ping response over the RxData sublink. The Wizard then launches the Packet Viewer tool in Logic Analyzer GUI to display the captured packets. The following screens display the status of the two flows in the Wizard followed by a screen displaying the two packets received from RFIC that is, ACK for the Ping request and then Ping response in the Packet Viewer tool.

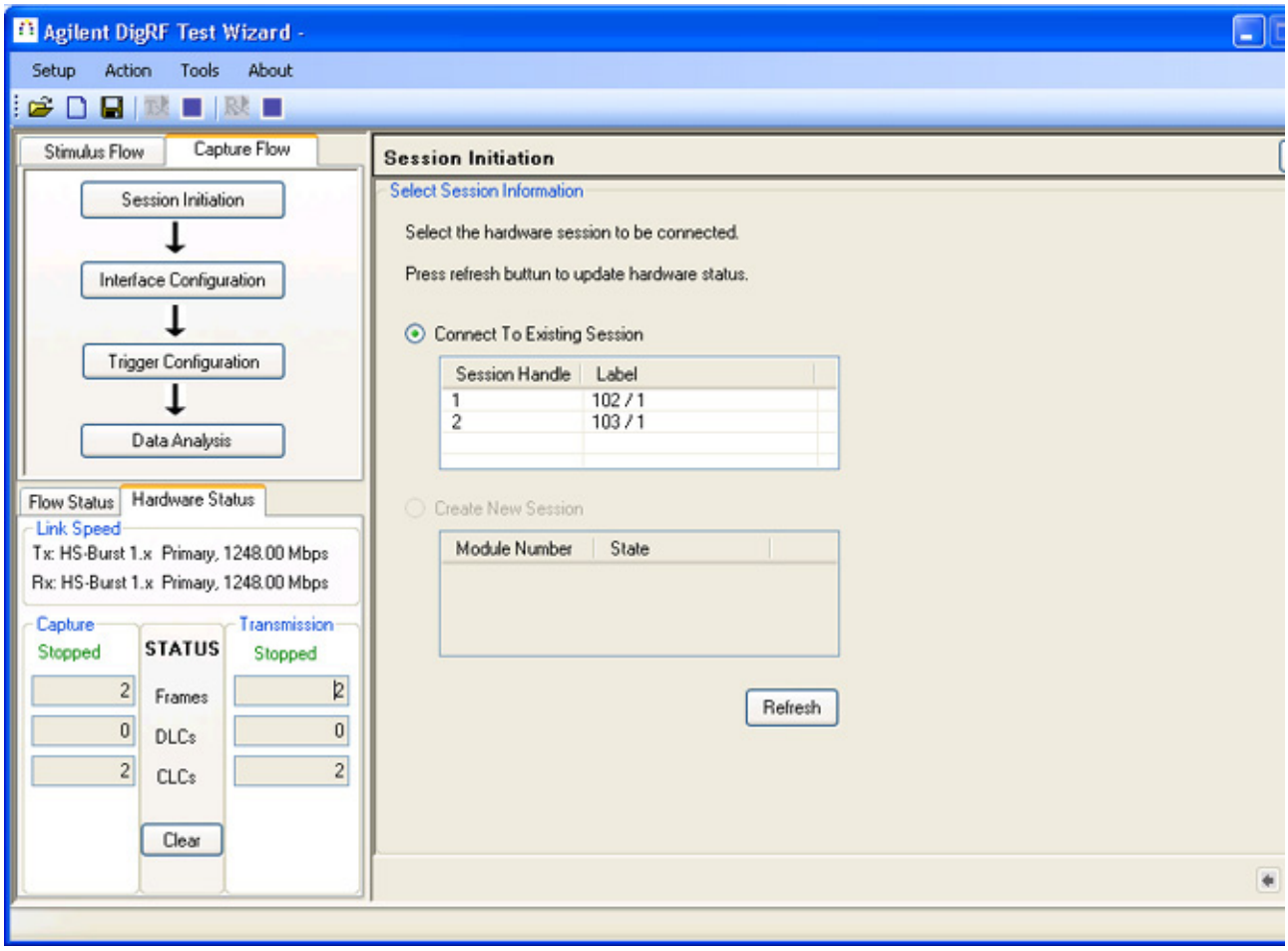


Figure 51 Stimulus and capture flow status

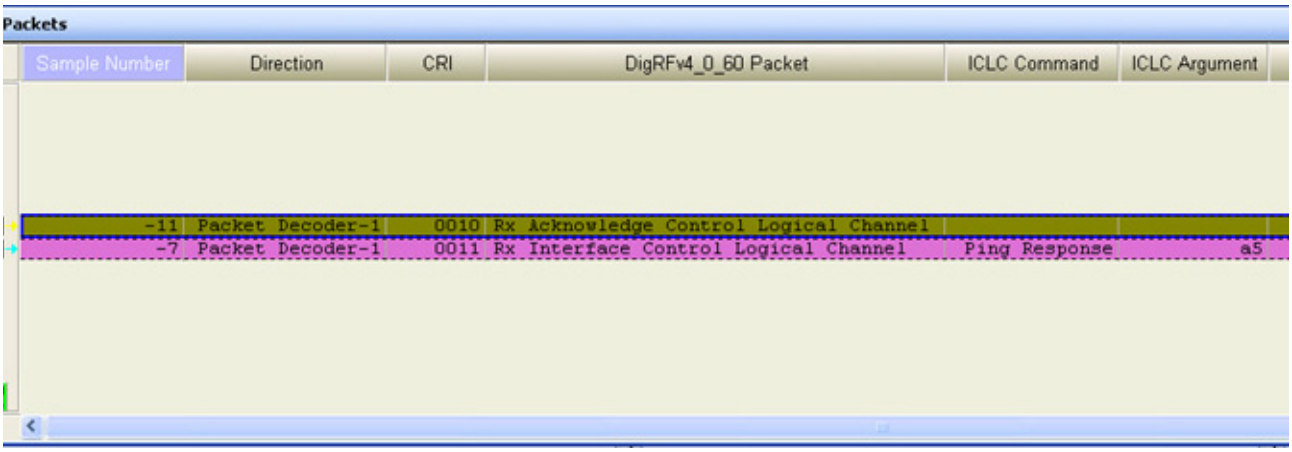


Figure 52 Packets received from RFIC

NOTE You can also use the Protocol Exerciser for DigRF GUI to send the Ping Request as stimulus and Logic Analyzer GUI to capture the Ping response.

Testing the link in Clock Test mode

In the following example, the link is tested in the clock test mode by turning on the Clock Test mode from DigRF Exerciser emulating a BBIC. The **Turn Clock Test Mode On** control frame is sent as stimulus to DUT (RFIC) to turn on this mode. Once this mode is turned on, the Rx data is captured to test the RFIC's response to the clock test mode. You can also turn off the clock test mode from DigRF Exerciser emulating a BBIC and check how the RFIC terminates its responses to the clock test mode.

To turn on the clock test mode from DigRF Exerciser (emulating a BBIC) over a DigRF v4 0.60 link:

1 In the Protocol Exerciser for DigRF GUI, configure the stimulus flow as follows:

   a Configure the DigRF link settings using the **General Settings** page. Ensure that the **Emulate Interface** is selected as **BBIC**.

   b In the **Frame Configuration** page, access the **Turn Clock Test Mode On** control frame template from **Control Frame Templates** > **Default** > **Tx** group in the **Frame Templates** tab.

   c Drag and drop the **Turn Clock Test Mode On** control frame template to the configured frames section of the appropriate traffic block, for instance, Init block.

   d Apply or save the changes.

2 In the Logic Analyzer GUI, configure the capture flow as follows:

   a Connect to the DigRF Exerciser module through a session.

   b Configure the data capture settings using the External Protocol Analyzer Setup dialog box. Ensure that **Rx** is selected as the direction for data capture in the **Properties** tab of this dialog box.

   c Click **OK**.

3 Add a Packet Decoder and Packet Viewer instance to the data capture module that you configured in step2. Ensure

that the Decode bus is selected as Rx in Packet Decoder to decode Rx packets.

4 Start the data capture by clicking the **Start** button in the **Status** tab of the External Protocol Analyzer Setup dialog box in Logic Analyzer GUI.

5 Start the stimulus by clicking the  **Run** button on the toolbar in the Protocol Exerciser for DigRF GUI.

On starting the stimulus and capture, DigRF Exerciser sends the Turn Clock Test Mode On control frame to RFIC and starts capturing the responses sent by RFIC over the link.

You can view the captured RFIC responses in Packet Viewer after acquiring the captured data in Logic Analyzer using the  toolbar button.

You can turn off the clock test mode from DigRF Exerciser by sending the **Turn Test Mode Off** control frame as stimulus to RFIC.

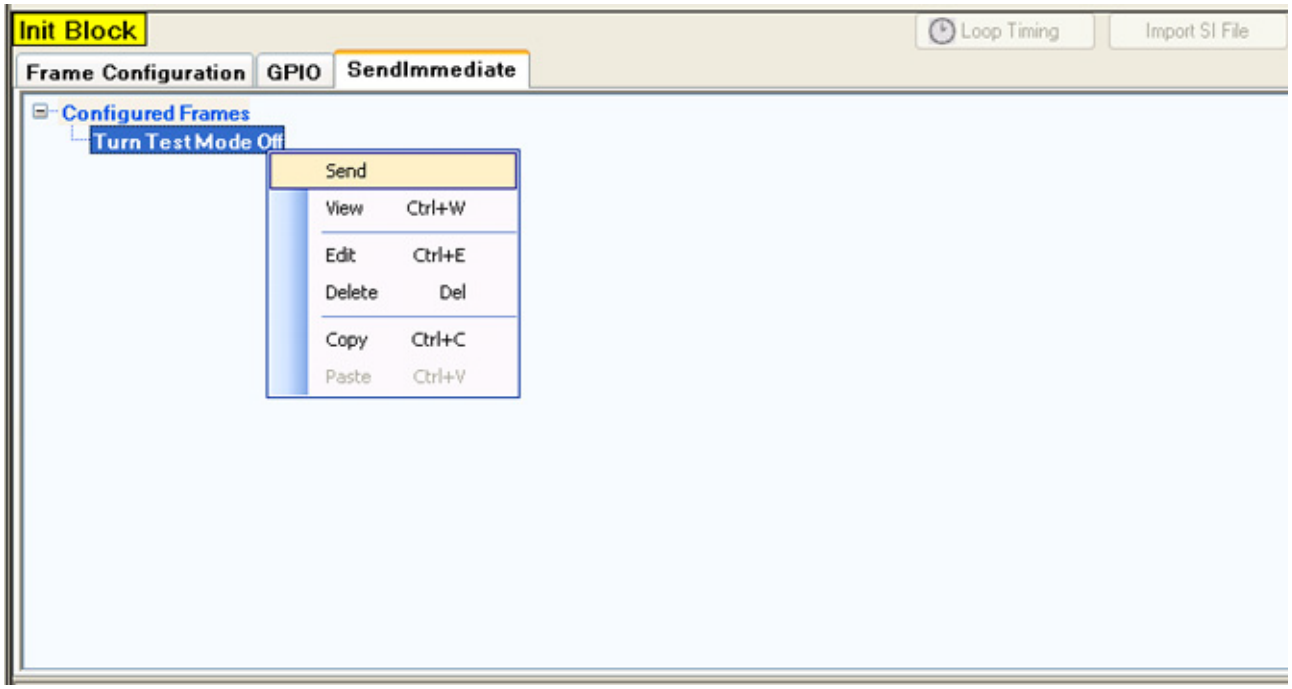
In the Protocol Exerciser for DigRF GUI, send the ICLC message to turn off the clock test mode by performing the following steps:

1 Configure the DigRF link settings using the General Settings page.

2 In the **Frame Configuration** page, access the **Turn Test Mode Off** control frame template from **Control Frame Templates** > **Default** > **Tx** group in the **Frame Templates** tab.

3 Drag and drop the **Turn Test Mode Off** control frame template to the **SendImmediate** section of the appropriate traffic block.

4 Right-click the added frame and click **Send**.



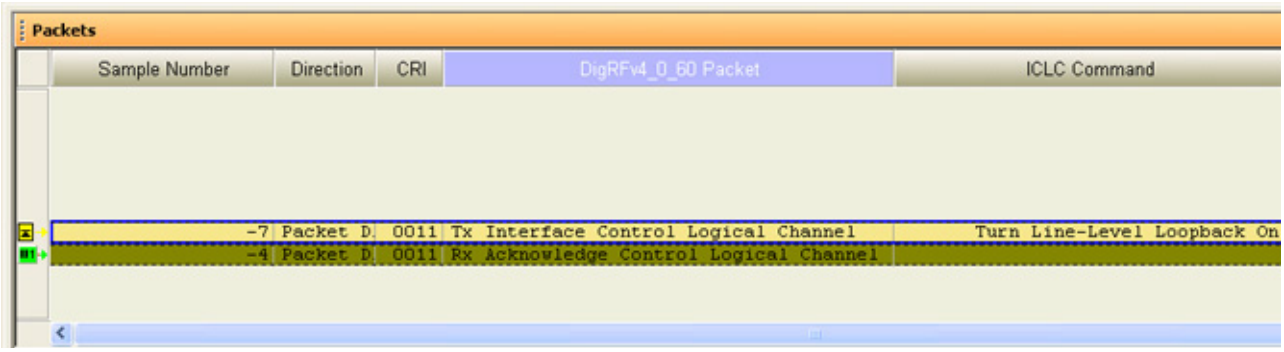
The Turn Test Mode Off control frame is immediately sent to change the behavior of the running stimulus test and turn off the clock test mode. On turning off the clock test mode, you can check RFIC's response to end the transmission.

NOTE You can also use the DigRF Test Wizard GUI to turn on the Clock Test mode and to capture the RFIC response to this mode.

Testing the link in Line and Logic Loopback Modes

DigRF Exerciser provides control frame templates to turn on the line loopback mode from Tx and Rx sublinks. For instance, you can use the Turn Line-Level Loopback On control frame template available in Rx and Tx groups in the Protocol Exerciser for DigRF GUI to turn on this mode while sending stimulus to DUT over a DigRF v4 0.60 link. Similarly, to turn on the Logic loopback mode, you can use the Turn Logic Level Frame Loopback On control frame available in the Tx group of frame templates.

The following screen displays the bidirectional packets captured in Packet Viewer with Line-level loopback turned on from DigRF Exerciser (emulating a BBIC) and RFIC response with an ACK.


Packets
Sample Number
Direction
CRI
DigRFv4_0_60 Packet
ICLC Command
-7 Packet D 0011 Tx Interface Control Logical Channel Turn Line-Level Loopback On
-4 Packet D 0011 Rx Acknowledge Control Logical Channel

Testing ACK/NACK Mechanisms

You can use DigRF Exerciser's stimulus and capture capabilities to test if the DUT's ACK/NACK mechanisms are accurately implemented to ensure data transfer reliability over the DigRF link.

Enabling ACK/NACK on DigRF Exerciser

As per your test requirements, you can control whether or not DigRF Exerciser should send ACK/NACKs to DUT. To enable the sending of ACK/NACK from DigRF Exerciser, ensure that:

- the speed mode for the transmission from DigRF Exerciser is set to **HS- BURST**. If you have configured DigRF Exerciser to transmit in SYS- BURST mode, then DigRF Exerciser does not transmit ACK/NACK irrespective of whether or not you have turned on the ARQ protocol.
- the ARQ protocol is turned on for DigRF Exerciser. To do this, ensure that the **Turn off ARQ Protocol** checkbox is deselected in the **Transmission** tab of the General settings page in Protocol Exerciser for DigRF GUI.
- the **Enable ACK for following CLCs** checkboxes are selected for the CLCs for which you want DigRF Exerciser to send ACK/NACK. These checkboxes are available in the **Transmission** tab of the General settings page in Protocol Exerciser for DigRF GUI.
- the **Receive frame checks** are enabled in the Receive tab of the General settings page. If these checks are disabled, DigRF Exerciser does not check the received frames for specific errors and therefore, does not send NACKs for errored frames.

Turning off ACK/NAK from DigRF Exerciser

When DigRF Exerciser emulates a BBIC, you can turn on or turn off the ACK/NACK responses on TxData (BBIC to RFIC) and RxData (RFIC to BBIC) sublinks during a stimulus flow of frames. To do this, you can send the **ARQ (ACK/NACK) operation on TxData Sub- link** and **ARQ (ACK/NACK) operation on RxData Sub- link** control frames as stimulus to turn off or partially/completely turn on ACK/NACK on TxData and RxData sublinks.

Before sending these control frames, you should ensure that the **Turn off ARQ Protocol** checkbox and speed mode settings are appropriately set on DigRF Exerciser to match

the turn on or turn off of ACK/NACK. For instance, if the Turn off ARQ Protocol checkbox is selected and you send the ARQ (ACK/NACK) operation on TxData Sub-link control frame with Complete On argument, the ACK/NACK will still not be turned on.

Sending an ACK/NAK from DigRF Exerciser

If you enabled the sending of ACK/NACK in the stimulus settings of DigRF Exerciser, then it sends ACK/NACK to the DUT based on whether or not it received a frame successfully and without errors from DUT during a stimulus flow.

Viewing ACK/NAK Statistics

You can check the number of ACK and NACK responses sent to DUT and received from DUT in a stimulus flow by viewing the status information of the stimulus flow. The following screen displays this information in the Status page of the Protocol Exerciser for DigRF GUI.

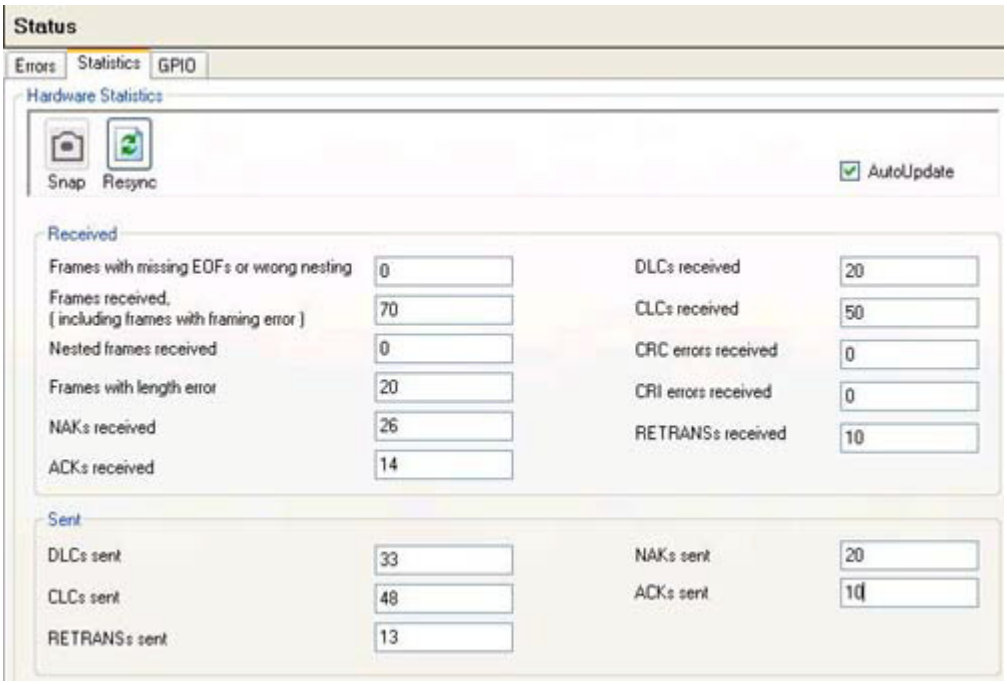
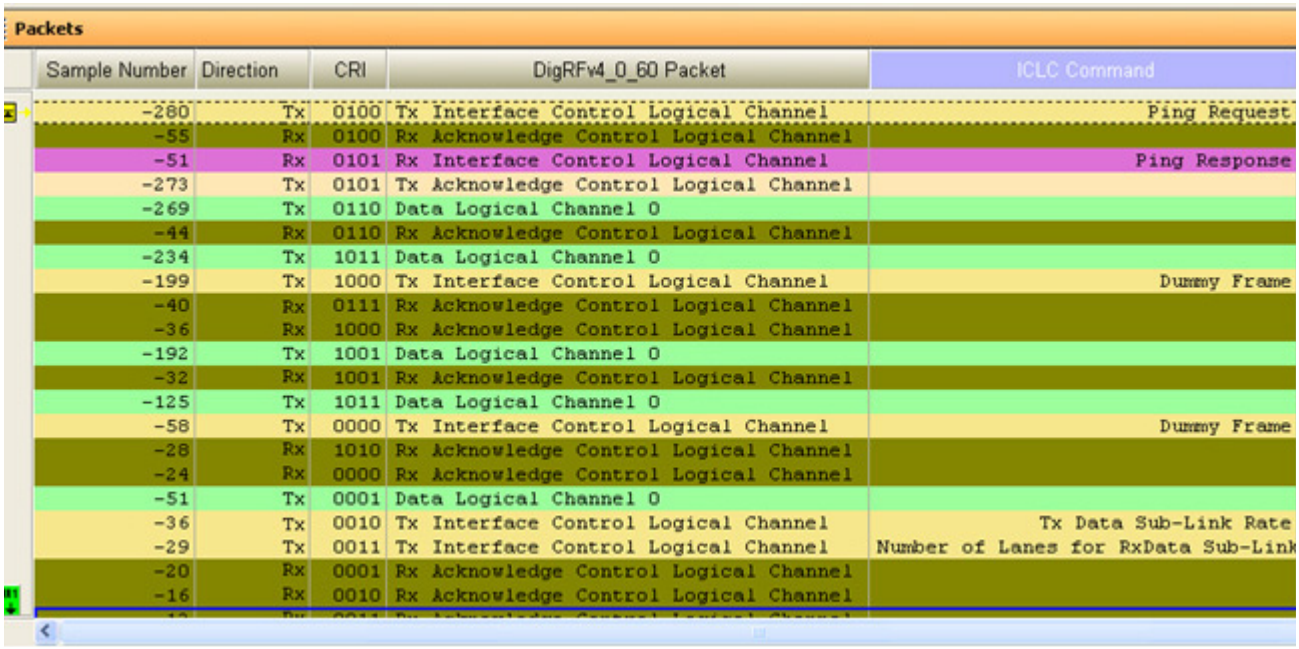


Figure 53 ACK/NAK statistics

You can also view the number of ACK/NACK received from DUT in the capture flow configured in the Logic Analyzer GUI. Using the bidirectional data capture, you can view the packet sent to DUT and the ACK/NACK received from DUT as response in the Packet Viewer.



Packets

Sample Number	Direction	CRI	DigRFv4_0_60 Packet	ICLC Command
-280	Tx	0100	Tx Interface Control Logical Channel	Ping Request
-55	Rx	0100	Rx Acknowledge Control Logical Channel	
-51	Rx	0101	Rx Interface Control Logical Channel	Ping Response
-273	Tx	0101	Tx Acknowledge Control Logical Channel	
-269	Tx	0110	Data Logical Channel 0	
-44	Rx	0110	Rx Acknowledge Control Logical Channel	
-234	Tx	1011	Data Logical Channel 0	
-199	Tx	1000	Tx Interface Control Logical Channel	Dummy Frame
-40	Rx	0111	Rx Acknowledge Control Logical Channel	
-36	Rx	1000	Rx Acknowledge Control Logical Channel	
-192	Tx	1001	Data Logical Channel 0	
-32	Rx	1001	Rx Acknowledge Control Logical Channel	
-125	Tx	1011	Data Logical Channel 0	
-58	Tx	0000	Tx Interface Control Logical Channel	Dummy Frame
-28	Rx	1010	Rx Acknowledge Control Logical Channel	
-24	Rx	0000	Rx Acknowledge Control Logical Channel	
-51	Tx	0001	Data Logical Channel 0	
-36	Tx	0010	Tx Interface Control Logical Channel	Tx Data Sub-Link Rate
-29	Tx	0011	Tx Interface Control Logical Channel	Number of Lanes for RxData Sub-Link
-20	Rx	0001	Rx Acknowledge Control Logical Channel	
-16	Rx	0010	Rx Acknowledge Control Logical Channel	

Figure 54 ACK/NAK captured

Testing ACK/NACK responses from DUT

You can use DigRF Exerciser to test if a DUT sends ACK/NACK in response to the stimulus frames. For instance, you can send a frame with 8B/10B (Disparity) error as stimulus to DUT. You can check if the DUT responds with a NACK to this errored frame. The status page in Protocol Exerciser for DigRF GUI displays the counter for NACK received from DUT.

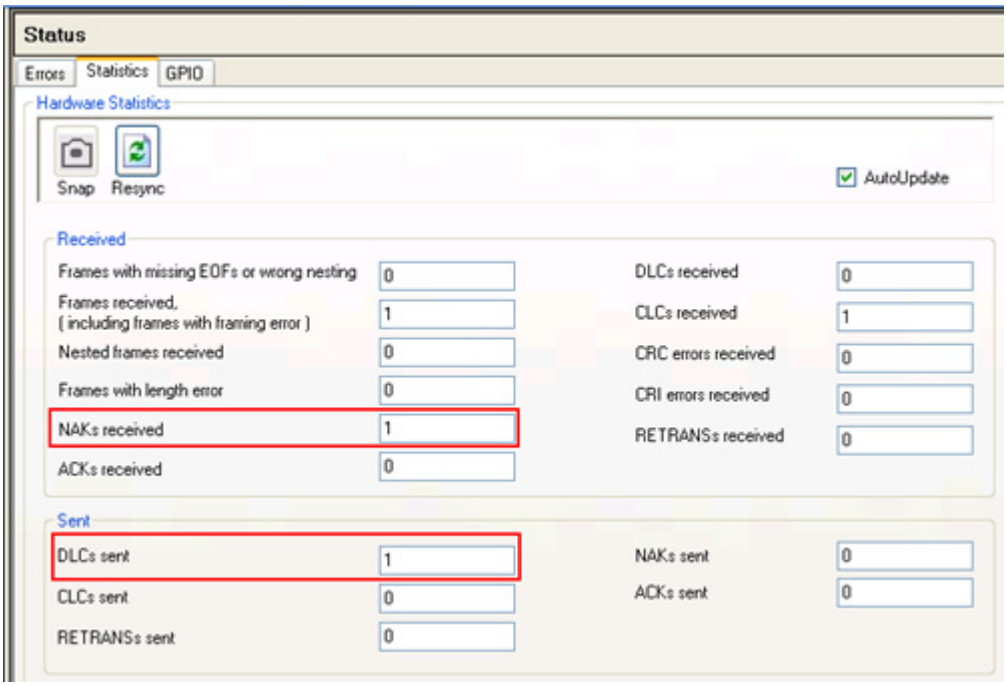


Figure 55 NAK status

You can also configure dual capture (capturing the Tx and Rx data over the link) to view the ACK or NACK response received in relation to the errored frame sent as stimulus.

The following screen displays the output of such a dual capture scenario where an errored data frame is sent to DUT and a NACK is received from DUT in response.

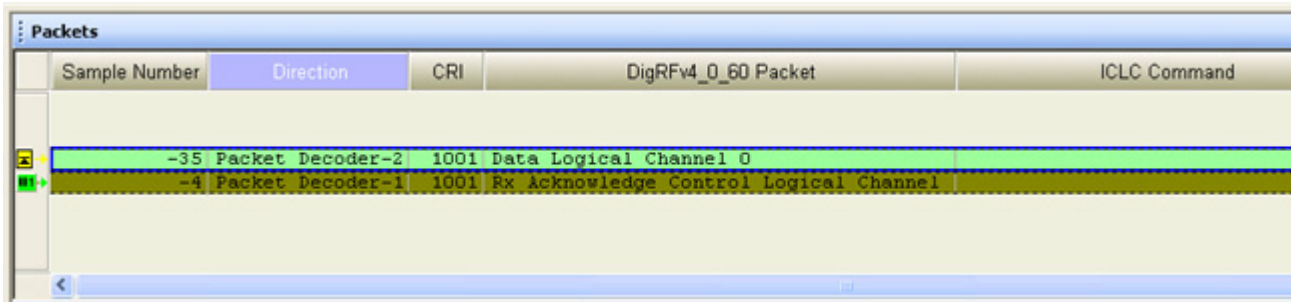


Figure 56 NAK captured

To know how to send an errored frame as stimulus, refer to Testing RFIC/BBIC Under Error Conditions on page 162 and to capture Tx and Rx data simultaneously, refer to Configuring a Dual Capture Setup on page 98.

Testing DUT's responses to ACK/NACK

You can also test how the DUT responds to the ACK/NACK received from DigRF Exerciser. For instance, you can test if the DUT responds to a NACK received from DigRF Exerciser by retransmitting the frame. Refer to the topic Testing Frame Retransmission on page 153 to know more.

Testing Nested Frames

A nested frame is a control frame of specific types embedded within the payload of a data or a control frame that acts as the encapsulating frame for the nested frame. You can test the nested frames implementation at the DUT's end by;

- Sending a nested frame as stimulus to DUT and checking its response.
- Checking the frames received from DUT for nested frame errors and viewing and analyzing the received nested frame from DUT for validating the frame structure.

Sending a nested frame as stimulus to DUT

You can use the APIs available for RDX test platform to configure frames in a high priority queue to implement nesting in stimulus sent to DUT. You can send these nested frames as stimulus within another encapsulating data or control frame to the DUT. Refer to the API help to know more.

The nesting feature is disabled in all the frame templates provided as the default set in the Protocol Exerciser for DigRF GUI.

Checking the nested frames received from DUT

You can check whether or not the nested frames received from the DUT are of the appropriate CLC type as defined in the specifications. To do this, you can enable the nested frame type checking for the frames that DigRF Exerciser receives from DUT over a configured DigRF link in a stimulus flow.

To enable nested frame type checking:

1. Click the **General Settings** icon in the Protocol Exerciser for DigRF GUI.
2. Click the **Receive** tab.
3. Deselect the **Disable Nested Frame Type Checking** checkbox in the **Receive Frame Checks** group.
4. Save the settings.

If the DUT sends a nested frame of an incorrect CLC type, then DigRF Exerciser reports this as a protocol error (wrong nesting) in the Status page of the Protocol Exerciser for DigRF GUI. You can also view the total number of nested frames received from the DUT in a stimulus flow and how

many of these frames have the wrong nesting. The following screen displays this statistics in the Statistics tab of the Status page.

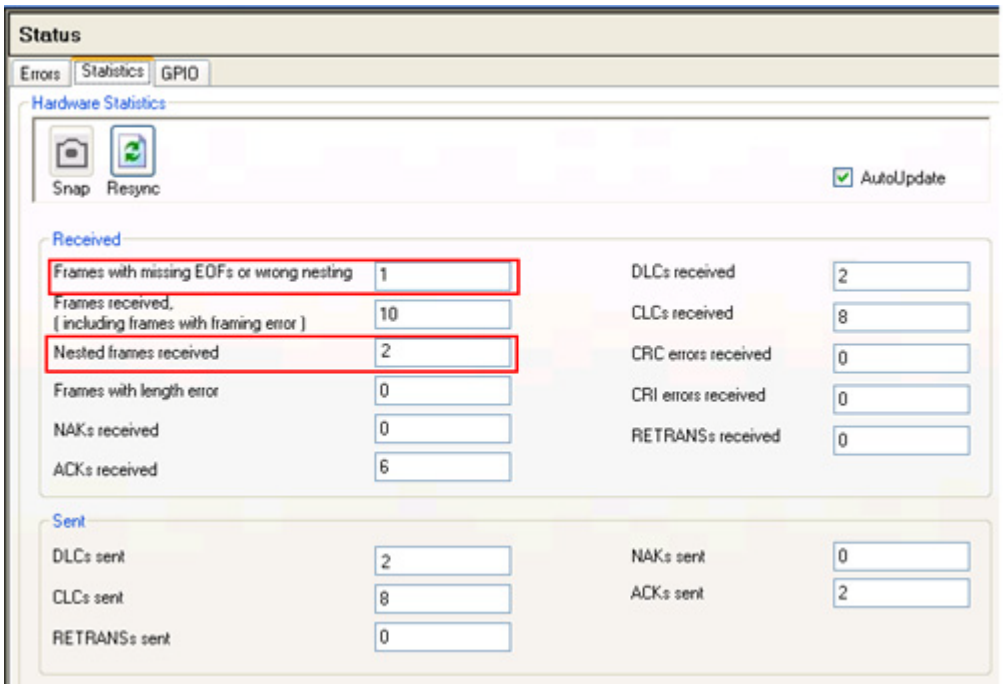


Figure 57 Nested frame status

You can also view and validate the structure of a nested frame received from a DUT. To do this, you can capture the data received from DUT using the DigRF Exerciser or Analyzer module. Once the data is captured and available for analysis in Logic Analyzer GUI, you can validate the frame structure of the nested frame using Packet Viewer and Packet Decoder tools in Logic Analyzer GUI. Refer to the topic Validating a DigRF Frame Structure on page 170 to know more.

Testing Frame Retransmission

You can retransmit frames while sending stimulus to DUT and also test how the DUT handles the retransmission of frames over the DigRF link.

Retransmitting frames in a stimulus flow from DigRF Exerciser

While sending stimulus to DUT, DigRF Exerciser can retransmit frames to DUT if it receives a NACK from DUT for an errored or lost frame sent as stimulus to DUT. To enable such a retransmission, you need to ensure the following while configuring the stimulus flow in the Protocol Exerciser for DigRF GUI:

- The **Turn Off ARQ Protocol** checkbox is deselected in the **Transmission** tab of the **General Settings** page.
- The **Enable Retransmission** checkbox is selected in the **Transmission** tab of the **General Settings** page.

The number of retransmissions sent by DigRF Exerciser in response to NACKs from DUT is displayed as **RETRANSs sent** in the **Status** page of the Protocol Exerciser for DigRF GUI.

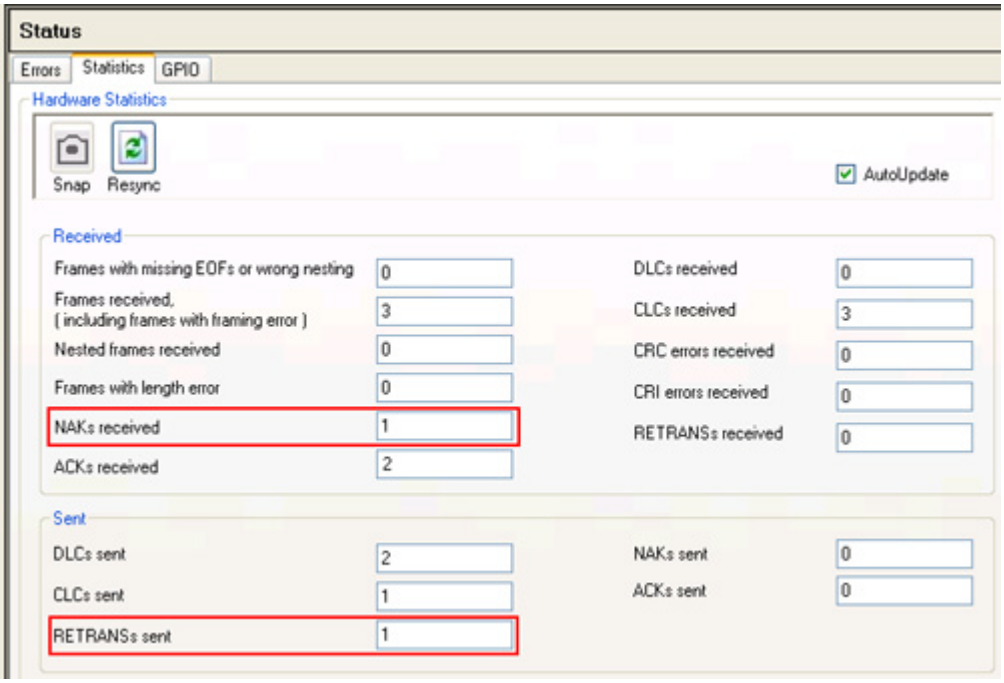


Figure 58 Retransmission status

The following screen displays a frame retransmitted by DigRF Exerciser in response to a NACK received from DUT.

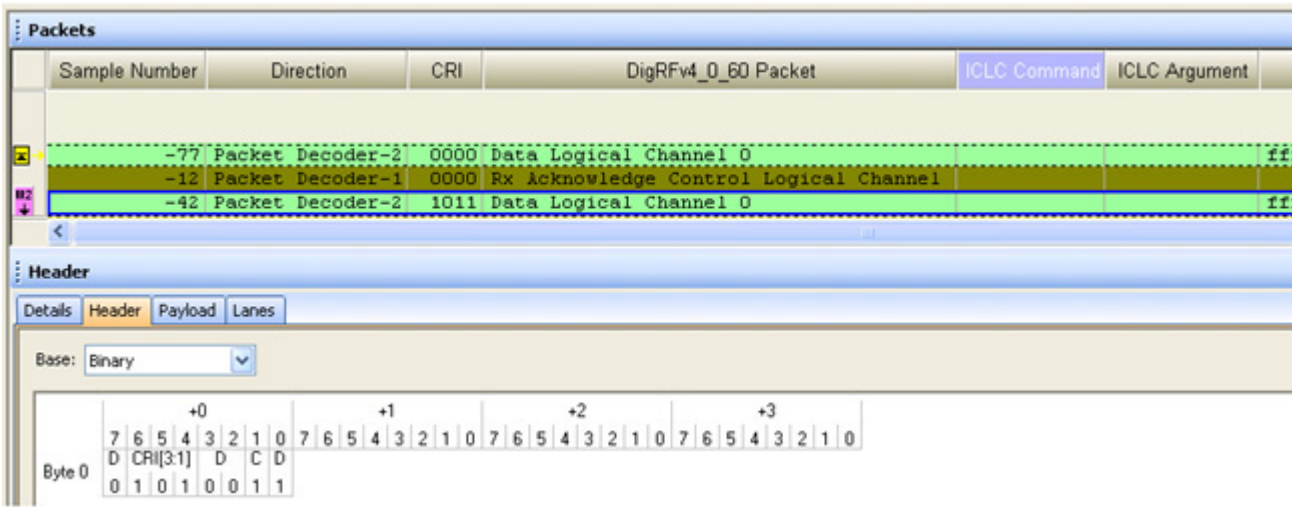
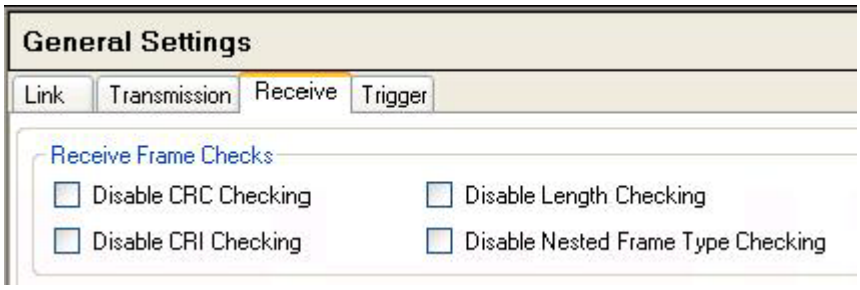


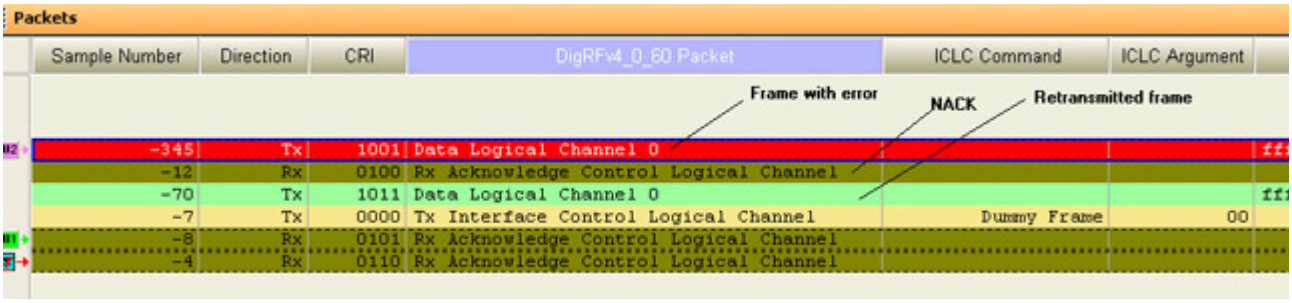
Figure 59 Frame retransmission from Exerciser

Testing retransmission of frames from DUT

To test retransmission of frames from DUT, you can enable received frame checks in DigRF Exerciser so that DigRF Exerciser checks the frames received from DUT for errors while stimulating a DUT.



For the errored frames received from DUT, DigRF Exerciser sends NACKs to DUT. You can then capture the data received from DUT to check the retransmission of the frame for which DigRF Exerciser sent a NACK. The following screen displays a capture sequence of an errored frame received from DUT on TxData sublink, followed by a NACK from Exerciser and then the retransmission from DUT.



Further, you can validate the structure of the retransmitted frame received from DUT. Refer to the topic Validating a DigRF Frame Structure on page 170 to know how you can validate the structure of a retransmitted frame captured over the DigRF link.

Testing High Speed and Low Speed Modes of Operation

DigRF Exerciser supports the HS-BURST and SYS-BURST modes of operation. You can test a DUT in any of these modes by providing stimulus in the selected mode.

While creating a link between DigRF Exerciser and RFIC/BBIC using the General Settings > Link tab in Protocol Exerciser for DigRF GUI, you can select the mode of operation for the TxData and RxData sublinks. You can choose the speed mode in which DigRF Exerciser should send stimulus and receive responses from DUT.

Once a link between DigRF Exerciser and DUT is configured and functional, you can change the mode of operation for the DUT (RFIC) from DigRF Exerciser emulating a BBIC. To do this, you can send the Tx control frame templates - RxData Sublink Rate and TxData Sublink Rate with the changed mode of operation as stimulus to RFIC. These control frames change the speed for the RxData and TxData sublinks to help you test:

- the DUT at the maximum supported speed.
- how the DUT responds to the speed changes to suit the changing speed requirements.

Speed change - Example

In the following example, the DigRF v4 0.60 link is initially configured at a single lane HS-Burst 1.x mode on both sides. The following sequence of stimulus frames is used to change the mode of operation on BBIC (DigRF Exerciser in this case) and RFIC from HS-Burst 1.x to HS-BURST 2.x mode. The number of lanes are then changed from 1 to 2 for the RFIC.

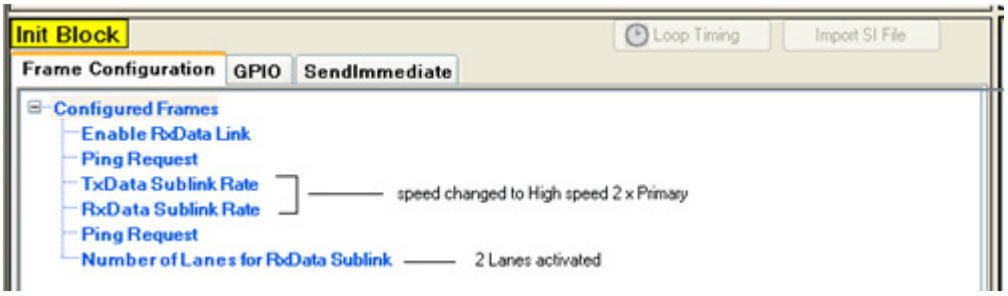
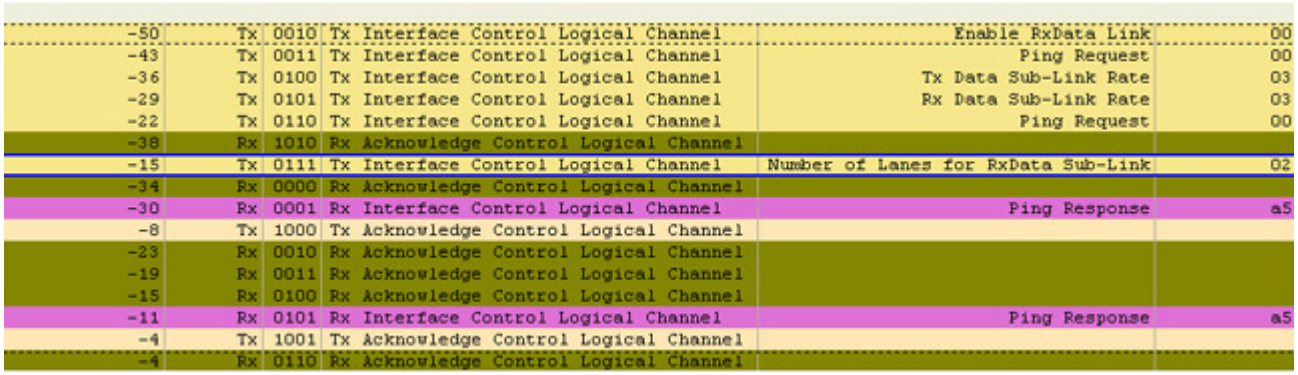


Figure 60 Changing speed to HS-BURST

The speed change sequence is captured both ways. The following is the outcome of the dual capture with DigRF Exerciser and DUT's responses captured.



-50	Tx	0010	Tx Interface Control Logical Channel	Enable RxData Link	00
-43	Tx	0011	Tx Interface Control Logical Channel	Ping Request	00
-36	Tx	0100	Tx Interface Control Logical Channel	Tx Data Sub-Link Rate	03
-29	Tx	0101	Tx Interface Control Logical Channel	Rx Data Sub-Link Rate	03
-22	Tx	0110	Tx Interface Control Logical Channel	Ping Request	00
-38	Rx	1010	Rx Acknowledge Control Logical Channel		
-15	Tx	0111	Tx Interface Control Logical Channel	Number of Lanes for RxData Sub-Link	02
-34	Rx	0000	Rx Acknowledge Control Logical Channel		
-30	Rx	0001	Rx Interface Control Logical Channel	Ping Response	a5
-8	Tx	1000	Tx Acknowledge Control Logical Channel		
-23	Rx	0010	Rx Acknowledge Control Logical Channel		
-19	Rx	0011	Rx Acknowledge Control Logical Channel		
-15	Rx	0100	Rx Acknowledge Control Logical Channel		
-11	Rx	0101	Rx Interface Control Logical Channel	Ping Response	a5
-4	Tx	1001	Tx Acknowledge Control Logical Channel		
-4	Rx	0110	Rx Acknowledge Control Logical Channel		

Figure 61 Speed change data capture

Refer to the topic Validating a DigRF Frame Structure on page 170 to get examples of how to validate a SYS-BURST and a HS-BURST data frame structure.

Detecting Protocol Violations in Received DigRF Frames

You can detect if there are any DigRF protocol violations in the frames received from the DUT during the stimulus flow. To do this, you can configure settings in Protocol Exerciser for DigRF GUI to ensure that DigRF Exerciser checks the data and control frames received from the DUT for protocol violations. On encountering a protocol violation in received frames, it records these violations as protocol errors and categorize these errors. You can view these protocol errors in the Status page of the Protocol Exerciser for DigRF GUI.

For this release, the **Errors** tab in the Status page is not functional.

You can view the total number of received frames with errors in different categories such as CRC errors, CRI errors, and length errors. You use the Statistics tab of the Status page in the Protocol Exerciser for DigRF GUI to get this information. The following screen displays the **Statistics** tab of the **Status** page in the Protocol Exerciser for DigRF GUI. It displays the protocol errors encountered in the frames received from an RFIC.

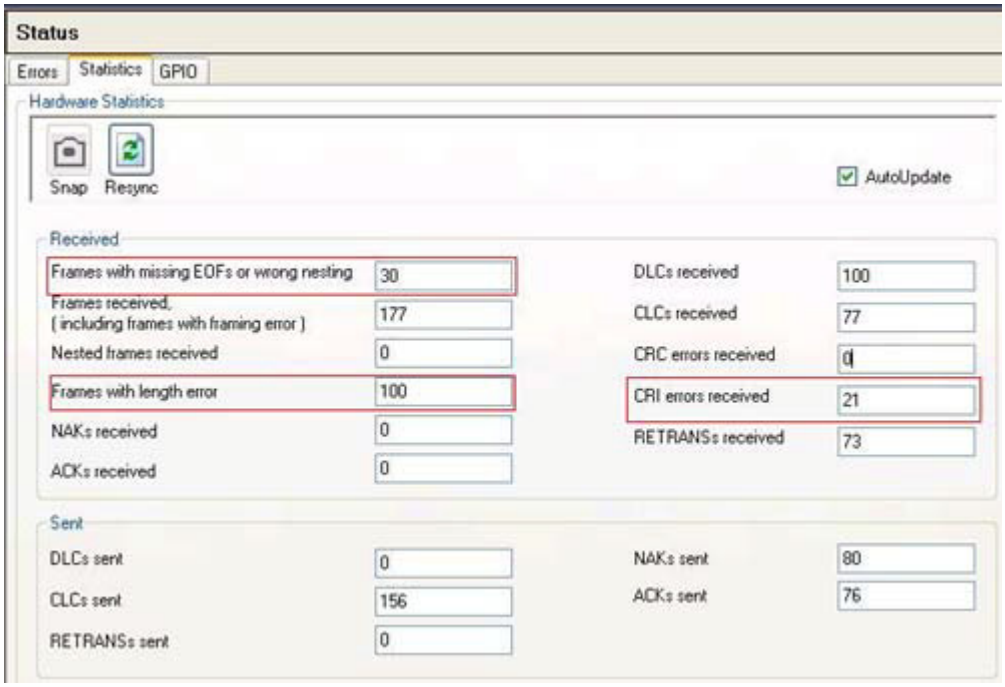


Figure 62 Protocol errors statistics

If you have enabled the ARQ protocol, then DigRF Exerciser also sends NACK for the errored frames received from DUT during the stimulus flow.

Configuring frame level checks to detect protocol violations

You can select the frame level checks that you want DigRF Exerciser to perform on the DigRF frames received from DUT. DigRF Exerciser then performs these checks on the received frames to update the Error and Statistics information in the Status page of the Protocol Exerciser for DigRF GUI. For instance, if you enable CRC checking, then DigRF Exerciser will perform CRC checks on the received frames and report any CRC errors detected.

You configure received frame level checks using the **Receive** tab of the **General Settings** navigation page of the Protocol Exerciser for DigRF GUI. The following screen displays the frame level checks that you can enable or disable in the Receive tab.

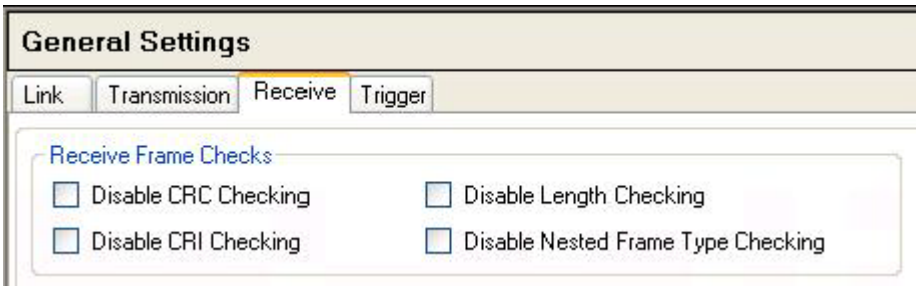


Figure 63 Receive checks

To know more about each of these checks, refer to the Receive tab topic of the Protocol Exerciser for DigRF GUI Reference in this online help.

You can also configure received frame level checks in a data capture setup using the **Capture Options** tab of the External Protocol Analyzer Setup dialog box in the Logic Analyzer GUI.

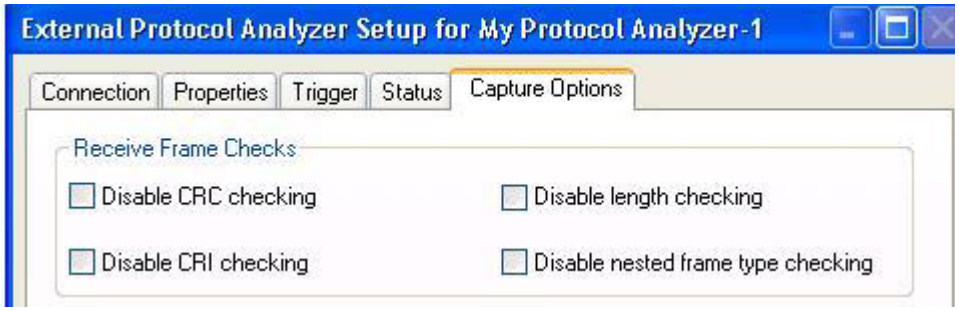
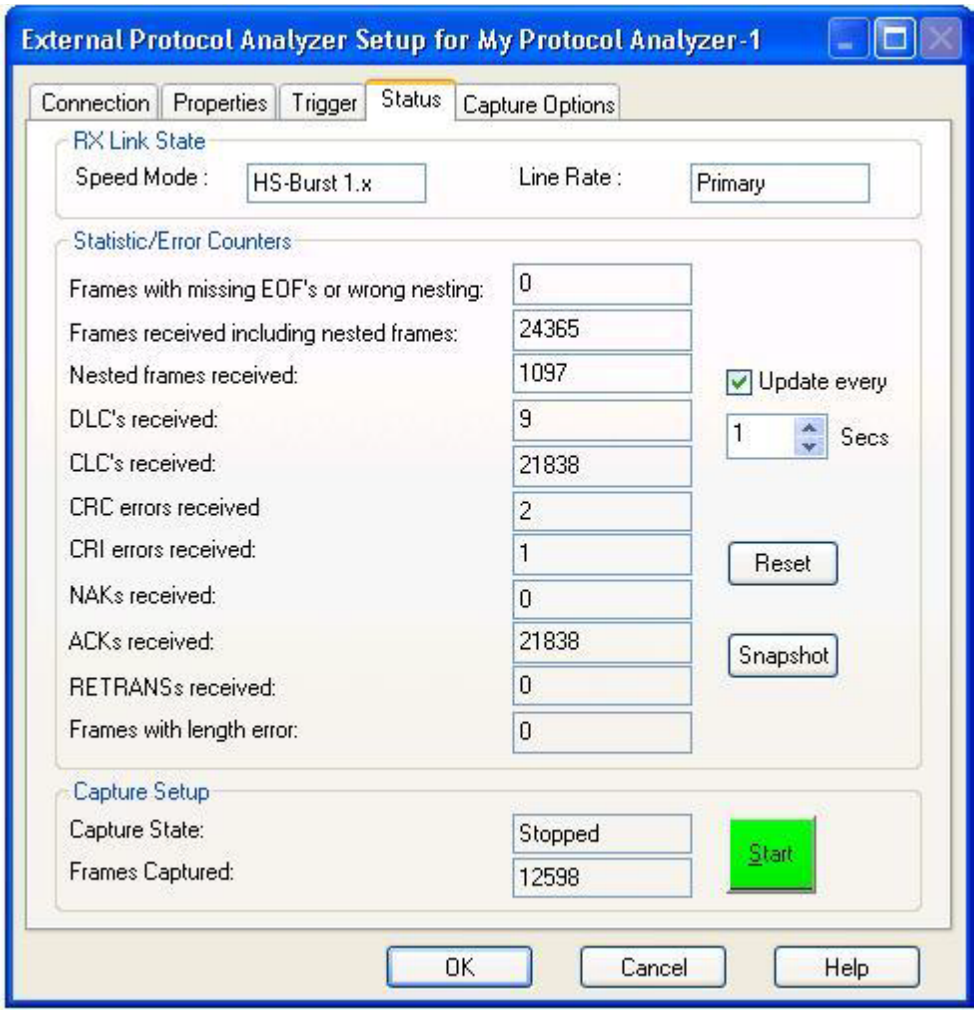


Figure 64 Receive frame checks in capture

On enabling these checks, the frames captured using either DigRF Exerciser or Analyzer module are checked for the selected protocol errors and the error statistics for the captured data is displayed as follows in the Status tab.



To know how to configure data capture setup and view the capture statistics, refer to the topic, **Configuring a Tx or Rx Data Capture Setup** and **Starting the Data Capture**.

Testing RFIC/BBIC Under Error Conditions

You can test how a DUT (RFIC/BBIC) responds to error conditions by sending DigRF frames with selected protocol errors as stimulus to the DUT. For instance, you can check whether or not DUT categorizes the frame as an errored frame and sends a NACK in response to the errored frame.

You can use the Protocol Exerciser for DigRF GUI to insert protocol errors in the frames that you add to the stimulus sequence of frames for a traffic block. You can insert errors in a control or a data frame.

Supported Error Insertions

DigRF Exerciser supports the following protocol errors to be inserted in a control or a data frame:

- **CRC** - Represents an error introduced in the CRC of the frame. This error category is disabled for a TAS Logical Channel and TACLC control frames on TxData sublink and all data frames as these frames do not have a CRC value.
- **CRI Missing** - Selecting this error sends the frame with a missing CRI.
- **CRI Failure** - For this release, the CRI Failure error cannot be inserted and is disabled for all frames.
- **Disparity** - Represents an 8b/10b encoding error.
- **Symbol/Coding** - Represents an error introduced in the coding of symbols in a frame.
- **Framing** - Represents a framing error such as error in the end of frame or length of the frame.

Inserting Errors

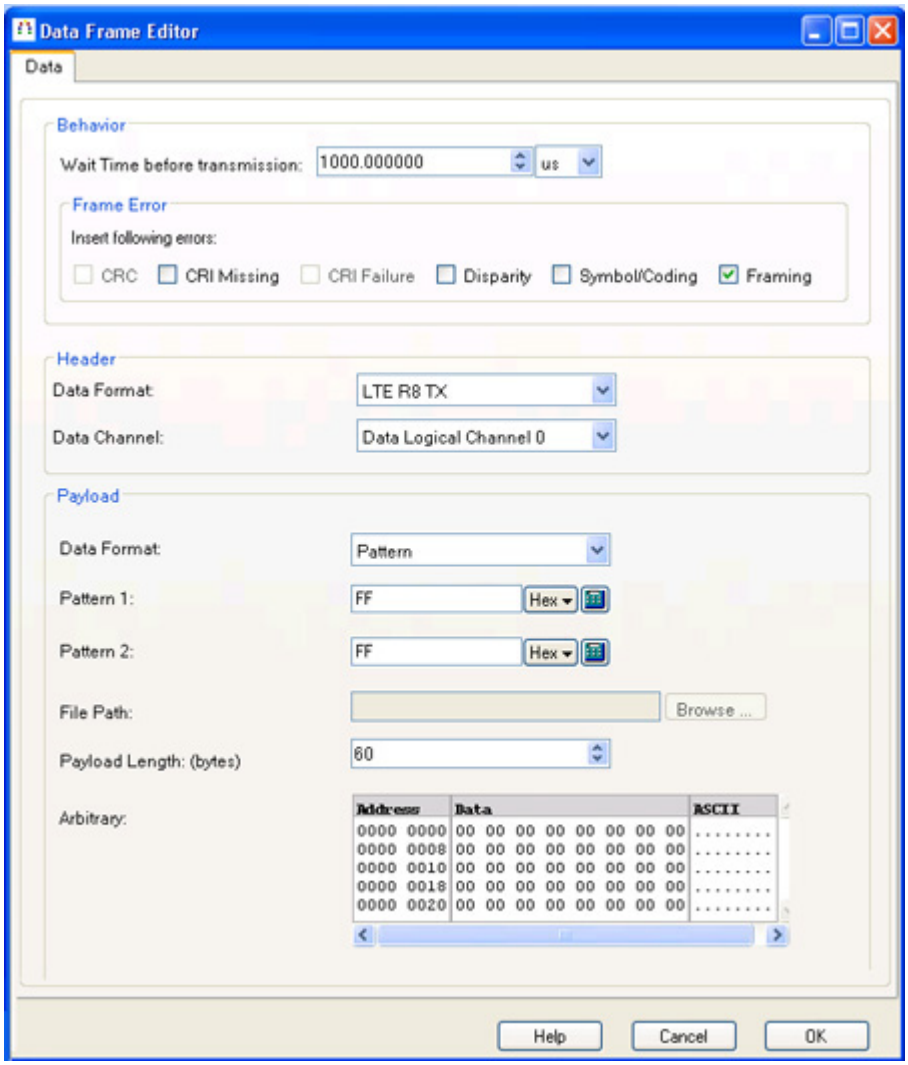
To insert a protocol error in a DigRF frame to be sent as stimulus to DUT:

1. Click the **Frame Configuration** icon in the navigation pane of the Protocol Exerciser for DigRF GUI.
2. Drag and drop a data or a control frame template from the **Frame Templates** tab to the **Frame Configuration** or **SendImmediate** tabs.
3. Right-click the added frame and select **Edit**.
4. In the **Frame Error** group, select the check box for the protocol error(s) that you want to insert in the frame.
5. Click **OK**.

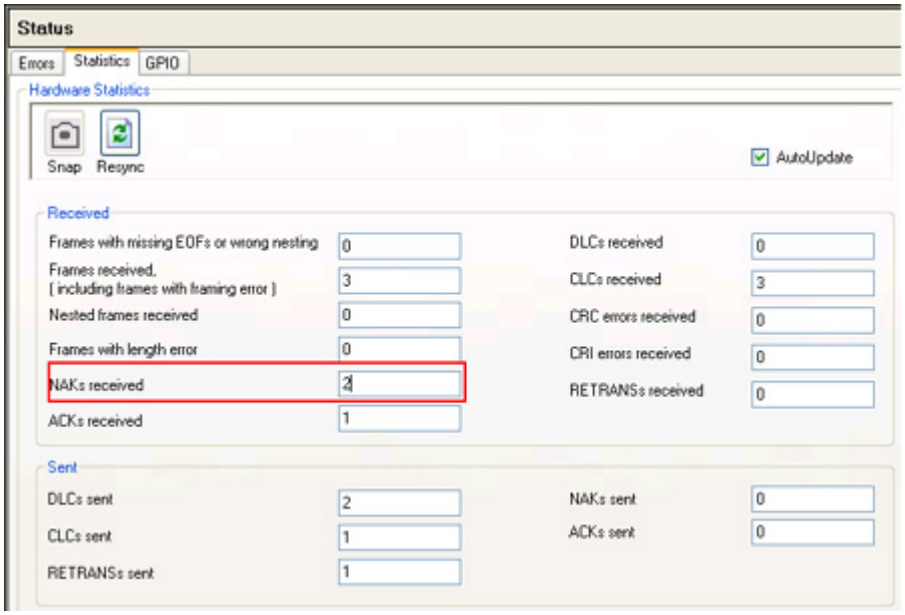
You can then send this errored frame as stimulus.

Testing RFIC/BBIC under Error Conditions - Example

In this example, DigRF Exerciser emulates a BBIC and sends an errored frame to RFIC. The following screen displays a data frame with framing error inserted.

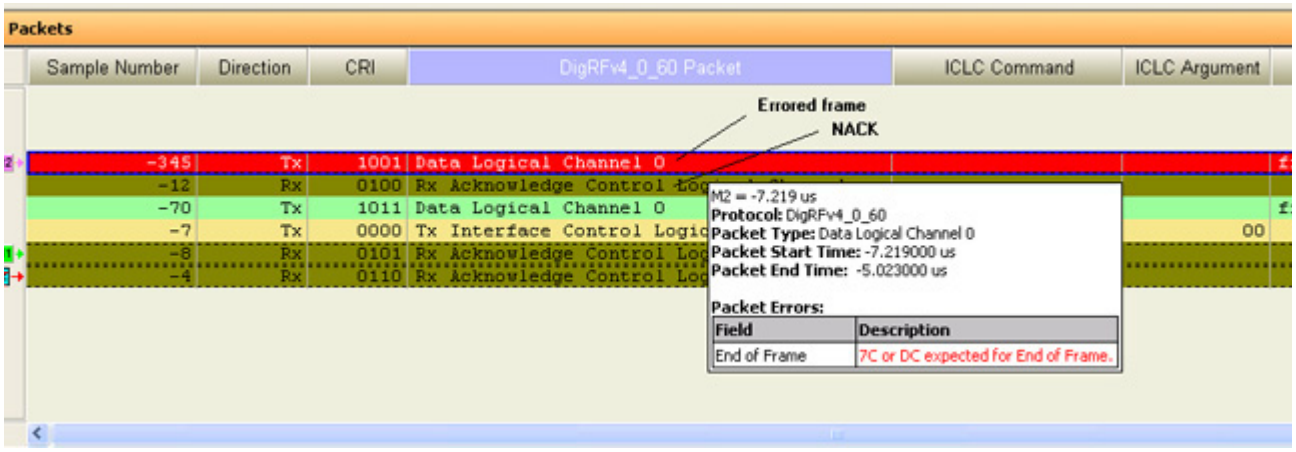


The following screen displays a NACK received from RFIC in response to this data frame sent with framing error.



Using DigRF Exerciser, you can do a dual capture of Rx data in relation to the Tx data to view the RFIC response to the framing error frame. You can then view and analyze the transmitted error frame and the response in relation to the error frame using Packet Viewer and Packet Decoder tools.

The following screen displays the NACK captured in response to the frame transmitted with framing error in Packet Viewer.



Analyzing the Captured DigRF Data

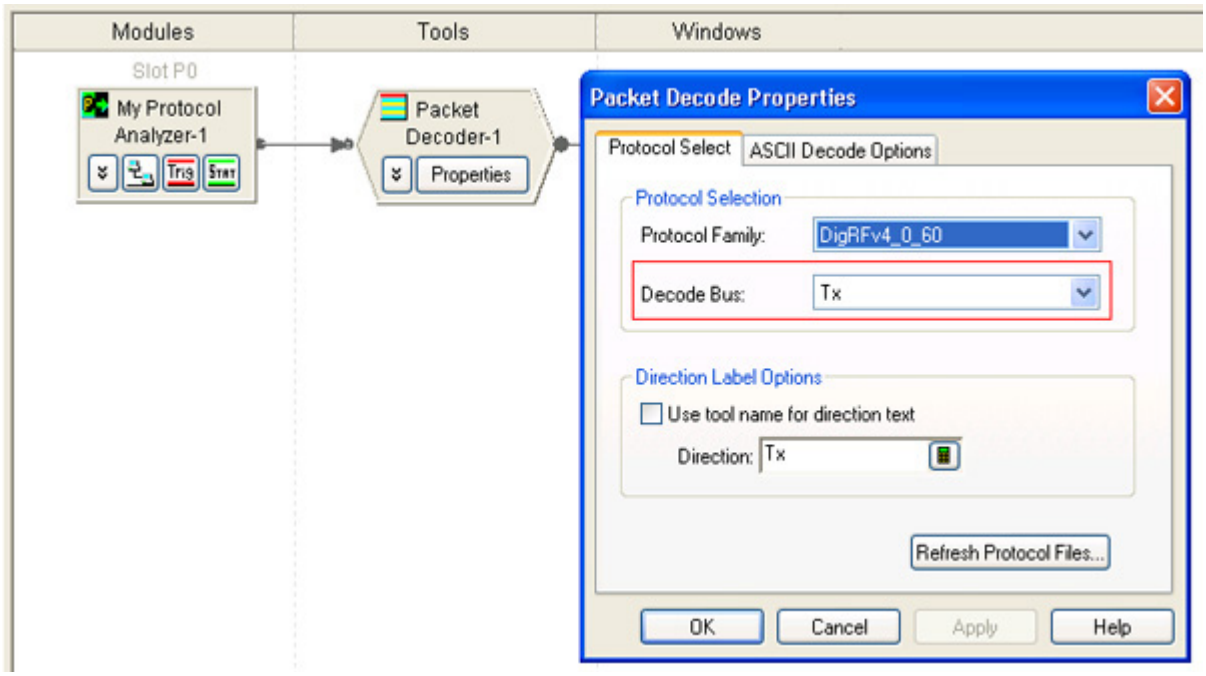
Introduction to DigRF Analysis Tools

Once you have captured DigRF data using either DigRF Exerciser or Analyzer module and obtained this data in the Logic Analyzer application through a session, you can view, decode, interpret, and analyze this captured data. You do this using various DigRF analysis tools. These tools are installed while installing RDX test platform and are available in the Logic Analyzer GUI. Some tools that help you in cross domain signal testing and analysis are not installed as a part of the RDX test platform but these tools interoperate with RDX test platform on installation. This topic introduces you to the tools that are either part of RDX test platform or interoperate with RDX test platform to help you analyze data in digital or RF domain.

NOTE To get a detailed description of each of these tools, refer to the online help provided with each of these tools.

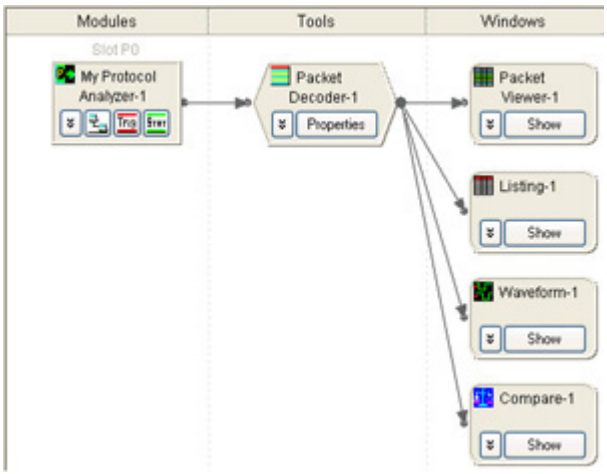
Packet Decoder (Decoding DigRF Packets)

Packet Decoder interprets the captured DigRF packets and presents an easy to understand description of the packets in viewing tools such as Packet Viewer in the Logic Analyzer GUI. While using the Packet Decoder tool, ensure that you select the appropriate protocol and the decode bus matching the packets that you want the Packet Decoder to decode. Else, it will not displays accurate results.



You can view the packets decoded by Packet Decoder as:

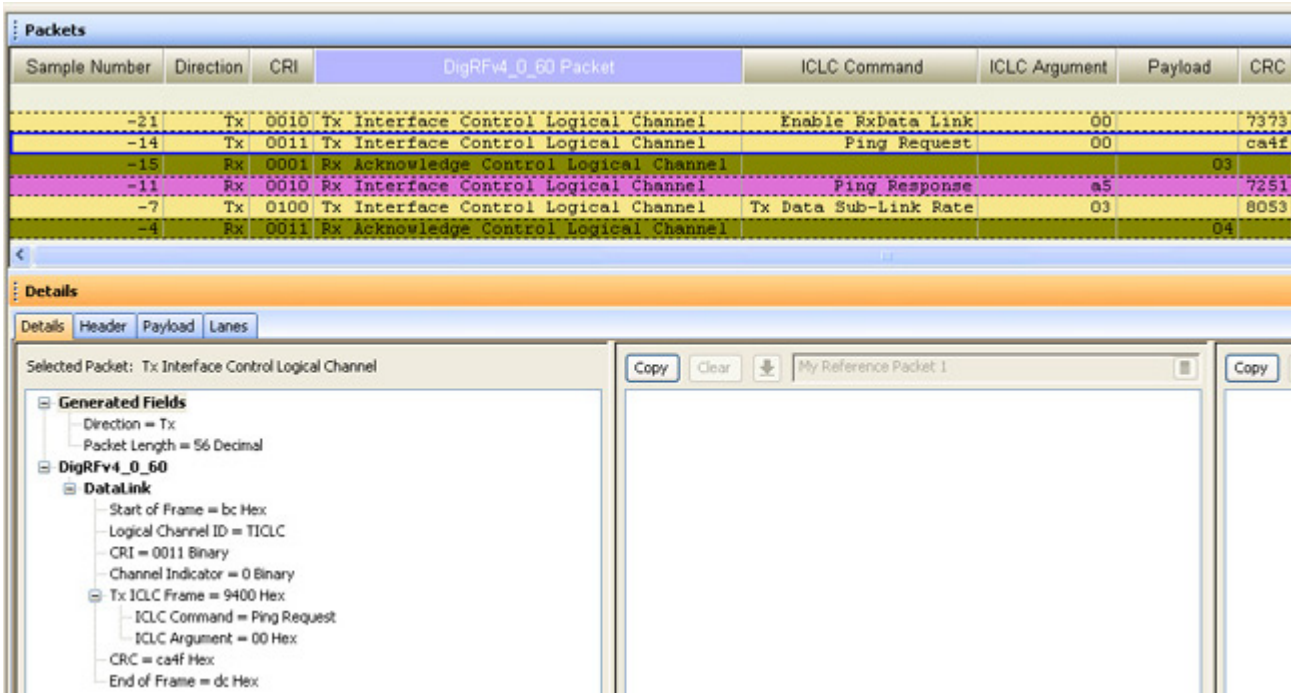
- Decoded packets in Packet Viewer
- Waveforms in Waveform Viewer
- Listing
- Compare Display (comparing data from different acquisitions)



Packet Viewer (Viewing DigRF Packets)

The Packet Viewer tool displays the DigRF packets decoded by Packet Decoder. The Packer Viewer window is customized for the protocol family being decoded. For a DigRF packet, it displays the frame components such as Header, Payload, CRC, CRI, EOF/EOT, and length of the frame. Using this tool, you can also perform DigRF packet comparison and debugging.

If you have configured dual capture, you can view the co-related Tx and Rx packets exchanged between BBIC and RFIC using the Packet Viewer tool. The following screen displays such a sequence of packets. All the packets are displayed with a timestamp.



Signal Extractor (Extracting DigRF IQ Data)

Signal Extractor is a utility in the logic analyzer framework that allows extracting the IQ data from the DigRF data packets using a specific set of DigRF commands/algorithms. You can view this extracted IQ data in either the Waveform Viewer, as a Listing, or send it to the Agilent VSA software for further RF analysis.

While extraction, it only extracts the IQ data from DigRF data frames and excludes protocol data and DigRF control frames from extraction.

You can use the Signal Extractor tool in Logic Analyzer GUI if you have the appropriate license for this tool. However, a license is not needed if a connection has been established with the DigRF Exerciser/Analyzer module used for data capture.

NOTE

A new set of APIs have been provided in RDX test platform Release 1.9. It is possible to extract the IQ data directly using the newly added APIs instead of using the Signal Extractor tool in the Logic Analyzer GUI. The direct IQ data extraction is much faster than using the Signal Extractor tool. Based on the parameters that you specify for IQ data extraction, the new APIs fetch the required number of frames and extract the IQ data from these frames. You can save the extracted IQ data in a CSV file and use this file for further signal analysis in VSA. Refer to the API help to know more about the new APIs.

The direct IQ data extraction using the new set of APIs is licensed. You need to have the appropriate hardware license to use these new APIs.

Waveform Viewer

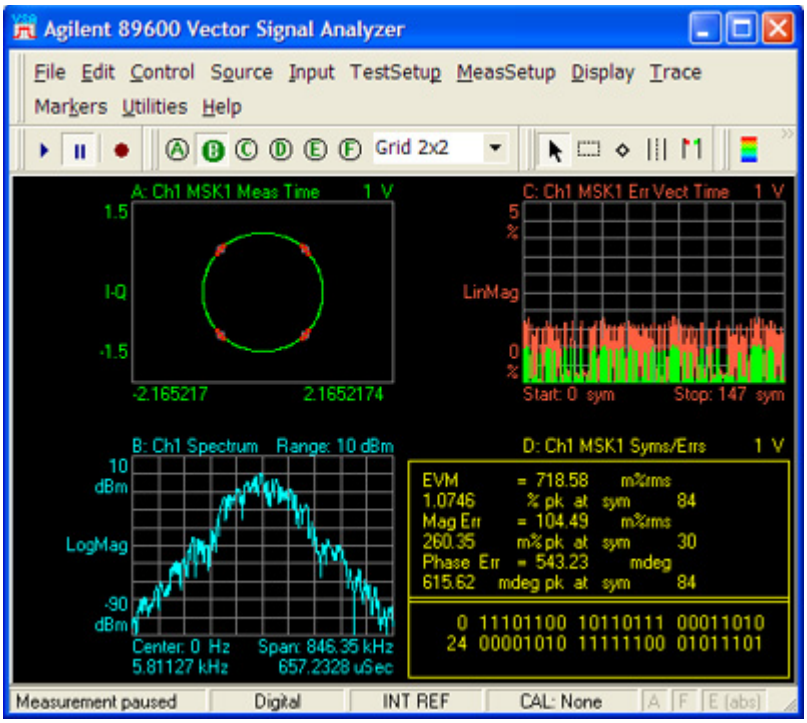
The Waveform Viewer displays the IQ data extracted from the DigRF packets in a D-to-A view.

VSA (Sending data to VSA for further Analysis)

Agilent's Vector Signal Analysis software (VSA) allows RF analysis of the IQ waveform data. It is available as a standalone product and needs to be installed separately from the RDX test platform. Once installed, you can send the extracted IQ data from Signal Extractor to VSA using the VSA GUI, which connects it to Signal Extractor.

VSA measures carrier offset, Error Vector Magnitude (EVM) and frequency error for QPSK, QAM, GSM, EDGE, WiMAX, and W-CDMA etc.

VSA lets you analyze signals and gather the data to troubleshoot signal problems.



To know more about how to use VSA in performing RF analysis of captured data, refer to the topics Configuring Data Capture with VSA Integration on page 104 and Analyzing Captured Data using VSA on page 175.

Validating a DigRF Frame Structure

You can validate if the structure of DigRF frames received from DUT (RFIC or BBIC) is as per the DigRF specifications.

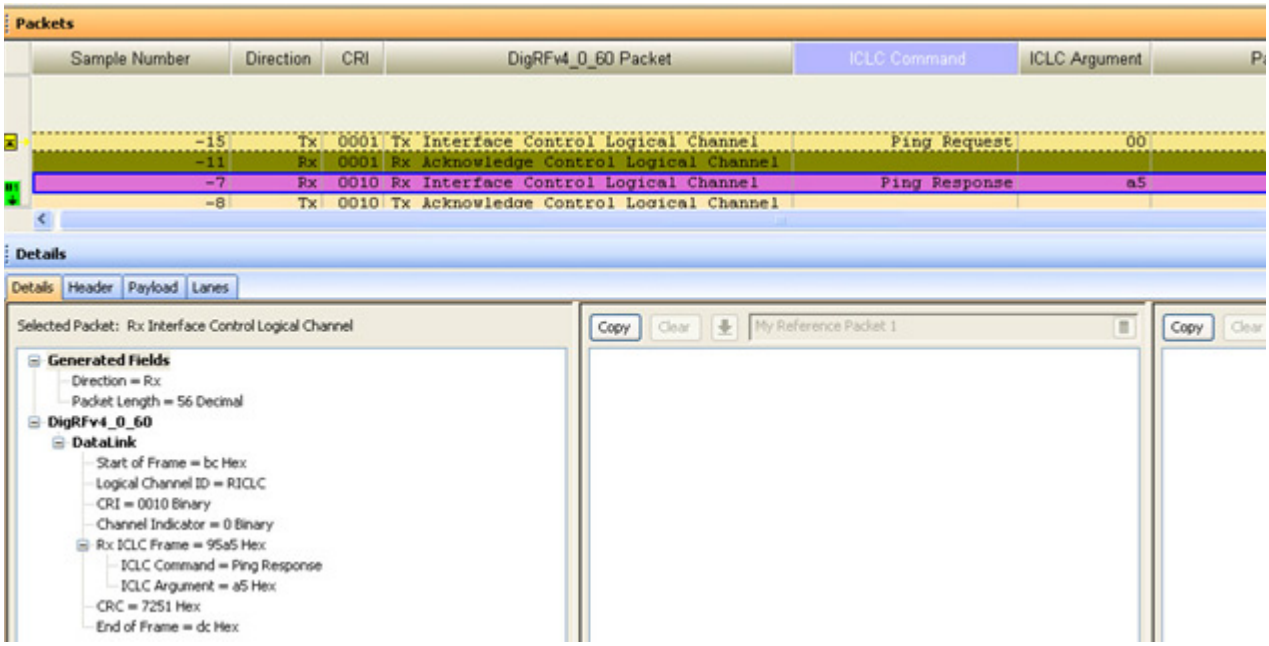
To accomplish this, you can capture the frames received from DUT using the DigRF Exerciser or Analyzer module and view the captured frames in Packet Viewer and Packet Decoder to validate and analyze the structure.

You can check if the frame components such as SOF, Header, Payload, CRC, EOF/EOT and length in a frame are as per the specifications. You can also validate the structure of specific types of frames such as nested frames or SYS-BURST (low speed) data frames to see if the construction of such frames is as per the specifications.

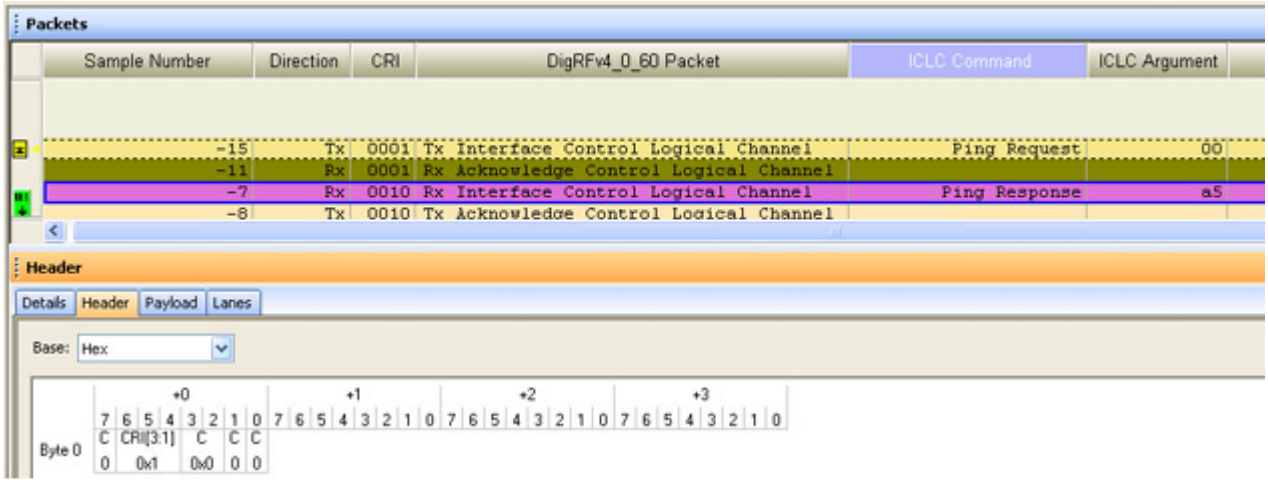
In this topic, some examples are included to display the details and structure of specific DigRF frames that have been captured using DigRF Exerciser module and displayed in Packet Viewer. In these examples, stimulus is provided using DigRF Exerciser and then dual capture is done to validate the received frames.

Example 1 - Validating a Control Frame Structure

In this example, DigRF Exerciser emulates a BBIC and sends a Ping Request control frame as stimulus to DUT (RFIC). The Tx and Rx data is captured using DigRF Exerciser, decoded using Packet Decoder, and decoded packets are displayed in Packet Viewer. In the following screen, the details of the Ping Response frame received from RFIC are displayed in Packet Viewer.

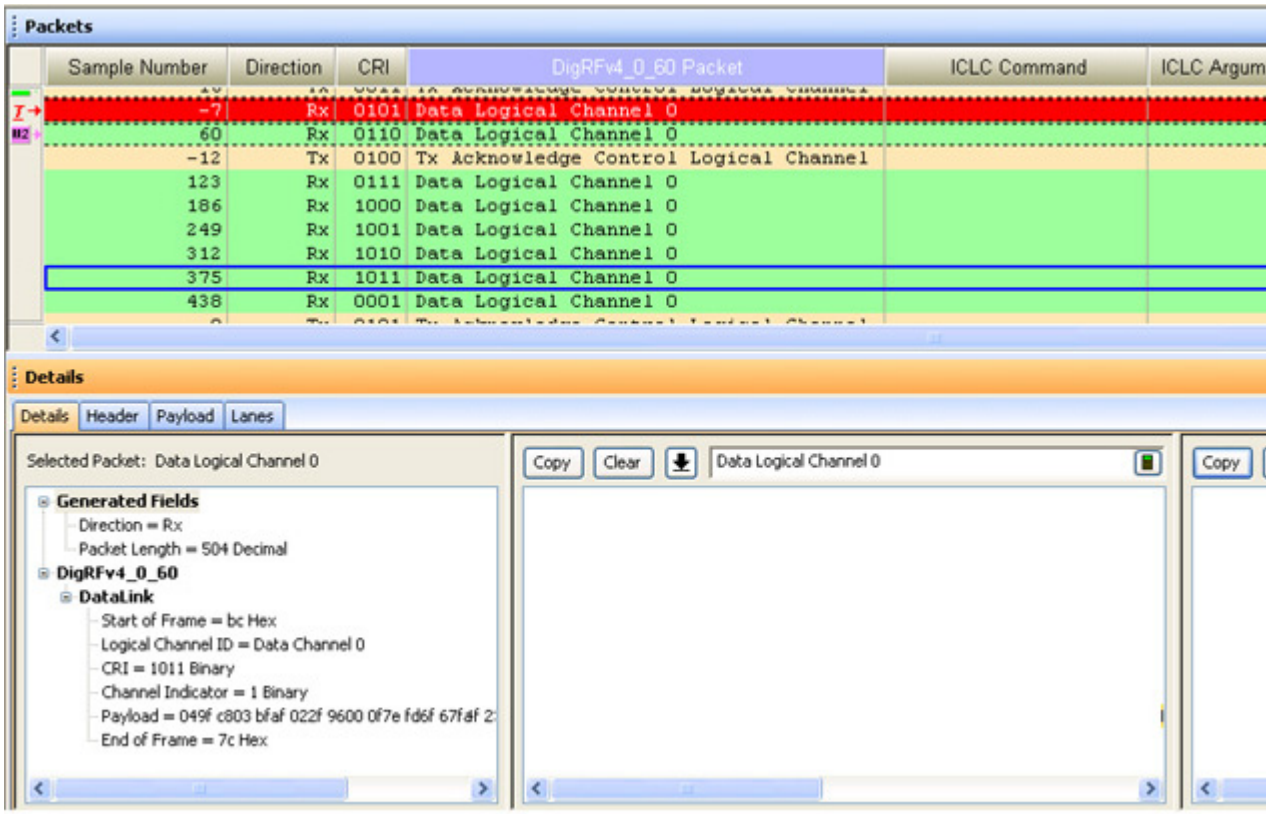


The following screen displays the header of the Ping Response frame received from RFIC.



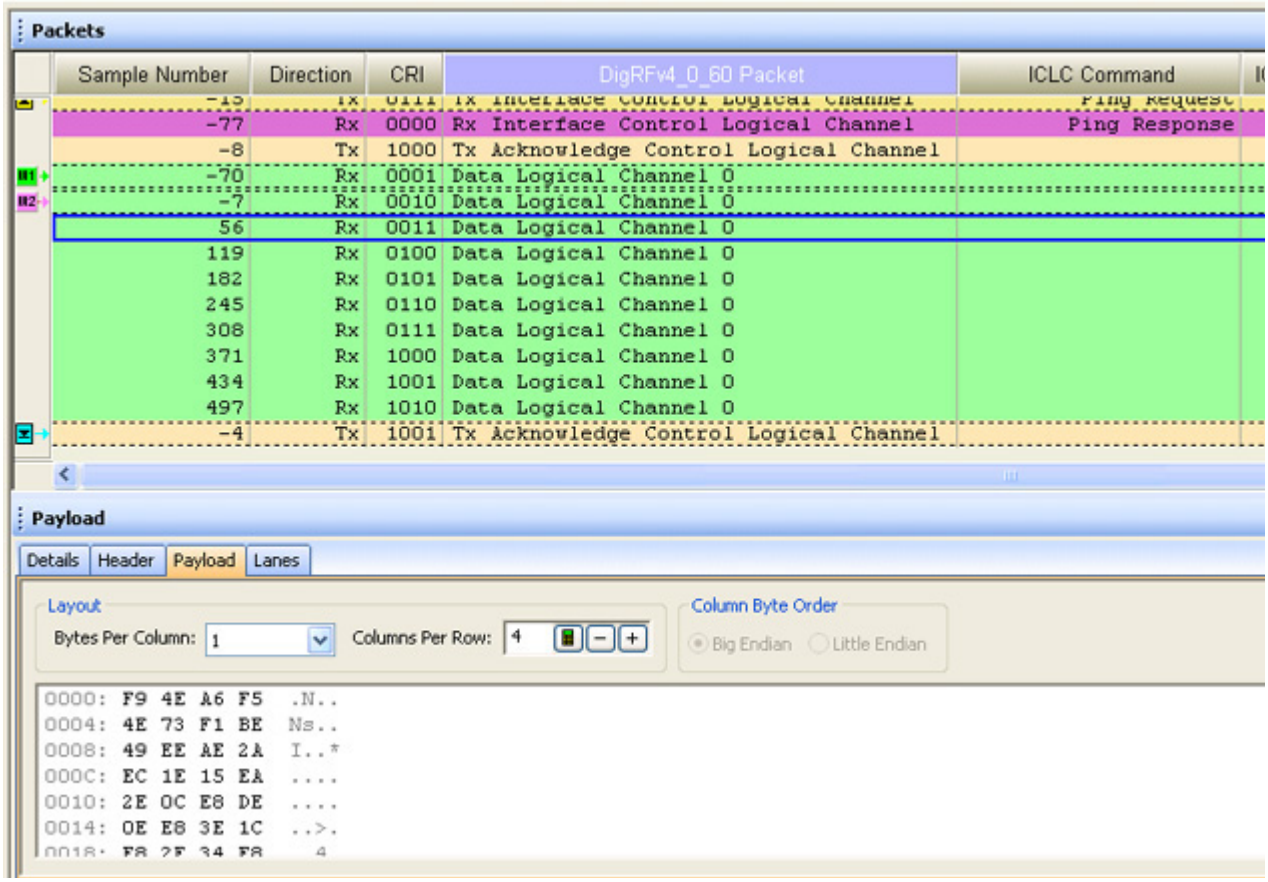
Example 2 - Validating a Retransmitted Frame Structure

The following screen displays a retransmitted frame captured using DigRF Exerciser and displayed in Packet Viewer. The header and other details of the retransmitted frame are displayed in the lower pane of the Packet Viewer.



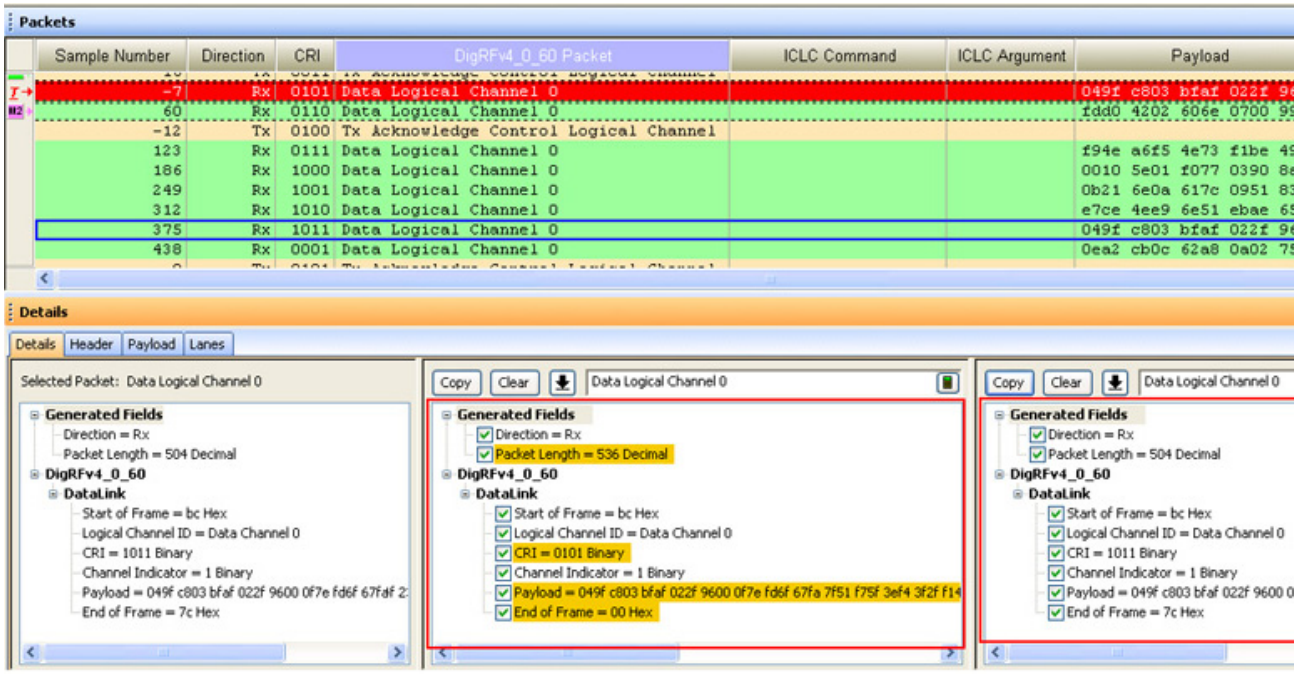
Example 4 - Validating a High Speed Data Frame Structure

The following screen displays a burst of LTE Rx data frames received from an RFIC in the HS-BURST mode. The payload of one of these data frames in the burst is also displayed in the lower pane of the Packet Viewer.



Example 5 - Comparing the Structure of Frames

In the following example, the structure of two data frames received from an RFIC is compared in Packet Viewer. The frames are selected from the list and copied in the highlighted sections by clicking the Copy button. The first frame structure is of a data frame with framing error in the end of frame. The second frame structure is of the data frame retransmitted in response to the NACK received for the first frame. The differences in the structure of the two frames are highlighted by Packet Viewer.


Packets
Sample Number
Direction
CRI
DigRFv4_0_60 Packet
ICLC Command
ICLC Argument
Payload
-7 Rx 0101 Data Logical Channel 0 049f c803 bfaf 022f 9
60 Rx 0110 Data Logical Channel 0 fdd0 4202 606e 0700 9
-12 Tx 0100 Tx Acknowledge Control Logical Channel
123 Rx 0111 Data Logical Channel 0 f94e a6f5 4e73 f1be 4
186 Rx 1000 Data Logical Channel 0 0010 5e01 f077 0390 8
249 Rx 1001 Data Logical Channel 0 0b21 6e0a 617c 0951 8
312 Rx 1010 Data Logical Channel 0 e7ce 4ee9 6e51 ebae 6
375 Rx 1011 Data Logical Channel 0 049f c803 bfaf 022f 9
438 Rx 0001 Data Logical Channel 0 0ea2 cb0c 62a8 0a02 7
Details
Details
Header
Payload
Lanes
Selected Packet: Data Logical Channel 0
Generated Fields
Direction = Rx
Packet Length = 504 Decimal
DigRFv4_0_60
DataLink
Start of Frame = bc Hex
Logical Channel ID = Data Channel 0
CRI = 1011 Binary
Channel Indicator = 1 Binary
Payload = 049f c803 bfaf 022f 9600 0f7e fd6f 67faf 2
End of Frame = 7c Hex
Copy
Clear
Data Logical Channel 0
Generated Fields
Direction = Rx
Packet Length = 536 Decimal
DigRFv4_0_60
DataLink
Start of Frame = bc Hex
Logical Channel ID = Data Channel 0
CRI = 0101 Binary
Channel Indicator = 1 Binary
Payload = 049f c803 bfaf 022f 9600 0f7e fd6f 67fa 7f51 f75f 3ef4 3f2f f14
End of Frame = 00 Hex
Copy
Clear
Data Logical Channel 0
Generated Fields
Direction = Rx
Packet Length = 504 Decimal
DigRFv4_0_60
DataLink
Start of Frame = bc Hex
Logical Channel ID = Data Channel 0
CRI = 1011 Binary
Channel Indicator = 1 Binary
Payload = 049f c803 bfaf 022f 9600 0
End of Frame = 7c Hex

Analyzing Captured Data using VSA

This topic describes how you can send the DigRF data captured using the DigRF Exerciser/Analyzer module to VSA for further RF signal analysis.

You can perform offline or online analysis of data using VSA. This topic describes both these modes of data analysis using VSA.

Offline analysis of captured data using VSA

Offline analysis here means that a connection is not required with the DigRF Exerciser/Analyzer hardware while performing data analysis in VSA. In this mode, you can save the data captured using the DigRF Exerciser/Analyzer module in a file using the Logic Analyzer GUI. You can later view, analyze, and send this saved data from this file to the VSA GUI for offline analysis.

In offline analysis, when VSA reaches the end of the Logic Analyzer data capture, it returns to the beginning of the data and continues the measurement. In this analysis, VSA can only fetch already captured data from Logic Analyzer and runs this captured data repeatedly. It cannot trigger the Logic Analyzer for recapture.

To perform offline analysis using VSA:

1 In the Logic Analyzer GUI, save the data that you captured using the DigRF Exerciser/Analyzer module. Refer to the topic Viewing the Captured Data Offline on page 119 to know how to save the captured data.

2 In the Logic Analyzer GUI, import the captured data from the file for offline viewing and analysis. Refer to the topic Viewing the Captured Data Offline on page 119 to know how to import the saved data.

3 Add the **Signal Extractor** tool with the imported data module in the Logic Analyzer GUI. This tool extracts IQ data from the captured data and sends it to the VSA GUI for RF analysis. VSA can input data from selected Logic Analyzer software tools. The first supported tool is the Signal Extractor. The VSA will only take data from software tools that receive their input from hardware modules. The VSA will not receive data from a tool whose input is another tool's output. In offline mode, when no connection with the DigRF Exerciser/Analyzer hardware is there, you need an appropriate license to use the Signal Extractor tool.

4 Start the VSA GUI.

5 Link the VSA GUI to the Logic Analyzer application.

   a VSA gets the Logic Analyzer address using the 89600 IO Connections software utility.

   b The 89600 IO Connections software utility is installed with the VSA software and is located at **Start** > (All) **Programs** > **Agilent 89600 VSA** > **Logic Analyzer** > **IO Connections**. If the Logic Analyzer application resides on the same PC as the VSA, then use the name "localhost."

   c In the VSA GUI, click **Utilities** > **Hardware** > **ADC** 1. **Clear Simulate Hardware** if currently selected and select **Agilent VSA Logic Analyzer Input**. VSA will then link to the Logic Analyzer application.

6 Analyze the saved data offline in the VSA GUI.

Online analysis of captured data using VSA

Online analysis here means that the Logic Analyzer GUI is connected to the DigRF Exerciser/Analyzer hardware for data capture and the captured data is simultaneously sent from Logic Analyzer to VSA for analysis while being connected to the DigRF Exerciser/Analyzer hardware. In this type of analysis, VSA can generate real time graphs from the captured data received from the Logic Analyzer GUI.

In online analysis, VSA runs to the end of the current Logic Analyzer data capture buffer and instructs or triggers the Logic Analyzer to run again for recapture.

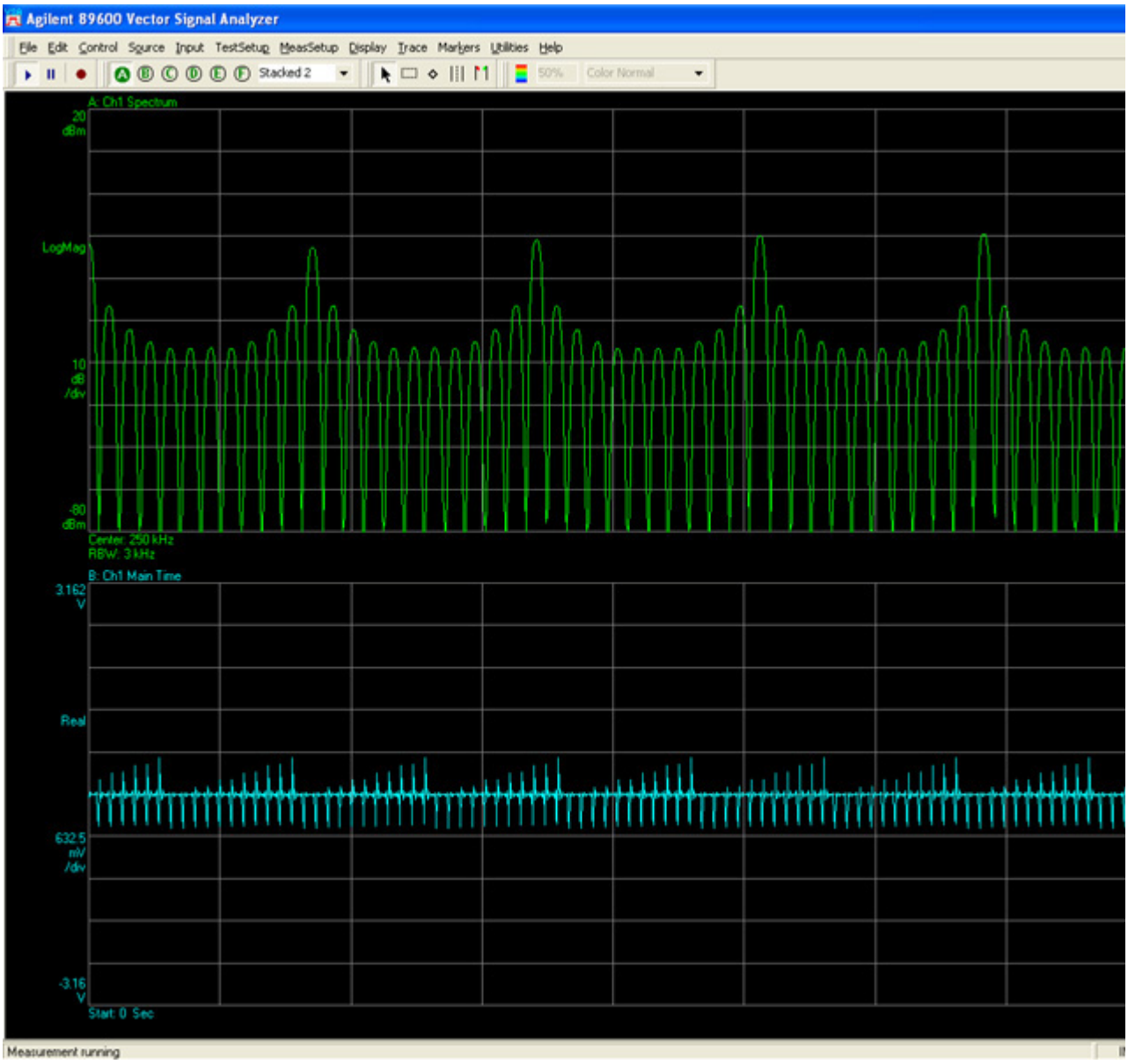
For online analysis of data in VSA, some configurations are required for VSA integration with the Logic Analyzer GUI. To know about these configurations on the Logic Analyzer GUI and the VSA GUI, refer to the topic Configuring Data Capture with VSA Integration on page 104.

Once you have performed these configurations, add a Signal Extractor tool to extract IQ data from the captured data and to send it to VSA for analysis. VSA can take data from selected Logic Analyzer software tools. The first supported tool is the Signal Extractor. VSA takes data from software tools that receive their input from hardware modules. VSA does not receive data from a tool whose input is another tool's output.

The captured data is available in real time for analysis in VSA when you click the  toolbar button in the Logic Analyzer GUI and the  toolbar button in VSA GUI. On

clicking these buttons, the data capture gets started, the captured data is uploaded in Logic Analyzer GUI, and the extracted IQ data using Signal Extractor is passed to VSA for online RF analysis.

The following screen displays the extracted IQ data passed from Signal Extractor to VSA for online analysis.



4 Configuring and Using GPIO Interface for Transmission

Besides providing DigRF v3 and v4 interface for stimulus over the DigRF link, the DigRF Exerciser module also provides a General Purpose Input Output (GPIO) interface. You can use this interface for any generic purpose such as providing stimulus for a proprietary interface to DUT.

The DigRF Exerciser module hardware has a GPIO Connector component that controls and listens to various signals on the test board for instance, controlling the DUT power. The GPIO Bus consists of up to 36 pins which you can configure as input or output. You can specify a bit pattern for these pins, one bit per pin. The bit pattern is stored in the Transmit memory of the DigRF Exerciser module and is sent as output as per the selected clock when you start the GPIO transmission.

The GPIO output pins are grouped in sections, Bank A to F. You can decide the pins you want to enable in each of these sections.

While configuring the GPIO interface, you:

- enable and configure the output pins in Bank A to F on the GPIO interface.
- configure the data (bit pattern 0 or 1) to be transmitted from the output pins.

To configure DigRF Exerciser module's GPIO Interface for output pins and data:

1 Launch the Protocol Exerciser for DigRF GUI by clicking **Start > Programs >Agilent RDX for DigRF > Exerciser for DigRF** option on the Windows task bar.

  The **Select type of session** window is displayed.

2 Select the type of session you want to create with the DigRF Exerciser module (online or offline) for configuring the GPIO interface. Refer to the topic Creating a DigRF Exerciser Session on page 38 to know more about sessions. You can configure GPIO interface even in an offline mode. However, to start sending the data over the

configured GPIO interface, you need to connect to the DigRF Exerciser module through an online session.

The **Agilent Protocol Exerciser for DigRF** window is displayed.

3 Click the **Frame Configuration** icon from the navigation bar.

4 Click the **Init** block from the traffic flow graph displayed in the **Frame Configuration** page. You can configure the GPIO interface only in the Init block of transmission from DigRF Exerciser module. In other blocks, the options are disabled.

5 Click the **GPIO** tab displayed in the lower panel of the Frame Configuration page.

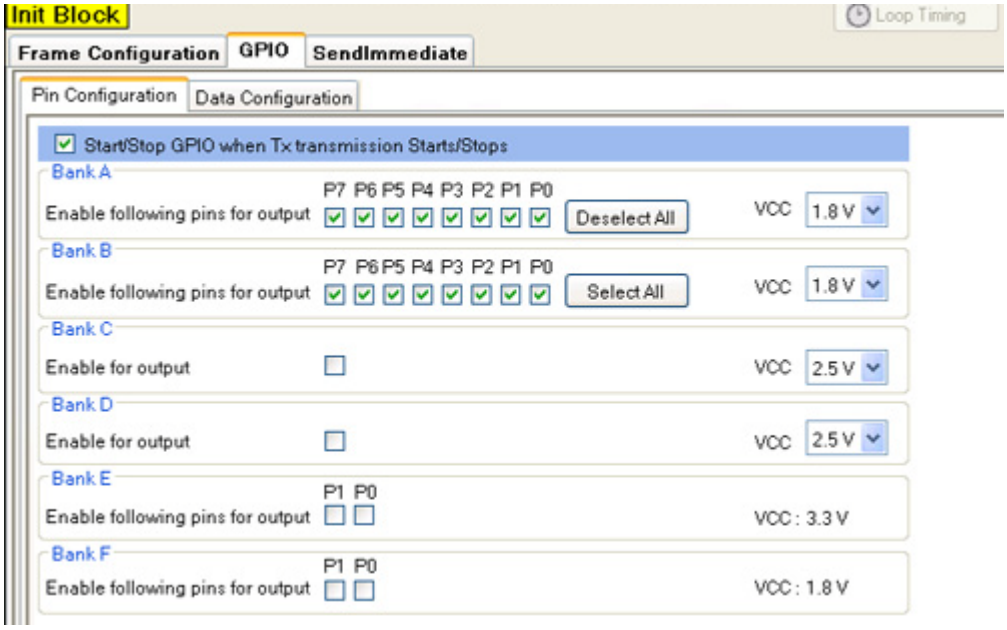
6 Enable and configure the output pins for the GPIO interface by performing the following steps:

   a Click the **Pin Configuration** tab.

   b Select the **Start/Stop GPIO when Tx Transmission starts/stops** checkbox to ensure that GPIO transmission is started and stopped automatically when the transmitter side of DigRF Exerciser starts and stops transmission.

   c The output pins are grouped into Bank A to F. Select the checkboxes for the output pins which you want to enable in each of these banks. Bank C and D also have eight pins each. For these banks, you can either enable all the eight pins or none of these.

   d From the **VCC** drop-down listbox, select the voltage to be used for the output pins enabled for a bank.



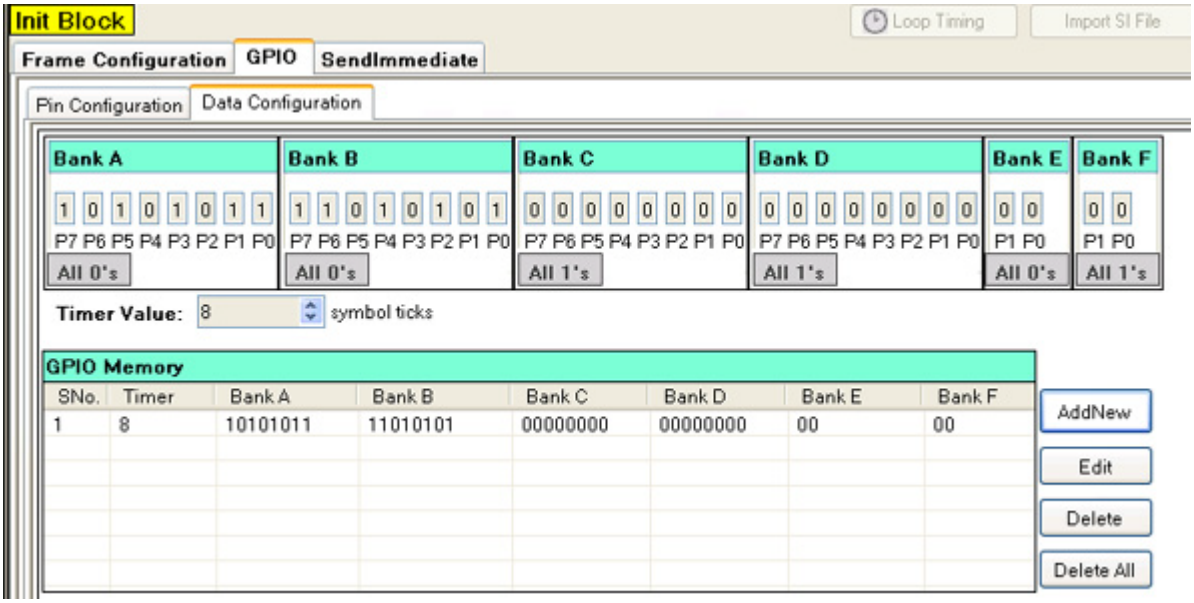
7 Configure the data to be transmitted from the output pins by performing the following steps:

a Click the **Data Configuration** tab.

b You can specify one bit (either 0 or 1) for each output pin in a bank making it a 36 bits pattern for all 36 pins in Bank A to F. This 36 bits pattern becomes one row in the GPIO memory. You can add upto 256 rows of output bit patterns in the GPIO memory. To add one such row of output bit pattern, click **AddNew**, specify the bit for each pin from Bank A to F, and then click **AddToList**.

c In the **Timer Value** text box, specify the duration in symbol ticks for which the bit pattern specified for the output pins will be available on the output signal.

A row of bit pattern for the output pins of GPIO interface is added in the GPIO memory and gets displayed in the **GPIO Memory** group box.



8 Click **Apply** to confirm the configurations.

Starting the Transmission over the GPIO Interface

Once you have configured the output pins and the bit pattern for these output pins, you can start the transmission over the GPIO interface to DUT.

There are two ways to start transmission over the GPIO interface. You can:

- either configure the DigRF Exerciser module to start the GPIO transmission automatically when the Transmitter side of Exerciser starts the transmission. That is, GPIO transmission starts automatically when you click the **Run** toolbar button in the Protocol Exerciser for DigRF GUI to start the transmission from DigRF Exerciser. To accomplish this, select the **Start/Stop GPIO when Tx Transmission starts/stops** checkbox in the **GPIO -> Pin Configuration** tab of the **Init** block in the Frame Configuration page.
- or manually start the GPIO transmission by clicking the **Start GPIO** toolbar button in the Protocol Exerciser for DigRF GUI.

On starting the GPIO transmission, DigRF Exerciser module starts sending the configured data from the enabled output pins on the GPIO interface.

Stopping the Transmission over the GPIO Interface

You can manually stop the GPIO transmission by clicking the **Stop GPIO** toolbar button in the Protocol Exerciser for DigRF GUI.

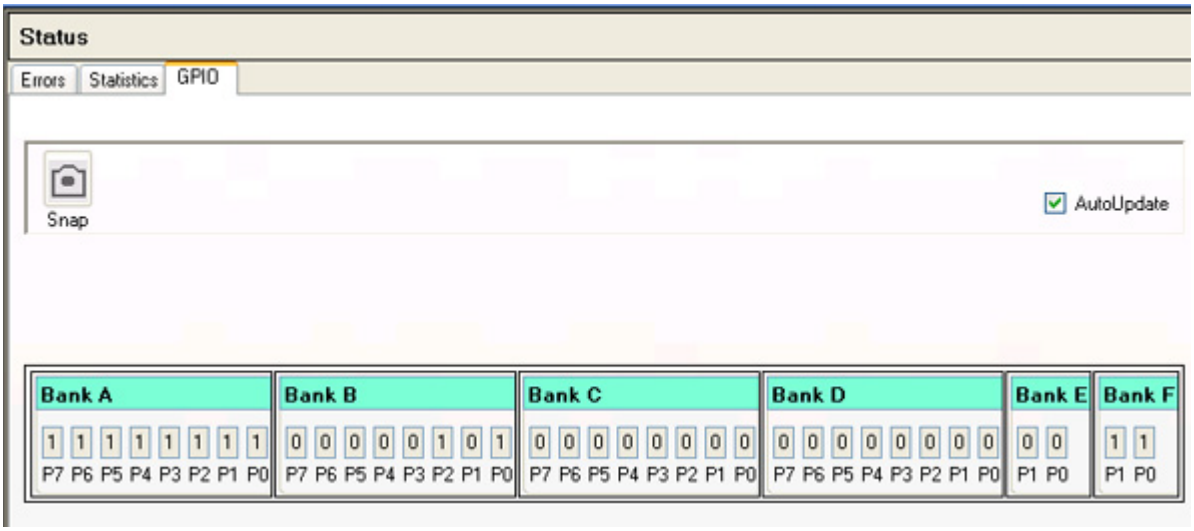
If you configured GPIO transmission to start automatically when the Transmitter side of Exerciser starts the transmission, then the GPIO transmission automatically stops when the Transmitter side of Exerciser stops the transmission.

Viewing the output of the GPIO transmission

You can view the output of the pins that you configured in Bank A to F for the GPIO interface. To view the GPIO output:

1. Click the **Status** icon in the navigation panel of the Protocol Exerciser for DigRF GUI.
2. Click the **GPIO** tab.
3. Select the **AutoUpdate** checkbox to ensure that the current results of the GPIO transmission are automatically updated after every 1 second in this tab. Alternatively, click **Snap** to get the currently applicable updated results of the GPIO transmission.

The following screen displays the GPIO transmission from the output pins enabled for Bank A to F.



5 Cross Domain Testing of an RFIC

RDX test platform provides tools to perform cross domain testing of an RFIC covering the DigRF as well as RF sides of an RFIC to achieve a complete testing scenario for the RFIC.

You can aim at testing whether the data received by RFIC over the DigRF link passes correctly to the wireless side of RFIC and vice versa. Another goal of such testing can be testing the quality of the modulation.

RDX test platform helps you perform cross domain RF and digital testing by providing stimulus, capture, and analysis tools in RF and digital domains. Some of these tools are a part of RDX test platform and some interoperate with RDX test platform to provide an environment for complete testing. This topic describes how you can do cross domain testing using these tools. To get a detailed description of each of these tools, refer to the online help provided with each of these tools. This topic only focuses on how you can use these tools together to perform cross domain testing.

For cross domain testing using RDX test platform, you can use the tools as follows:

- **DigRF stimulus** - Use the DigRF Exerciser module to provide DigRF stimulus to RFIC.
- **RF stimulus** - Use the Signal Studio environment to provide RF stimulus to RFIC. You need to install Signal Studio separately as it is not installed as a part of RDX test platform. Agilent Signal Studio is a standards-based signal-creation tool that you can use for signal simulation. You can use this tool to generate reference signals to characterize and evaluate an RFIC by providing appropriate RF stimulus. Signal Studio works with the RDX test platform and supports a variety of cellular and wireless formats including WiMAX and LTE.
- **DigRF data capture** - Use either DigRF Exerciser or Analyzer module to capture (Tx, Rx, or both) DigRF data.
- **DigRF Analysis tools** - View, decode, and analyze the captured DigRF data using various DigRF Analysis tools in Logic Analyzer.

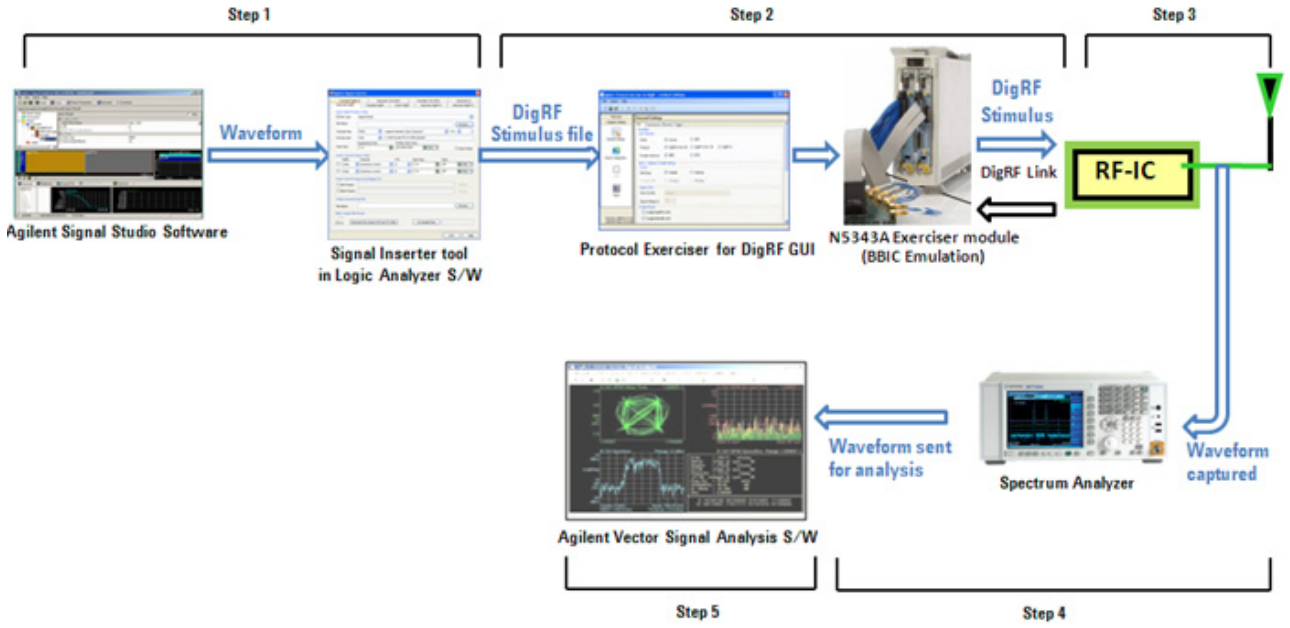
- **RF analysis** - Send the captured DigRF data after extraction to VSA environment for RF level analysis. You need to install VSA separately as it is not installed as a part of RDX test platform.

Using the above-mentioned tools, you can test the Transmit as well Receive paths of an RFIC to cover the complete testing paths. The following examples describe the transmit and receive path testing of an RFIC.

RFIC transmit path testing

The RFIC transmit path testing, in this example, aims at validating whether or not an RFIC depacketizes the DigRF frames received from BBIC over the DigRF link into IQ data and transmits successfully over the air interface. The example checks if any distortions or errors are introduced in the digital data during the depacketization and transmission from RFIC.

The following diagram illustrates this flow of testing using appropriate tools:



The following is the explanation of the flow of RFIC testing with reference to the above diagram:

1 Create DigRF Stimulus for RFIC - In step 1, a waveform is created using Agilent Signal Studio software. This

waveform is then packetized into DigRF packets in a DigRF stimulus file using the Signal Inserter tool.

2 Provide DigRF stimulus to stimulate the RFIC - In step 2, DigRF Exerciser emulates a BBIC over a DigRF link configured between DigRF Exerciser and RFIC (DUT). The stimulus file created in step 1 is imported in the DigRF Exerciser GUI to get the DigRF frames. The DigRF frames are then transmitted to RFIC on the TxData sublink.

3 In step 3, RFIC depacketizes the stimulus, converts digital signals into analog and generates RF waveform and transmits it over the air interface.

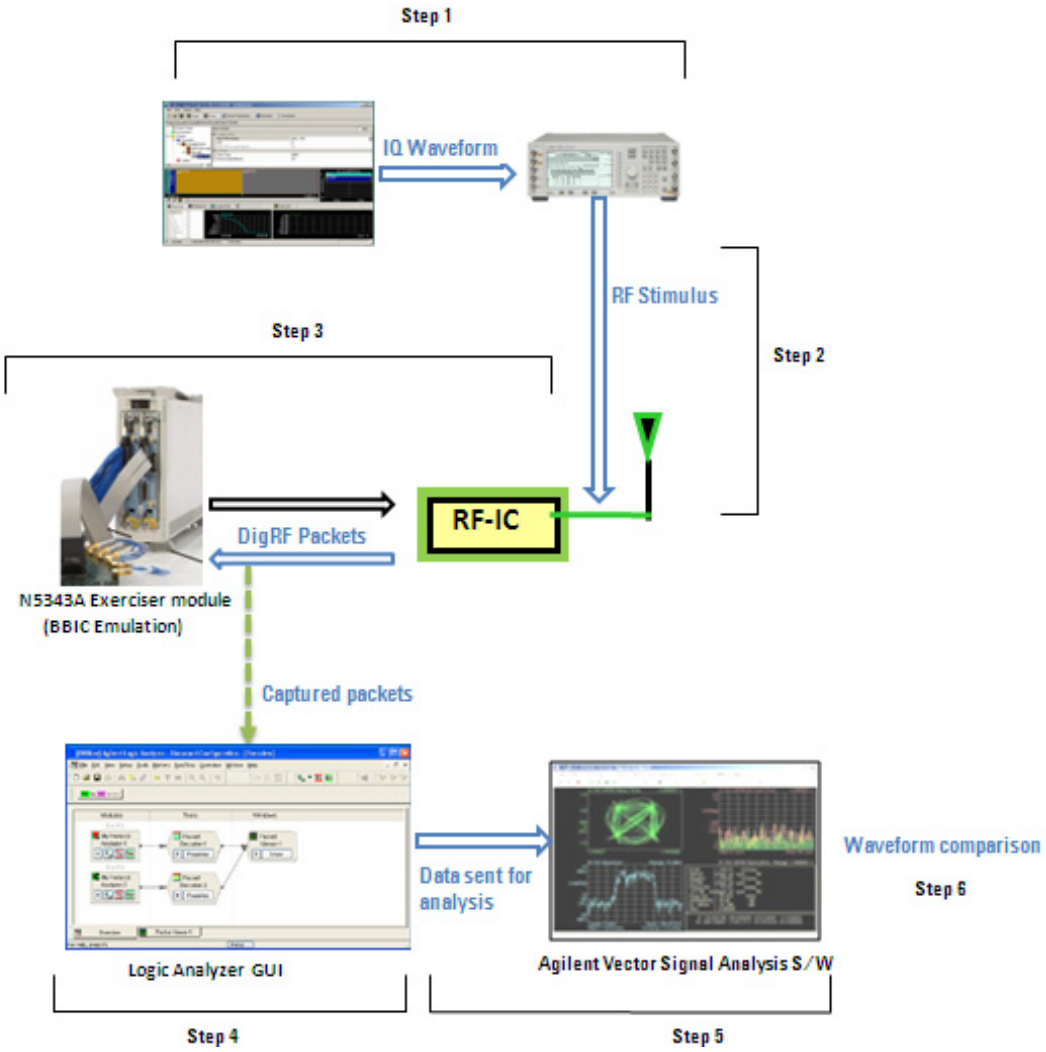
4 In step 4, Agilent Spectrum Analyzer captures the transmitted waveform from the antenna side and the captured waveform is sent to Agilent Vector Signal Analyzer (VSA).

5 In step 5, the waveform used in step 1 is compared with the waveform generated in step 4 to check if there are any distortions or glitches in the data during the overall transmission sequence.

RFIC receive path testing

The RFIC receive path testing in this example aims at validating whether or not an RFIC digitizes the signals received from the air interface into digitized IQ data and transmits successfully over the DigRF link as DigRF frames. The example checks if any distortions or errors are introduced in the data during the packetization and transmission from RFIC over the DigRF link.

The following diagram illustrates this flow of testing using appropriate tools:



The following is the explanation of the flow of RFIC testing with reference to the above diagram:

1. Create RF Stimulus for RFIC - In step 1, a waveform is created using Agilent Signal Studio software. This waveform is then modulated and an analog waveform is generated using Agilent Vector Signal Generator software.
2. Provide RF stimulus to stimulate RFIC - In step 2, Agilent Vector Signal Generator software sends the RF stimulus created in step 1 to RFIC.
3. In step 3, RFIC processes the RF stimulus, renders the digital IQ, packetizes it, and transmit it as DigRF packets over the DigRF link to a BBIC or the DigRF Exerciser emulating a BBIC.

4 In step 4, DigRF Exerciser or Analyzer module is used to capture the DigRF packets that RFIC sent in step 3. Captured packets are obtained in the Logic Analyzer GUI.

5 In step 5, the captured data is further sent to Agilent Vector Signal Analyzer (VSA) software to analyze the captured data. VSA regenerates the waveform from the captured data.

6 The waveform used in step 1 is compared with the waveform generated in step 5 to check if there are any distortions or glitches in the data during the overall sequence of transmission.

6 Testing BBIC and RFIC Integration

This topic provides an example to describe how you can test the integrated RFIC and BBIC by monitoring and analyzing the data exchanged between these over the DigRF link.

To test the RFIC and BBIC integration scenario, you can use the DigRF Analyzer module that provides non intrusive monitoring and capturing of the DigRF traffic between the RFIC and BBIC. Using this module, you can capture the data transmitted on the TxData sublink (BBIC to RFIC) as well as the data transmitted on the RxData sublink (RFIC to BBIC).

You can also set up trigger conditions to ensure that the DigRF Analyzer module starts the data capture when the trigger condition is met.

The following sections describe how to configure capture settings to use DigRF Analyzer to capture data exchanged both ways over the DigRF link. Before configuring these capture settings, ensure that the hardware configurations are complete for this setup.

- The chassis having the DigRF Analyzer module must connect to the system controller hosting the RDX software.
- The DigRF Analyzer module must connect to the target test system (DUT with BBIC and RFIC) through a Flying Leads or a Soft Touch probe.
- RFIC and BBIC are integrated.

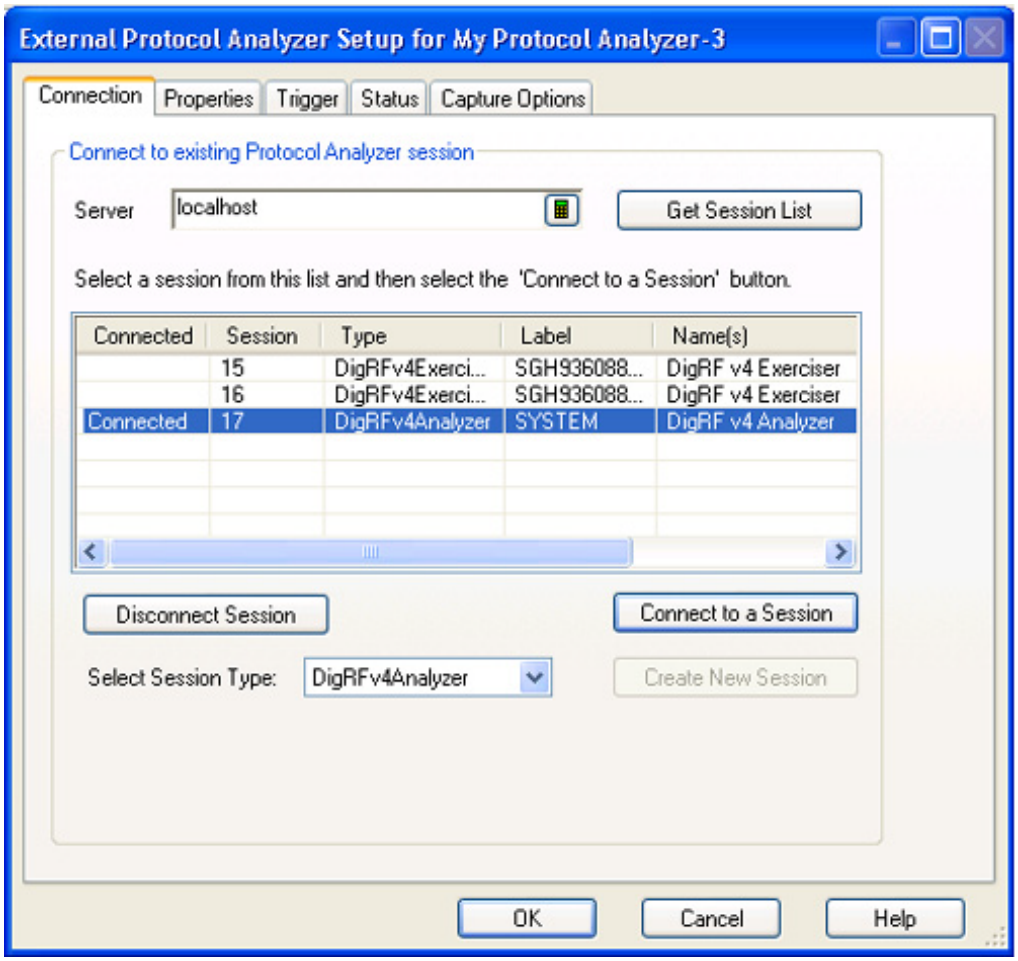
NOTE In the screenshots used in this topic, DigRF Exerciser modules are used in place of a BBIC and an RFIC to emulate these two ICs. The DigRF data exchanged between these two Exerciser modules is captured to demonstrate the RFIC and BBIC integration testing scenario.

Creating a session with DigRF Analyzer module

You use the Logic Analyzer GUI to control, configure, and use the data capture capabilities of DigRF Analyzer module. Therefore, a session is needed with the DigRF Analyzer

module to establish a connection between the Logic Analyzer GUI hosted on the system controller and the DigRF Analyzer module in the chassis.

The following screen displays a new session created to connect to the DigRF Analyzer module. To know more about sessions, refer to the topicEstablishing a Connection with DigRF Exerciser/Analyzer Module on page 88.

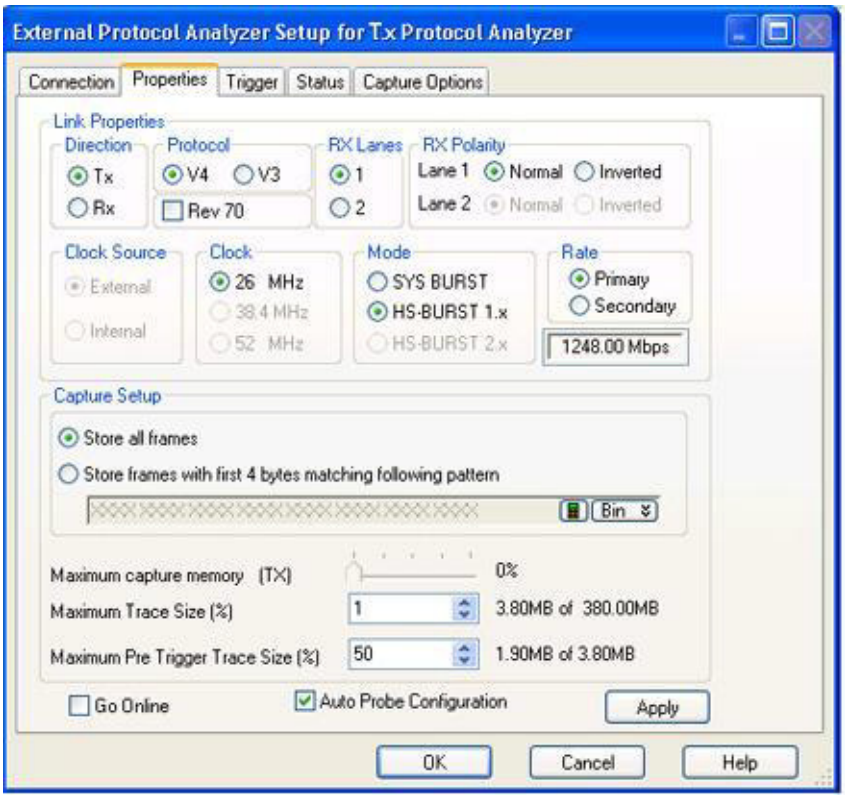


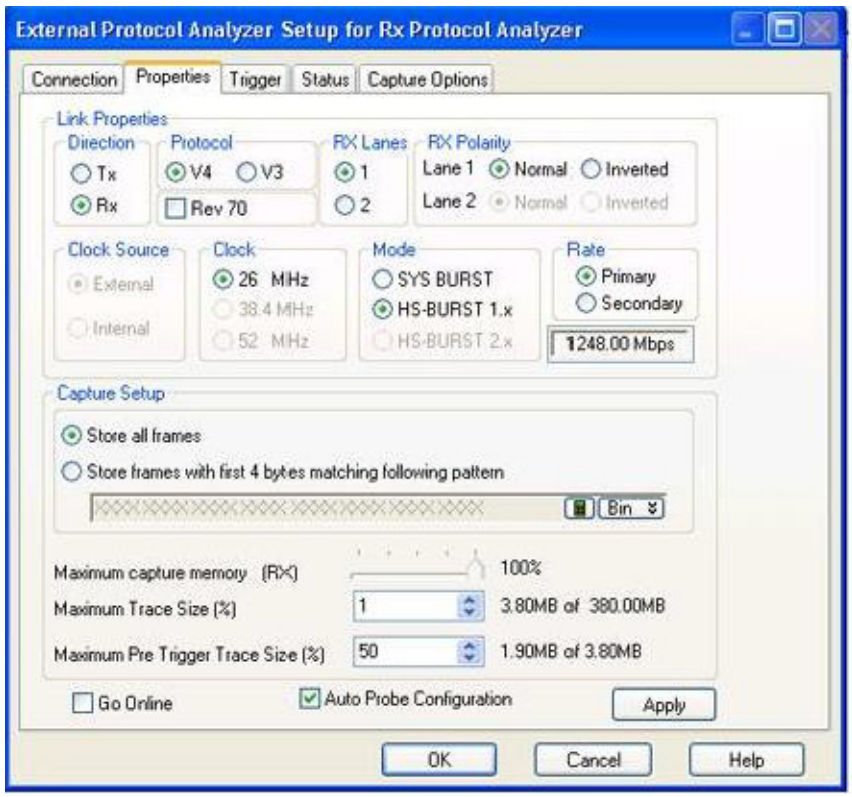
After a connection is created, more tabs have been added in the above dialog box to configure the data capture settings and start the data capture. Using the same session, another instance of the External Protocol Analyzer setup is created in Logic Analyzer GUI. One setup will be used for Tx and another for Rx data capture.

Creating Tx and Rx Data Capture Setups

To capture the Tx and Rx DigRF data, you need to specify data capture settings separately for the Tx and Rx sides of the DigRF link. Based on these settings, DigRF Analyzer captures the data on the TxData and RxData sublinks. To know more, refer to the topic, Configuring a Tx or Rx Data Capture Setup on page 91.

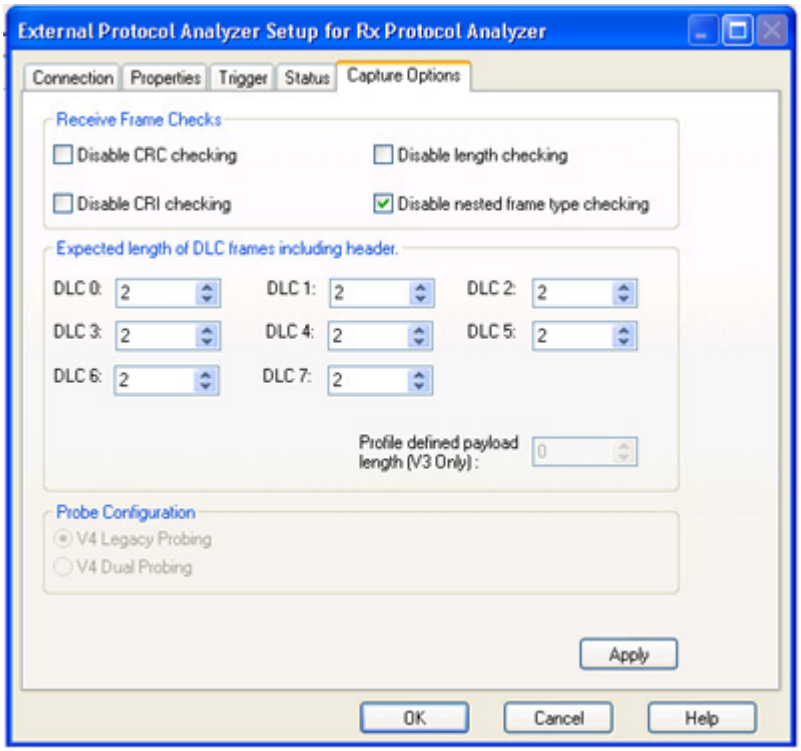
The following screens display the data capture setups for the TxData (Tx link direction) and RxData (Rx link direction) sublinks.





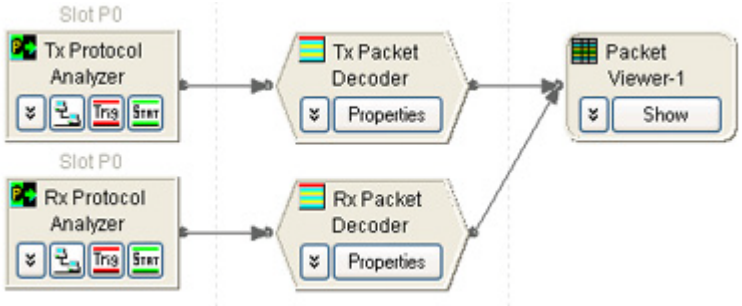
Setting up Protocol Error Checks on the Captured Data

You can select the protocol error checks to be performed on the captured data. The following screen displays the capture options set to enable CRI, CRC, and length checking for the captured frames. To know more, refer to the topic Configuring a Tx or Rx Data Capture Setup.



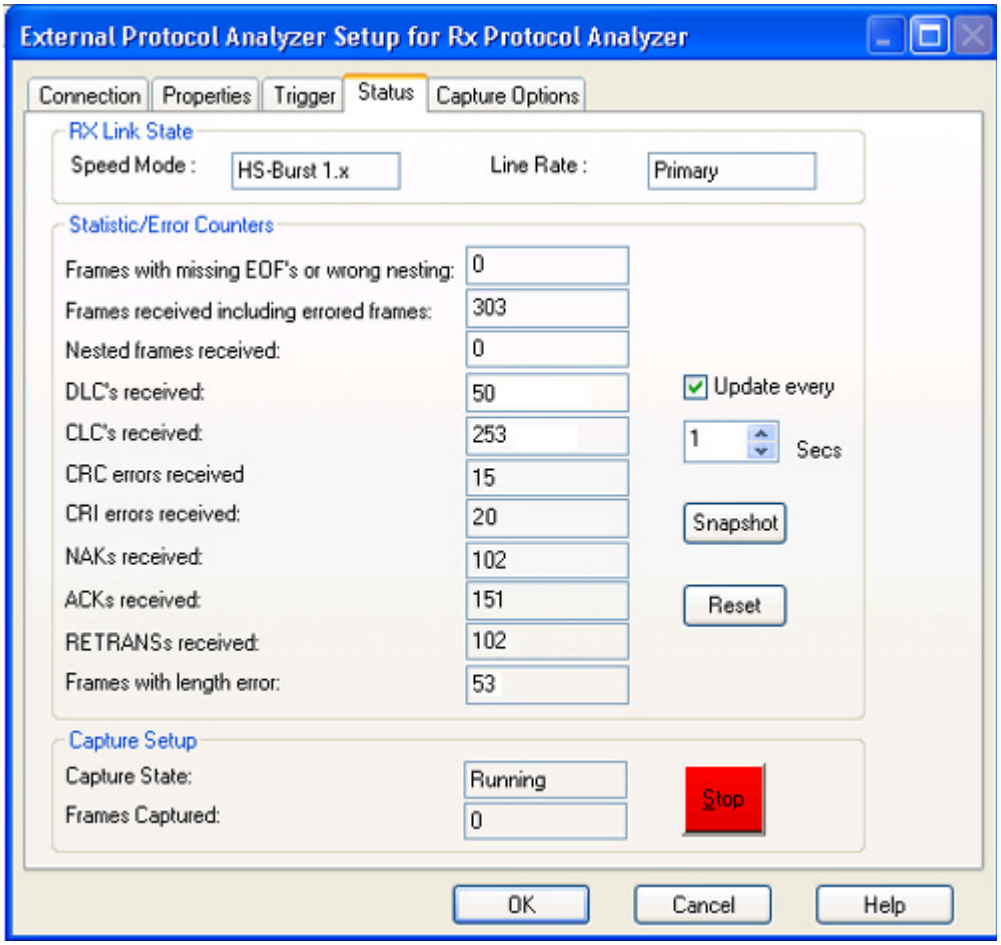
Correlating the Tx and Rx captured data

In Logic Analyzer GUI, you can either view the Tx and Rx data captured by DigRF Analyzer separately or co-relate the Tx and Rx data. Before, viewing the data, it needs to be decoded using the Packet Decoder tool. The following screen displays Packet Decoders (one with Tx and another with Rx decode bus) added to the data capture setups in Logic Analyzer GUI. To view co-related data, both the Tx and Rx Packet Decoder instances are connected to the same Packet Viewer instance.



Starting the data capture

After configuring the required settings, the data capture is started in the Logic Analyzer GUI. DigRF Analyzer starts storing the captured data from the TxData and RxData sublinks in the capture memory and the statistics counters are updated. The capture statistics also displays the number of Tx and Rx frames captured with CRC, CRI, and length errors.



To know more about starting the data capture, refer to the topic Starting the Data Capture.

The captured data is then acquired into the Logic Analyzer GUI by clicking the **Run** toolbar button for display in Packet Viewer. The following screen displays the co-related data exchanged between an RFIC and BBIC.

Packets

Sample Number	Direction	CRI	DigRFv4_0_60 Packet	ICLC Command
-280	Tx	0100	Tx Interface Control Logical Channel	Ping
-55	Rx	0100	Rx Acknowledge Control Logical Channel	
-51	Rx	0101	Rx Interface Control Logical Channel	Ping
-273	Tx	0101	Tx Acknowledge Control Logical Channel	
-269	Tx	0110	Data Logical Channel 0	
-44	Rx	0110	Rx Acknowledge Control Logical Channel	
-234	Tx	1011	Data Logical Channel 0	
-199	Tx	1000	Tx Interface Control Logical Channel	Dum
-40	Rx	0111	Rx Acknowledge Control Logical Channel	
-36	Rx	1000	Rx Acknowledge Control Logical Channel	
-192	Tx	1001	Data Logical Channel 0	
-32	Rx	1001	Rx Acknowledge Control Logical Channel	
-125	Tx	1011	Data Logical Channel 0	
-58	Tx	0000	Tx Interface Control Logical Channel	Dum
-28	Rx	1010	Rx Acknowledge Control Logical Channel	
-24	Rx	0000	Rx Acknowledge Control Logical Channel	
-51	Tx	0001	Data Logical Channel 0	
-36	Tx	0010	Tx Interface Control Logical Channel	Tx Data Sub-L
-29	Tx	0011	Tx Interface Control Logical Channel	Number of Lanes for RxData
-20	Rx	0001	Rx Acknowledge Control Logical Channel	
-16	Rx	0010	Rx Acknowledge Control Logical Channel	

Extracting IQ Data from the captured data packets

You can add a Signal Extractor tool instance to the data capture setups created in the Logic Analyzer GUI to extract IQ data from the Tx or Rx data packets. The extracted data can then be viewed as a listing or a waveform.

By viewing and analyzing the co-related data from BBIC and RFIC, you can find out the root cause of the interoperability issues.

7
GUI Reference

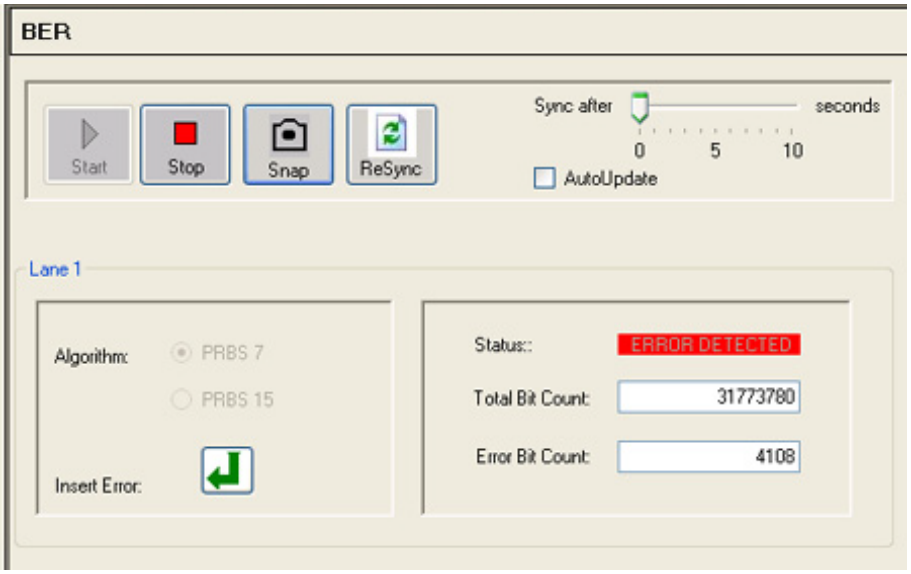
This chapter provides a detailed field level description of various dialog boxes, menus, and windows in the Protocol Exerciser for DigRF GUI and the DigRF Test Wizard GUI.

Protocol Exerciser for DigRF GUI Reference

Windows

BER Page

You use the BER page to perform BER testing and view the results. Using this page, you can send bits from the transmitter side of DigRF Exerciser to its receiver side to perform basic line testing. The page displays the total bit count and the error bit count received on the receiver side of DigRF Exerciser.



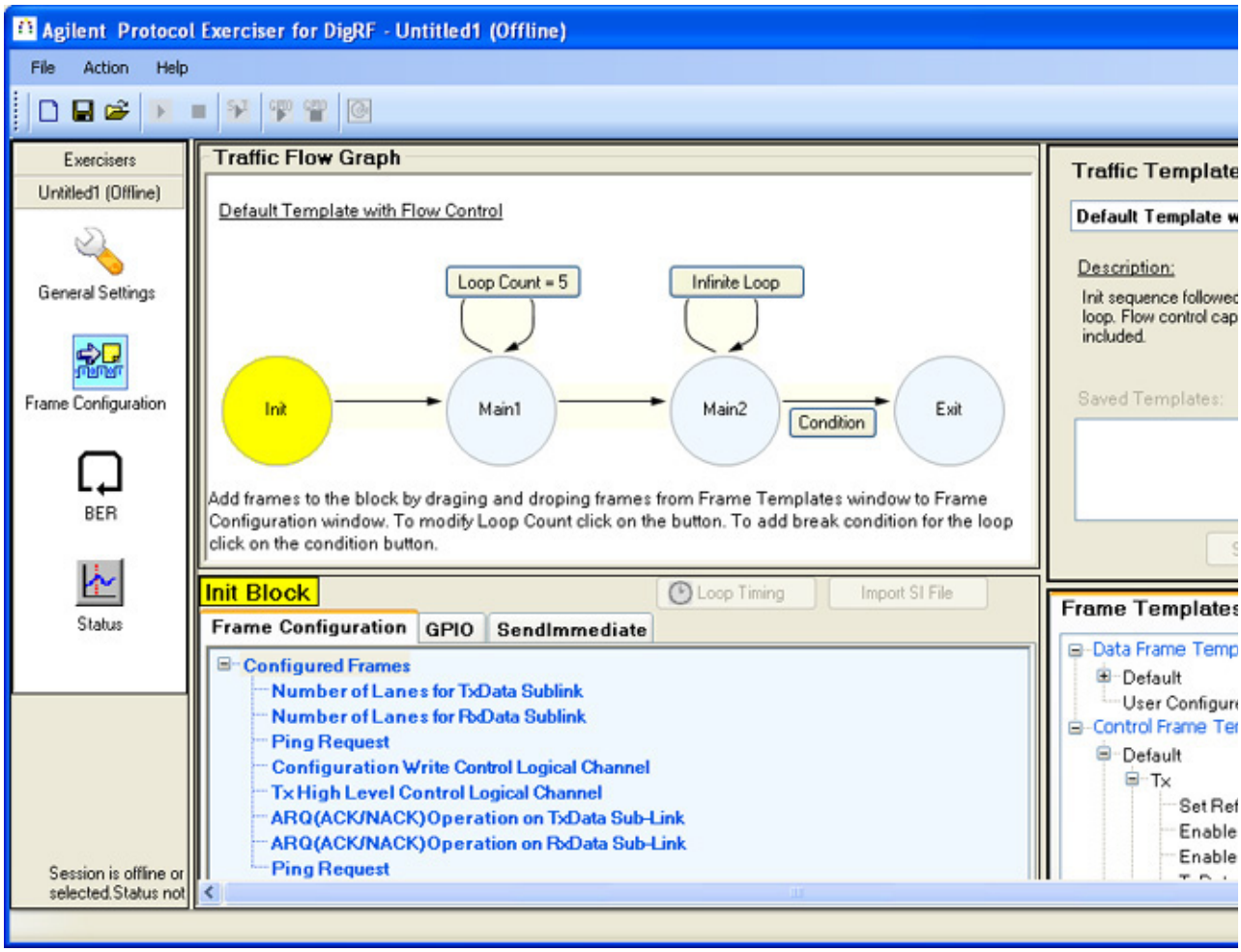
Field	Description
Start	Click Start to instruct the transmit side of the DigRF Exerciser module to start sending bits to the receiver side of the DigRF Exerciser module. Clicking Start also makes the following components, which are otherwise disabled, available for use: • Stop • Snap • ReSync • Insert Error

Field	Description
Stop	Click Stop to stop the transmit side of the DigRF Exerciser module from sending bits to the receiver side of the DigRF Exerciser module.
Snap	Click Snap to update the Total Bit Count and Error Bit Count counters on this page with the current BER results.
ReSynch	Click Resynch to reset the counters on this page to zeroes.
Sync After	The Sync After scroll bar enables you to specify after how many seconds (from 0 to 10) , you want to reset the BER counters.
AutoUpdate	Select the AutoUpdate checkbox to ensure that the BER counters on this page are automatically updated with the BER results. If Auto Update is not selected, then you have to click Snap whenever you want to update the total bits and error bits count in their respective text boxes.
Algorithm	The Algorithm section shows the algorithm used for bit transmission. At present, PRBS 7 is the default and only algorithm used for bit transmission.
Insert Error	Click Insert Error to insert an error bit in the transmission from transmitter to receiver side of the DigRF Exerciser module.
Status	The Status field shows one of the following two messages based on the BER testing results: • NO ERROR • ERROR OCCURRED
Total Bit Count	The Total Bit Count text box displays the total number of bits received by the receiver side of the DigRF Exerciser module. The contents of this text box are automatically updated if AutoUpdate is selected. Otherwise, you have to click Snap to update its contents.
Error Bit Count	The Error Bit Count text box displays the total number of error bits received by the receiver side of the DigRF Exerciser module. The contents of this text box are automatically updated if AutoUpdate is selected. Otherwise, you have to click Snap to update its contents.

Frame Configuration Window

You use the Frame Configuration Window to create a stimulus traffic flow and add the required control and data frames to this traffic flow blocks for sending stimulus to DUT.

This window is divided into various sections which are described below:



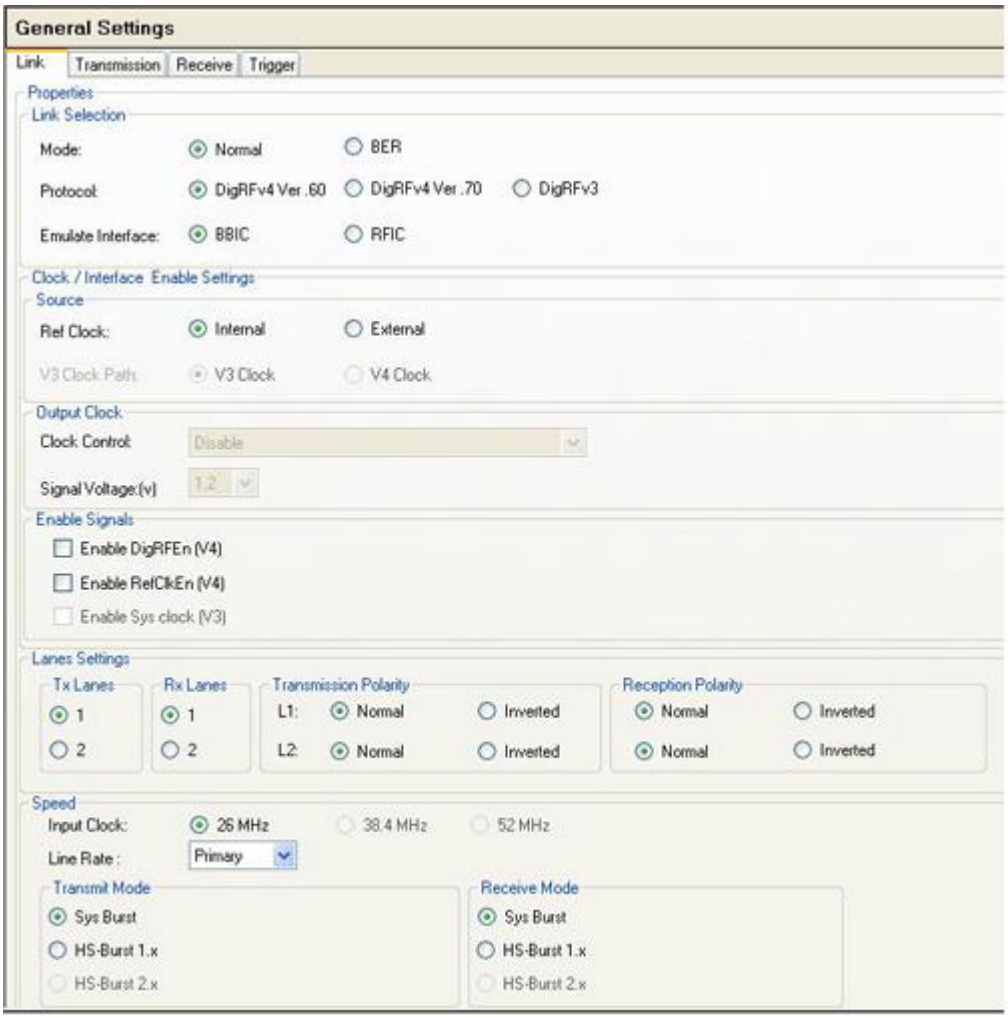
Field	Description
Traffic Flow Graph	Provides options to add a traffic flow to create a logical sequence for the DigRF stimulus. In this section, you can: • add traffic blocks (conditional and unconditional) • add break conditions to exit from these blocks • provide a loop to repeatedly run these blocks for stimulus • configure a block as a control block To know how to create a traffic flow, refer to the topic Defining a DigRF Traffic Flow on page 47.
Traffic Template	Displays the default traffic templates provided to help you create a traffic flow based on one of these templates. To know more about traffic templates, refer to the topic Defining a DigRF Traffic Flow on page 47.
Traffic Blocks	This section lets you add the required control and data frames to a selected block in the traffic flow graph. The section has three tabs and two buttons which are described below.
Frame Configuration	You use this tab to add data and control frames to the selected traffic block. When you run stimulus, the frames added in this tab are sent in the added sequence as stimulus to DUT. Refer to the topic Using Default Set of Data and Control Frame Templates on page 55 to know how to add frames to this tab.
GPIO	You use this tab to configure the: • output pins that you want to enable in banks A to F for the GPIO interface provided by the DigRF Exerciser module. • bit pattern(s) for the output pins. Refer to the topic Configuring and Using GPIO Interface for Transmission on page 179 to know more.

Field	Description
SendImmediate	Click this button to configure the timings for the loop defined for the selected traffic block. You can specify the time period for which DigRF Exerciser should wait before starting the first iteration of the loop. You can also specify the time period for which DigRF Exerciser should wait between the loop iterations for that traffic block. You can let DigRF Exerciser calculate this iteration time automatically based on the inter frame gap that you set for the first frame in the sequence using the Wait time Before Transmission field in the Frame Editor dialog box. You can also explicitly specify the time period for which DigRF Exerciser should wait before starting the next iteration of the loop for the traffic block.
Import SI File	Click this button to import DigRF frames from a .ldf or a .bdf stimulus file created using the Signal Inserter tool. Refer to the topic Importing DigRF Frames from a Signal Inserter Stimulus File to know more.
Frame Templates	This section lets you use the default set of data and control frames provided for the TxData and RxData sublinks. It also lets you create customized data and control frame templates.
Data frame templates	Displays a list of data frame templates that you can use to add data frames to a traffic block. These are categorized under the following two groups: • **Default** - Displays the default set of data frame templates provided in the Protocol Exerciser for DigRF GUI. You cannot edit these default templates. • **User Configured** - Displays the data frame templates that you created and customized according to your specific requirements.

Field	Description
Control frame templates	Displays a list of control frame templates that you can use to add control frames to a traffic block. These are categorized under the following two groups: • Default - Displays the default set of control frame templates provided in the Protocol Exerciser for DigRF GUI. You cannot edit these default templates. Default control templates are further categorized into Tx and Rx groups to provide control templates separately for the TxData and RxData sublinks respectively. • User Configured - Displays the control frame templates that you created and customized according to your specific requirements.
Delete	Click Delete to delete a selected data or control frame template from the User Configured list.
Edit	Click Edit to modify the settings for a selected data or control frame template from the User Configured list.
Add	Click Add to add a data or control frame template in the User Configured list. Refer to the topic Creating Data and Control Frame Templates on page 61 to know more.

General Settings - Link Tab

You use the General Settings - Link tab to configure a DigRF link between the DigRF Exerciser and DUT (RFIC or BBIC) to provide stimulus to the DUT over the configured link.



Field	Description
Link Selection	
Mode	Select the mode in which you want to create the link between the DigRF Exerciser and DUT. • **Normal**: Select this mode if you want to create a DigRF v3 or v4 link between the DigRF Exerciser and DUT to send DigRF stimulus and perform protocol testing. • **BER**: Select this mode if you want to create a link to perform the Bit Error Rate (BER) testing on the link. By enabling the BER mode, you can send bits to the receiver side of DigRF Exerciser from its transmitter side and compare the total bits count with the error bits count. To know more about this mode, refer to the topic Performing BER Testing.

Field	Description
Protocol	Select the DigRF protocol for which the link should be created. Based on the protocol that you select for the link, the options not relevant for that protocol are disabled on the tab page.
Emulate Interface	Select the interface type that you want the DigRF Exerciser to emulate for sending stimulus to a DUT over the DigRF link. The DigRF Exerciser can emulate an RFIC or a BBIC based on your selection.
Source	
Ref Clock	Select the reference clock source that you want to use for DigRF Exerciser. You can choose from the following options: • **Internal**: Select if you want to use DigRF Exerciser's internal or onboard oscillator clock as the source. • **External**: Select if you want to use an external clock source, such as a DUT clock source, for DigRF Exerciser.
v3 Clock Path	This option is applicable only for a DigRFv3 link.
Output Clock	
Clock Control	This option is enabled when you choose RFIC as the Emulate Interface for the DigRF Exerciser. Select the option to enable or disable the Reference output clock. • **Disable** - The output clock is disabled. • **Enable always** - The output clock is enabled since the start of the stimulus and remains enabled throughout the stimulus flow when DigRF Exerciser emulates an RFIC. • **Enable only if REFCLK_EN_IN input signal is active** - The output clock is enabled only if the DUT (BBIC in this case) sets the REFCLK_EN signal to active ('1') state.
Signal Voltage	Select the signal voltage level for the Reference clock (from RFIC to BBIC). This option is applicable only when DigRF Exerciser emulates an RFIC and you have enabled the reference clock using the Clock Control listbox.
Enable signals	
Enable DigRFEn (V4)	Select this checkbox if you want to set the DigRFEn control signal from BBIC (DigRF Exerciser in this case) to active state. This option is available when DigRF Exerciser is emulating a BBIC and you have selected DigRF v4 as the protocol for the link.

Field	Description
Enable RefClkEn (V4)	Select this checkbox to set the Reference Clock Enable control signal (RefClkEn) from BBIC (DigRF Exerciser in this case) to active state. This option is available when DigRF Exerciser is emulating a BBIC and you have selected DigRF v4 as the protocol for the link.
Enable Sysclock (V3)	Select this checkbox if you want to enable the DigRFv3 system clock from RFIC (DigRF Exerciser in this case). This option is available when DigRF Exerciser is emulating an RFIC and you have selected DigRF v3 as the protocol for the link.
Lane Settings	You can decide the number of lanes (1 or 2) for the transmitter and receiver side of the DigRF Exerciser over the DigRF link independent of each other. However, one lane is mandatory for each side.
Tx Lanes	The Tx Lanes group lets you choose the number of lanes that you want to provide for the transmitter side of DigRF Exerciser over the DigRF link. DigRF Exerciser uses these lanes to transmit data to DUT. This field is applicable for a DigRFv4 Ver .60 link.
Rx Lanes	The Rx Lanes group lets you choose the number of lanes that you want to provide for the receiver side of DigRF Exerciser over the DiGRF link. During stimulus, these lanes are used to receive data from DUT. This is applicable for DigRFv4 Ver .60 link.
Transmission Polarity	The Transmission Polarity group box lets you decide the lane polarity (Normal or Inverted) for the lanes used for the transmitter side of the DigRF Exerciser. You can define the lane polarity individually for each lane that you set for transmission. This polarity is applicable for the transmission from DigRF Exerciser to DUT.
Reception Polarity	The Reception Polarity group box lets you decide the lane polarity (Normal or Inverted) for the lanes used for the receiver side of the DigRF Exerciser. You can define the lane polarity individually for each lane that you set for receiving the data from DUT to DigRF Exerciser over the DigRF link.
Speed	
Input Clock	The only speed available and selected for the input clock is 26MHz.
Line Rate	Select the DigRF Interface data rate as either primary or secondary. This option is only valid for a DigRFv4 link.

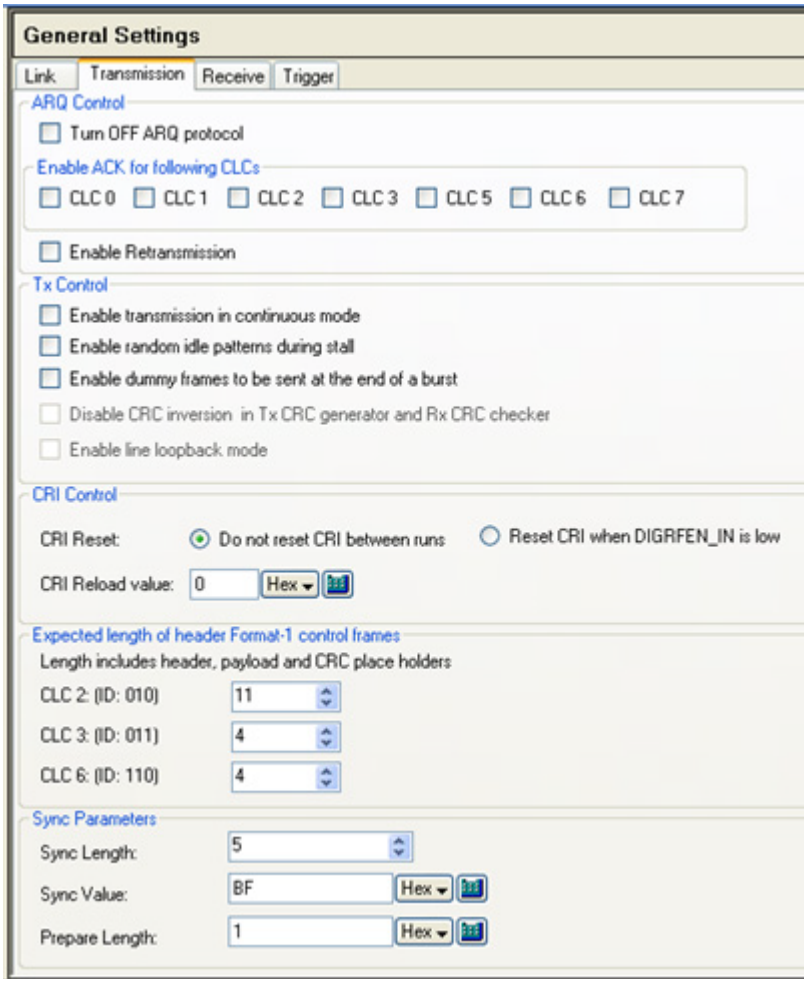
Field	Description
Transmit Mode	The Transmit Mode group box lets you choose the speed mode for the transmitter side of DigRF Exerciser, that is the speed at which the transmission is done from DigRF Exerciser to DUT. All the lanes configured for the Tx side will then use the selected speed mode for transmission. This option is only valid for a DigRFv4 link.
Receive Mode	The Receive Mode group box lets you choose the speed mode for the receiver side of DigRF Exerciser that is, the speed at which DigRF Exerciser receives data from DUT. All the lanes configured for the Rx side will then use the selected speed mode for transmission. This option is only valid for a DigRFv4 link.

Field	Description
Tx Speed Control	Set the behavior for the transmission speed of DigRF Exerciser. You can either set it to be fixed throughout the stimulus or set it to change as per the transmitted/received speed change control frames. You can select from the following options: Use Fixed speed - Indicates that the transmission speed of DigRF Exerciser remains fixed throughout the stimulus flow and even the speed change requests initiated by DigRF Exerciser or DUT during the stimulus flow does not change the speed. If you set the speed to be fixed, then you also need to select this fixed speed from the Tx Speed listbox. • **Transmitter speed is determined by TRANSMITTED Tx Speed Change Messages** - The transmission speed of DigRF Exerciser is set as per the TxData Speed change control frame transmitted by DigRF Exerciser during the stimulus. This field is applicable when DigRF Exerciser is emulating a BBIC. • **Transmitter speed is determined by TRANSMITTED Rx Speed Change Messages** - The transmission speed of DigRF Exerciser is set as per the RxData Speed change control frame transmitted by DigRF Exerciser during the stimulus. This field is applicable when DigRF Exerciser is emulating a BBIC. • **Transmitter speed is determined by RECEIVED Tx Speed Change Messages** - The transmission speed of DigRF Exerciser is set as per the TxData Speed change control frame received by DigRF Exerciser from BBIC (DUT) during the stimulus. This field is applicable when DigRF Exerciser is emulating an RFIC. • **Transmitter speed is determined by RECEIVED Rx Speed Change Messages** - The transmission speed of DigRF Exerciser is set as per the RxData Speed change control frame received by DigRF Exerciser from BBIC (DUT) during the stimulus. This field is applicable when DigRF Exerciser is emulating an RFIC. • **Remote loop** - Rx pin connected to Tx pin to configure a remote loop. This field is applicable only when you are configuring a DigRF V3 interface.
Tx Speed	Select the fixed speed at which the transmission is done from DigRF Exerciser to DUT. This field is enabled when you select Use Fixed speed as the transmission speed of DigRF Exerciser in the Tx speed Control field. This field is applicable only when you are configuring a DigRF V3 interface.

General Settings - Transmission Tab

You use the General Settings - Transmission tab to configure the settings for the transmission of stimulus from DigRF Exerciser to DUT (RFIC or BBIC) over the configured DigRF link.

Transmission settings for a DigRF v4 link



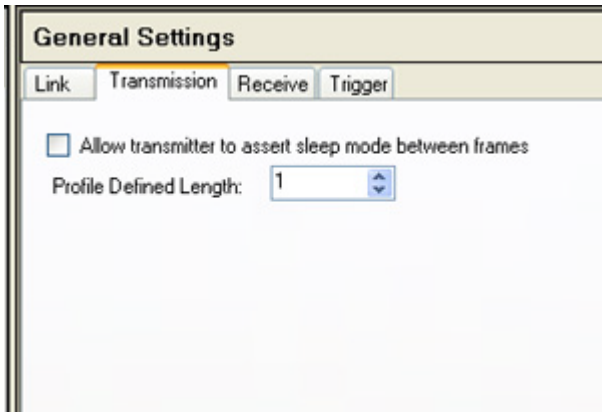
Field	Description
ARQ Control	

Field	Description
Turn off ARQ Protocol	Select this check box if you do not want DigRF Exerciser to transmit ACK/NACK as per the ARQ protocol in response to the frames received from DUT. Selecting or deselecting this checkbox works when you have configured DigRF Exerciser to transmit in the HS-BURST mode. If you have configured DigRF Exerciser to transmit in SYS-BURST mode, then DigRF Exerciser does not transmit ACK/NACK irrespective of whether or not you have turned off the ARQ protocol.
Enable ACK for following CLCs	You can enable the transmission of ACK from DigRF Exerciser for the selected Control Logical Channel (CLC) type control frames. Selecting the checkboxes ensure that an ACK is transmitted to DUT if a control frame of the selected CLC type is received successfully by DigRF Exerciser.
Enable Retransmission	Select this check box if you want DigRF Exerciser to retransmit frames to DUT in response to a NACK received from DUT for an errored or lost frame. To enable retransmission, you also need to ensure that you have deselected the Turn off ARQ Protocol check box for DigRF Exerciser.
Tx Control	
Enable transmission in continuous mode	Select this check box if you want DigRF Exerciser to transmit the stimulus in continuous mode. If you enable the continuous mode, DigRF Exerciser does not transmit EOT at the end of a burst. In the continuous mode, DigRF Exerciser does not transmit ACK/NACK to DUT even if you have turned on ARQ Protocol in this tab.
Enable random idle patterns during stal	Select this check box if you want DigRF Exerciser to transmit random idle patters during the time when the DigRF interface is in the stall mode.
Enable dummy frames to be sent at the end of a burst	Select this check box if you want DigRF Exerciser to transmit a dummy frame as stimulus at the end of a burst.
CRI Control	

Field	Description
CRI Reset	This setting controls when you want DigRF Exerciser to reset the CRI (running index) of the data and control frames that it transmits to DUT. You can choose from the following two options: • Select **Reset CRI when DIGRFEN_OUT is toggled** if you want DigRF Exerciser to reset the CRI of transmitted frames when it toggles the DigRFEN control signal (active or inactive). DigRF Exerciser emulates a BBIC in this case. • Select **Reset CRI when DIGRFEN_EN is low** if you want DigRF Exerciser to reset the CRI of transmitted frames when the BBIC deasserts the DigRFEN control signal to LOW. DigRF Exerciser emulates an RFIC in this case. • Select the **Do not reset CRI between runs** radio button to if you do not want DigRF Exerciser to reset the CRI of transmitted frames between multiple stimulus runs. For instance, if CRI was seven when you stopped a run, then DigRF Exerciser will start from eight (and will not reset to zero) when you initiate another run. The CRI is reset to 000b by default.
CRI Reload Value	Specify a number that DigRF Exerciser should use as the reload value for calculating the CRI of transmitted frames. This value is used when you click the Reload CRI toolbar button to reload the CRI on DigRF Exerciser for transmitted frames. Default is 0.
Expected length of Header format1 control frames	Set the expected length of the control frames belonging to the following CLC IDs: 010, 011, and 110 While transmitting from DigRF Exerciser, the length of control frames of the above-mentioned CLC IDs is set as per the expected length that you specify here. In the control frame templates that DigRF Exerciser provides for stimulus, the payload of control frames of 010, 011, and 110 CLC IDs is set according to the expected length you specify for these IDs.
Synch Parameters	
Synch Length	Specify the length of the synchronization pattern to be used upon exiting the SLEEP state when DigRF Exerciser transmits in the High speed modes.

Field	Description
Synch Value	Specify the value for the synchronization pattern to be used upon exiting the SLEEP state when DigRF Exerciser transmits in the High speed modes.
Prepare length	Specify the length of the PREPARE period, that is the period for which the PREPARE state is entered to prepare DUT to receive data on exiting the SLEEP state.

Transmission settings for a DigRF v3 link

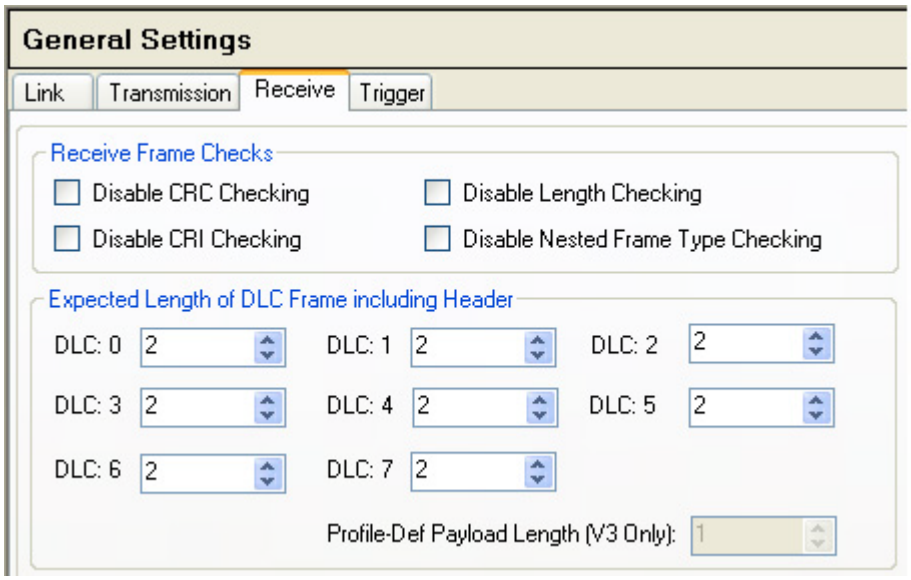


Field	Description
Allow transmitter to assert sleep mode between frames	Select this checkbox to ensure that the DigRF Exerciser's transmitter can assert the interface into sleep mode during the inter frame gaps of the stimulus frames.
Profile Defined Length	Specify the profile defined frame length for DigRFv3 frames transmitted from DigRF Exerciser. This length does not include header.

General Settings - Receive Tab

You use the General Settings - Receive tab to configure the settings for the frames received by DigRF Exerciser from DUT (RFIC or BBIC) over the configured DigRF link. These settings control the checks that you want DigRF Exerciser to perform the received frames to report any frame related errors.

Receive settings for a DigRF v4 link



Field	Description
Receive Frame Checks	
Disable CRC Checking	Select this checkbox to disable the CRC checks on the frames that DigRF Exerciser receives from DUT. If CRC check is enabled, DigRF Exerciser reports CRC errors (if any) in the status page of the Protocol Exerciser for DigRF GUI.
Disable Length Checking	Select this checkbox to disable the length checks on the frames that DigRF Exerciser receives from DUT. The length of frames is not checked against the expected length specified for that DLC type in this page. If you enabled length checking and a received frame crosses the specified expected length of frames for that DLC type, then it is reported as a Frame with length error in the Status page.
Disable CRI Checking	Select this checkbox to disable the CRI checks on the frames that DigRF Exerciser receives from DUT. If CRI check is enabled, DigRF Exerciser reports a CRI error in the Status page for a received frame that has missing/incorrect CRI.

Field	Description
Disable Nested Frame type checking	Select this checkbox to disable the nested frame type checks on the frames that DigRF Exerciser receives from DUT. If this check is enabled, DigRF Exerciser checks if the nested frames received from DUT are of the correct frame type as per the specifications. It reports a Frame with wrong nesting error in the Status page for a received nested frame that has an incorrect frame type for nesting.
Expected length of DLC Frame including header	Set the expected length for the data frames received from DUT. You can set the length for DLC 0 to 7. DigRF Exerciser uses this length to check if a received frame matches the expected length for that DLC type. It reports a Frame with length error in the Status page if length checking is enabled and a received frame crosses the expected length.

Receive settings for a DigRF v3 link

Field	Description
Profile Def Payload length (V3 Only)	Profile defined payload length for frames received on a DigRF V3 link. This length does not include header.

General Settings - Trigger tab

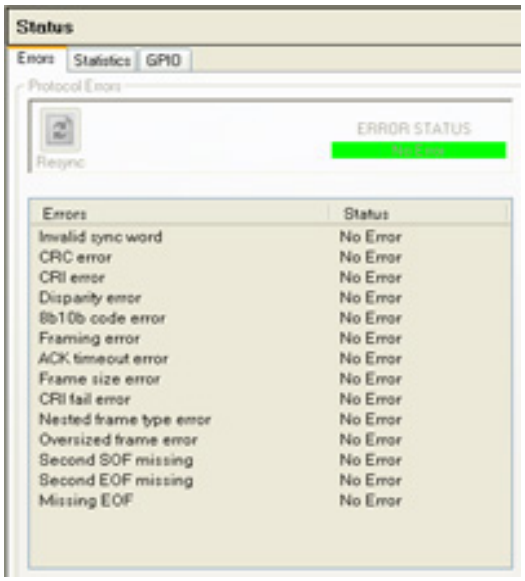
You use the General Settings - Trigger tab to enable and specify the pattern in the transmission that generates a trigger out pulse from DigRF Exerciser to another test equipment.

Field	Description
Enable pattern	Select this checkbox to ensure that a trigger out pulse is generated when DigRF Exerciser transmits the specified pattern as stimulus to DUT.
Channel	Select the channel type (CLC, DLC, or any of these) of the transmitted frame that should generate a trigger out pulse.

Field	Description
Control frame	If you selected the channel type as Control, then this group box is enabled where you can specify the pattern for the control frame. When DigRF Exerciser sends a control frame matching these details, the trigger condition is met.
Data frame	If you selected the channel type as Data, then this group box is enabled where you can specify the pattern for the data frame. When DigRF Exerciser sends a data frame matching these details, the trigger condition is met.

Status - Errors tab

You use the Status - Errors tab to view the protocol errors that DigRF Exerciser found in the frames received from DUT during the stimulus flow. For this release, the Errors tab in the Status page is not functional.

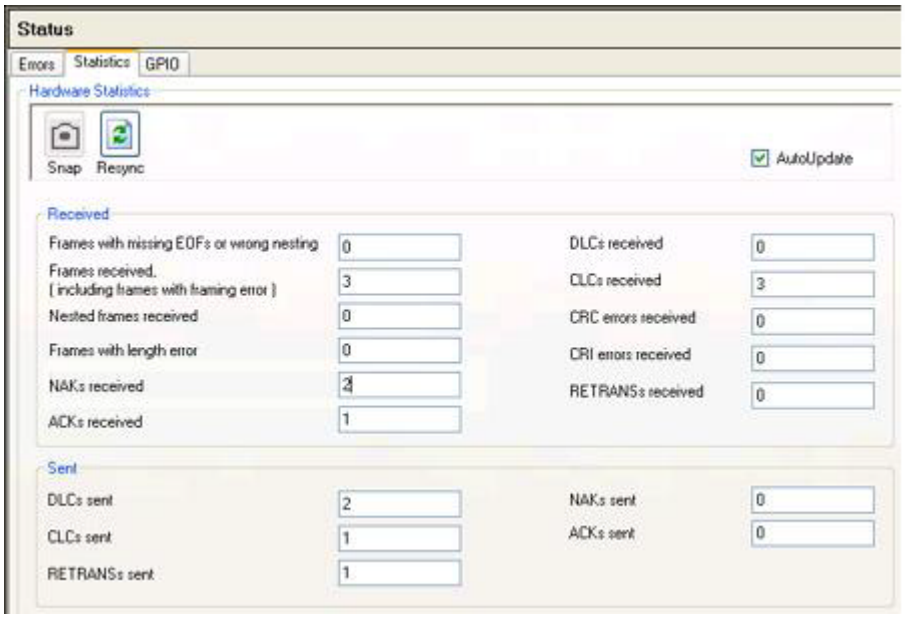


Field	Description
Resynch	Click Resynch to reset the counters for the displayed protocol error categories.

Field	Description
Error Status	This field shows one of the following messages. • **No Error**: Indicates that no error has been found in the transmission from DUT. • **ERROR OCCURRED**: Indicates that error(s) have been found in the transmission from DUT. These errors are then categorized and displayed separately.
Error	Displays the various protocol error categories supported. DigRF Exerciser checks the received frames for these errors and reports errors if any under these categories.
Status	The Status column shows one of the following messages to reflect the status of its corresponding error category listed in the Errors column. • No Error • ERROR OCCURRED

Status - Statistics tab

You use the Status - Statistics tab to view the statistics related to the stimulus flow in terms of the frames that DigRF Exerciser sent (Sent group box) and the frames it received from DUT (Received group box).



Field	Description
Snap	Click Snap to update the statistics counters displayed in this tab with the current stimulus results. If you want to use this option, ensure that the AutoUpdate checkbox is deselected.
Resynch	Click Resynch to reset the statistics counters in this tab to zeros. The counters keeps increasing for the subsequent stimulus runs if you do not click Resynch to reset the counter after a stimulus run.
AutoUpdate	Select this checkbox to ensure that the statistics counters in this tab are automatically updated with the stimulus results after every 1 second.
Received	
Frames with missing EOFs or wrong nesting	Displays the number of frames received from DUT with either missing EOF or wrong nesting. The counter is updated only if you have selected the appropriate receive frame check in the General settings - Receive tab. Refer to the General Settings - Receive Tab on page 214 to know more.
Frames received, (including frames with framing error)	Displays the total number of CLC and DLC frames received from DUT during a stimulus run. This also includes errored frames and ACK/NAKs received from DUT.
Nested frame received	Displays the total number of nested frames received from DUT during a stimulus run.
Frame with length error	Displays the total number of frames received from DUT with length error, that is, the length of the received frame does not match the expected length. The counter is updated only if you have selected the appropriate receive frame check in the General settings - Receive tab. Refer to the General Settings - Receive Tab on page 214 to know more.
NAKs received	The number of NACKs received from DUT in response to the errored or lost frames sent as stimulus.
ACKs received	The number of ACKs received from DUT as acknowledgements for the frames successfully received from DigRF Exerciser.
DLCc received	The number of DLCs received from DUT during the stimulus run.
CLCs received	The number of CLCs received from DUT during the stimulus run.
CRC error received	Displays the total number of frames received from DUT with CRC errors. The counter is updated only if you have selected the appropriate receive frame check in the General settings - Receive tab. Refer to the General Settings - Receive Tab on page 214 to know more.

Field	Description
CRI errors received	Displays the total number of frames received from DUT with CRI errors (missing/incorrect CRI in the frame). The counter is updated only if you have selected the appropriate receive frame check in the General settings - Receive tab. Refer to the General Settings - Receive Tab on page 214 to know more.
RETRANSs received	Displays the total number of frames that DUT retransmitted to Exerciser in response to a NACK received from Exerciser for a lost or an errored frame.
Sent	
DLCs sent	Displays the total number of DLCs sent by DigRF Exerciser to DUT in a stimulus run.
CLCs sent	Displays the total number of CLCs sent by DigRF Exerciser to DUT in a stimulus run.
RETRANSs sent	Displays the total number of frames that DigRF Exerciser retransmitted to DUT in response to a NACK received from DUT for a lost or errored frame. The counter is updated only if you have selected the appropriate options to enable the retransmissions from DigRF Exerciser. Refer to the topic Testing Frame Retransmission on page 153 to know more.
NAKs sent	Displays the number of NAKs that DigRF Exerciser sent to DUT in response to an errored or lost frame. The counter is updated only if you have selected the appropriate options to enable ACK/NAK from DigRF Exerciser. Refer to the topic Testing ACK/NACK Mechanisms on page 146 to know more.
ACKs sent	Displays the number of ACKs that DigRF Exerciser sent to DUT as acknowledgements for the frames that it received successfully. The counter is updated only if you have selected the appropriate options to enable ACK/NAK from DigRF Exerciser. Refer to the topic Testing ACK/NACK Mechanisms on page 146 to know more.

Status - GPIO tab

You use the Status - GPIO tab to view the output of the pins that you configured in Bank A to F for transmission on the GPIO interface. GPIO interface is a general purpose Bus interface provided by the DigRF Exerciser module besides providing the DigRF interface.

The bit pattern that you added in the GPIO memory for transmission on the 36 pins provided for the GPIO interface is sent as output when you start the GPIO transmission. The transmitted output bit is displayed for each configured pin in bank A to F in this tab page. Refer to the

topicConfiguring and Using GPIO Interface for Transmission on page 179 to know more about the GPIO interface and its configuration.

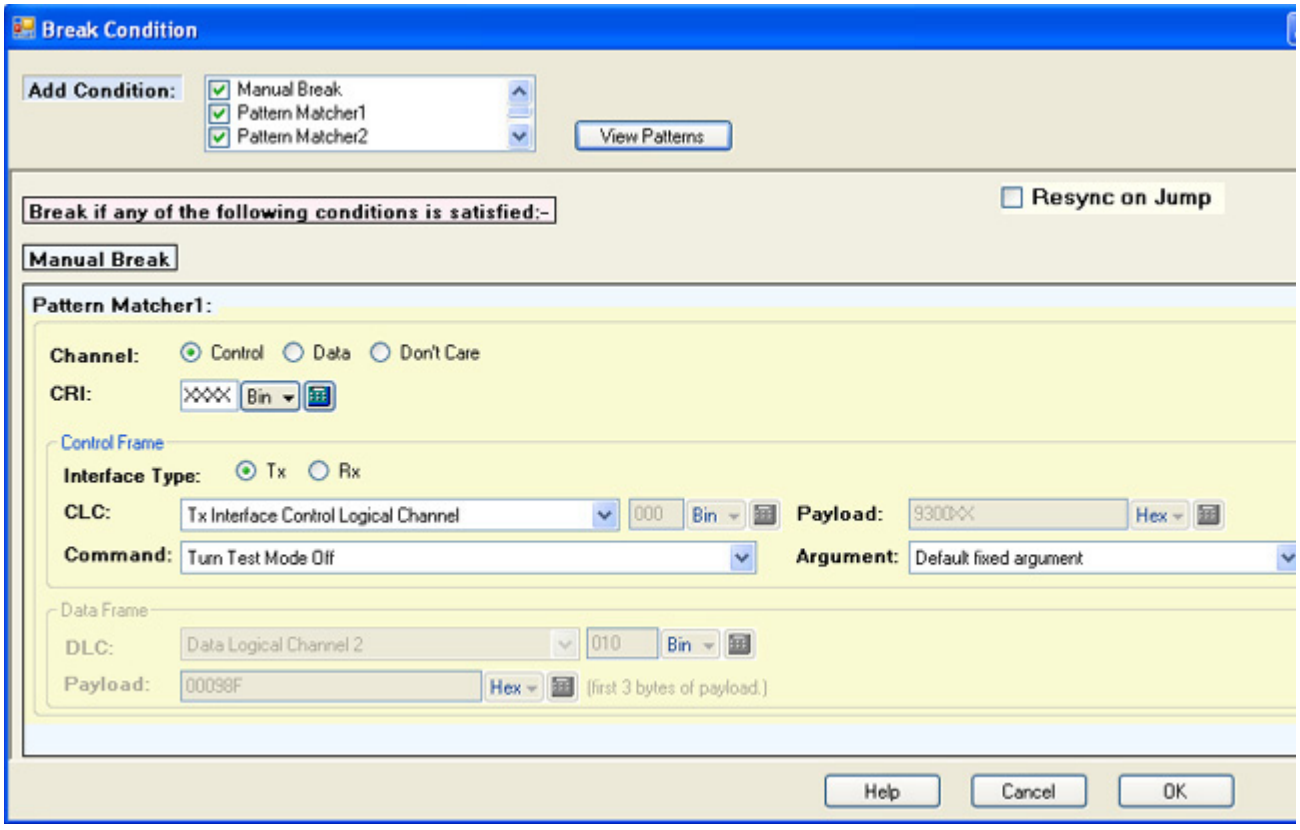
Field	Description
AutoUpdate	Select the checkbox to ensure that the current results of the GPIO transmission are automatically updated after every 1 second in this tab.
Snap	Click to get the currently applicable updated results of the GPIO transmission.
Bank A to F	Displays the configured bit pattern (0 or 1) transmitted on the output pins in bank A to F.

Dialog Boxes

Break Condition Dialog Box

You use the Break Condition dialog box to specify the break condition(s) for a loop defined for a traffic block in the DigRF stimulus flow. When this break condition is met, the stimulus flow breaks out of the loop of the traffic block for which the condition was specified and moves to the next block in the stimulus flow. You can specify a maximum of nine break conditions for a loop. Out of these nine conditions, one condition is set by adding a manual break to come out of the loop and the rest of the conditions are set by defining a maximum of eight pattern matchers. When DigRF Exerciser transmits a frame matching any of the specified patterns, the break condition is met.

The **Break Condition** dialog box is displayed when you click the **Condition** button attached to a traffic block in the traffic flow graph displayed in the Frame Configuration page.

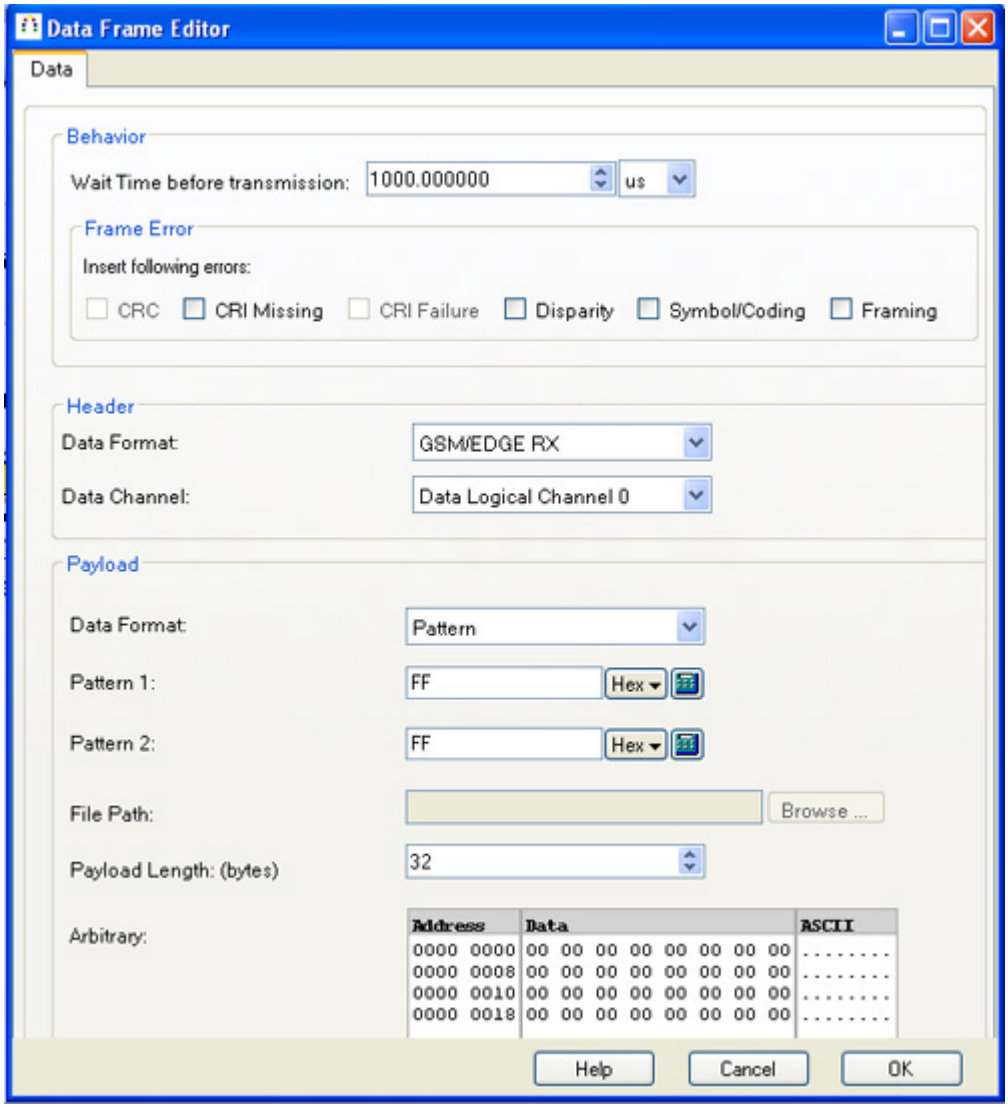


Field	Description
Add Condition	Displays the type of break conditions that you can add for a loop of a traffic block. You can add a Manual break and eight pattern matchers as break conditions. When you select the checkboes displayed with these nine break conditions, the selected condition gets added in the lower pane of this dialog box. If you add **Manual Break** as the break condition, then a **Break** button is added below the **Condition** button attached to the traffic block in the traffic flow graph. You can manually break the loop of the traffic block by clicking the **Break** button.
View Patterns	Clicking this button displays the pattern value calculated based on the pattern matcher specified in the lower pane of the dialog box. The pattern value displays the first four bytes of a frame: first byte is for the header and the next three bytes are for the payload as per the specified pattern matcher. It also displays the number of traffic blocks in the stimulus flow with frames matching a specified pattern.
Pattern Matcher	A pattern matcher group box is added based on the number of pattern matcher checkboxes selected for the break condition. You can use a pattern matcher group box to define the pattern matcher for the break condition using the following fields.
Channel	Select the type of frame (control or data frame) that should break the loop of the traffic block. Based on the type of frame selected, you can further define the specifications for that type of frame.
CRI	Specify the CRI of the transmitted frame of the selected Channel type that should break the loop of the traffic block.
Interface type	Select the DigRF Interface type. If DigRF Exerciser is emulating BBIC, then select Tx as the Interface type and if DigRF Exerciser is emulating RFIC, then select Rx as the Interface type. Based on the Interface type selected, appropriate Tx or Rx CLCs are displayed in the CLC listbox.
CLC	Displays the CLCs relevant for the TxData or RxData sublink. The list is populated based on whether you select Tx or Rx as the Interface type. When the selected CLC is transmitted from DigRF Exerciser, the break condition is met.
Payload	Specify the first three bytes of the payload of the control frame of the selected CLC type. In these three bytes, you can specify XX to match it to any byte value for the corresponding byte in the frame. For instance, you can specify 91XXXX Hex to ensure that any frame of the selected CLC type with the first byte of the payload as 91 matches the pattern. For an ICLC control frame, the payload is fixed and therefore, the Payload field is disabled and displays the fixed payload value for that type of frame.

Field	Description
Command	Displays a list of Interface Control Logical Channel (ICLC) commands relevant for the TxData or RxData sublink. The ICLC commands displayed in this listbox depend on whether you have selected Tx or Rx in the Interface type field. To enable the Command listbox, you need to select the appropriate Control Logical Channel that is, Tx Interface Control Logical Channel or Rx Interface Control Logical Channel in the CLC field. When the selected ICLC command is transmitted from DigRF Exerciser, the break condition is met.
Argument	Displays a list of arguments applicable for an ICLC command that you selected from the Command listbox. The listbox is therefore enabled only when you select Tx Interface Control Logical Channel or Rx Interface Control Logical Channel from the CLC listbox. When the selected ICLC command with the selected argument is transmitted from DigRF Exerciser, the break condition is met.
DLC	Select the DLC of the data frame that should break the loop of the traffic block on transmission.
Payload	Specify the first three bytes of the payload of the data frame of the selected DLC type. In these three bytes, you can also specify XX to match it to any byte value for the corresponding byte in the frame. For instance, you can specify 4233XX Hex to ensure that any frame of the selected DLC type with the first byte of the payload as 42 and second byte of payload as 33 matches the pattern.

Data Frame Editor Dialog Box

You use the Data Frame Editor dialog box to change the default behavior, header, and payload settings for a data frame template instance in the Frame Configuration page of the Protocol Exerciser for DigRF GUI. Using this dialog box, you can customize the data frames that you want to send as stimulus from DigRF Exerciser to DUT.



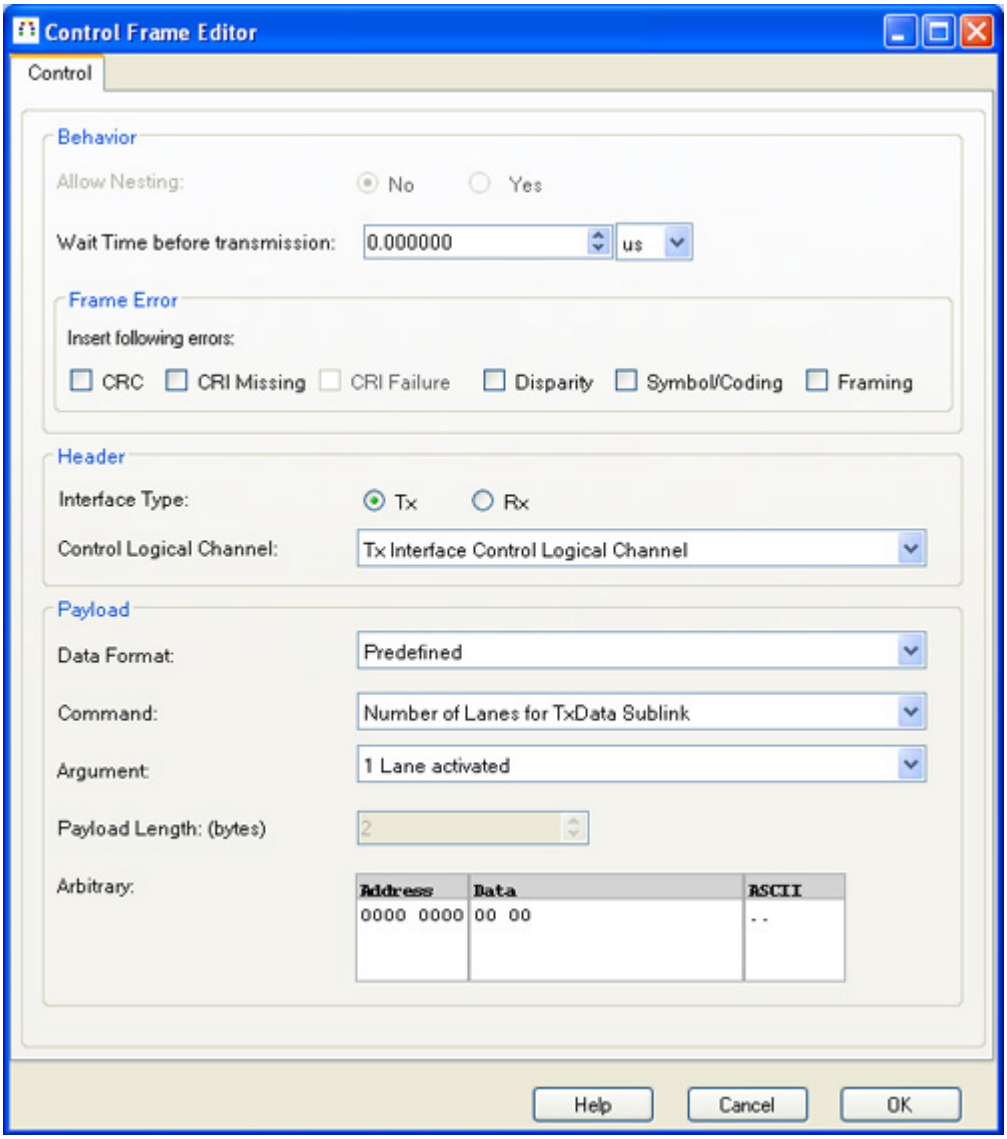
Field	Description
Behavior	
Allow Nesting	Nested frames are not currently supported using this dialog box.
Wait time before transmission	The time for which DigRF Exerciser should wait to transmit the control frame as stimulus after transmitting the frame prior to this frame in the sequence. This allows you to specify the delay timer between frames in the stimulus flow. You can specify a value ranging between 0 to 999 with time unit options as s (seconds), ms (milliseconds), us (microseconds), or ns (nanoseconds).

Field	Description
Frame Error	
CRC	Select this checkbox to insert a CRC error in the control frame. The checkbox is disabled for TAS Logical Channel and TACLC control frames on TxData sublink and all data frames as these frames do not have a CRC value.
CRI Missing	Select this checkbox to send the data frame with a missing CRI to DUT.
CRI Failure	For this release, the CRI Failure error cannot be inserted and is disabled for all frames.
Disparity	Select this checkbox to insert an 8B/10B Encoding error in the data frame.
SymbolCoding	Select this checkbox to insert an error in the coding of symbols in the data frame.
Framing	Select this checkbox to insert a framing error such as an error in the end of data frame or length of the data frame.
Header	
Data format	Select the air standard to be used as the format for the data frame. The list displays various air standards that DigRF Exerciser supports for the transmission of data frames as stimulus.
Data Channel	Displays the list of DLC types available for transmission of a data frame as stimulus on either TxData or RxData sublink.
Payload	
Data Format	Provides the following options to specify how you want to fill the payload of the data frame: • **Pattern** - Select this option if you want to use the byte patterns specified in the Pattern1 and Pattern2 fields to fill the payload of the data frame. In the payload, the byte pattern specified as pattern 1 is followed by byte pattern specified as pattern2. • **Increment**— Select this option if you want to use the byte value specified in the Start Value field as the start of the payload and the byte value specified in the Increment field to increment the payload. • **File** - Select this option if you want to use a specified .dpld (DigRF Payload) file to fill the payload of the data frame. • **Arbitrary** — Select this option when you want to fill the payload by manually specifying the arbitrary values.
Pattern1	Specify the byte pattern that you want to use as pattern1 to fill the payload of the data frame. The byte specified in this field is followed by the byte specified in the Pattern2 field to fill the payload of the data frame. This field is available if you select Pattern as the Data Format for the payload of the data frame.

Field	Description
Pattern2	Specify the byte pattern that you want to use as pattern2 to fill the payload of the data frame. The byte specified in this field is preceded by the byte specified in the Pattern1 field to fill the payload of the data frame. This field is available if you select Pattern as the Data Format for the payload of the data frame.
File path	Browse to select a .dpld (DigRF Payload) file that you want to use to fill the payload of the data frame. This field is available only when you select File as the Data Format for the payload of the data frame.
Payload length (bytes)	Displays the payload length (in bytes) of the data frame. You can change this length.
Arbitrary	The Arbitrary section is available only when you have selected the Arbitrary option in the Data Format drop-down list. It provides the Data column, where you can manually specify the arbitrary values to fill the payload of the frame. By default, the Data column contents are shown in the DWord aligned Hex View (little endian) format. To change it to other format, right-click in the Data column, and then select one of the following menu commands: • DWord aligned Hex View (little endian) • DWord aligned Hex View (big endian) • Byte aligned Hex View • Nibble aligned Binary View

Control Frame Editor Dialog Box

You use the Control Frame Editor dialog box to change the default behavior, header, and payload settings for a control frame template instance in the Frame Configuration page of the Protocol Exerciser for DigRF GUI. Using this dialog box, you can customize the control frames that you want to send as stimulus from DigRF Exerciser to DUT.



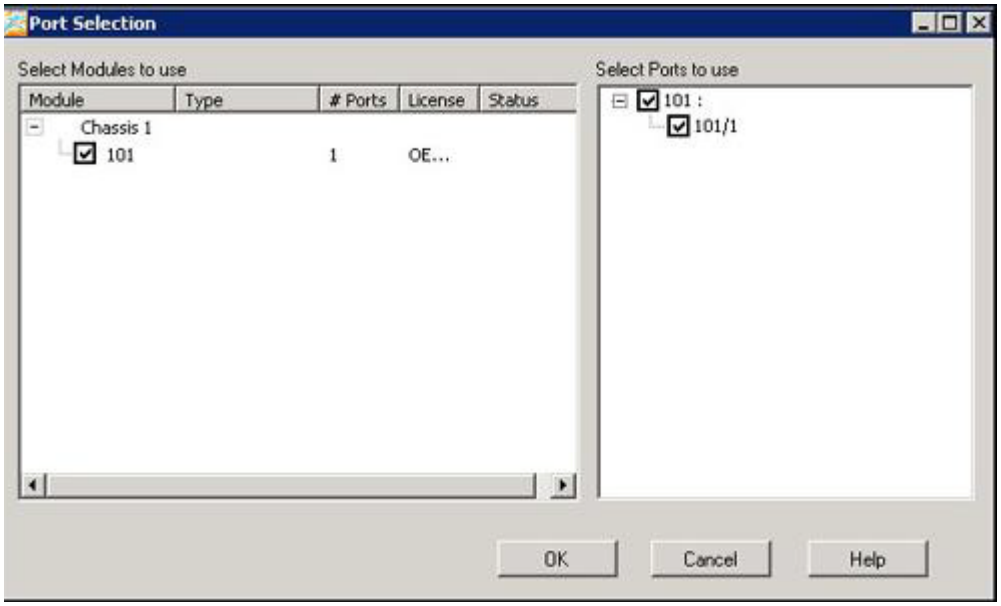
Field	Description
Behavior	
Allow Nesting	Nested frames are not currently supported using this dialog box.
Wait time before transmission	The time for which DigRF Exerciser should wait to transmit the control frame as stimulus after transmitting the frame prior to this frame in the sequence. This allows you to specify the delay timer between frames in the stimulus flow. You can specify a value ranging between 0 to 999 with time unit options as s (seconds), ms (milliseconds), us (microseconds), or ns (nanoseconds).

Field	Description
Frame Error	
CRC	Select this checkbox to insert a CRC error in the control frame. The checkbox is disabled for TAS Logical Channel and TACLC control frames on TxData sublink and all data frames as these frames do not have a CRC value.
CRI Missing	Select this checkbox to send the frame with a missing CRI.
CRI Failure	For this release, the CRI Failure error cannot be inserted and is disabled for all frames.
Disparity	Select this checkbox to insert an 8B/10B Encoding error in the control frame.
SymbolCoding	Select this checkbox to insert an error in the coding of symbols in a frame.
Framing	Select this checkbox to insert a framing error such as error in the end of frame or length of the frame.
Header	
Interface type	Select the Tx radio button if the control frame is to be transmitted as stimulus on the TxData sublink that is, from DigRF Exerciser emulating a BBIC to DUT (RFIC). Select the Rx radio button if the control frame is to be transmitted as stimulus on the RxData sublink that is, from DigRF Exerciser emulating an RFIC to DUT (BBIC). Based on whether you select Tx or Rx, the list of control frames available for transmission over TxData or RxData sublinks changes in the Control Logical Channel listbox.
Control Logical Channel	Displays the list of control frame types available for transmission as stimulus on either TxData or RxData sublink. The list is populated based on whether you select Tx or Rx in the Interface type field.
Payload	
Data Format	Provides the following options to specify how you want to specify the payload of the control frame: • Predefined — Select this option when you want to specify the payload using the control commands and arguments. • Arbitrary — Select this option when you want to fill the payload by manually specifying the arbitrary values.
Command	Displays a list of Interface Control Logical Channel (ICLC) commands relevant for the TxData or RxData sublink. The ICLC commands displayed in this listbox depend on whether you have selected Tx or Rx in the Interface type field. To enable the Command listbox, you need to select the appropriate Control Logical Channel that is, Tx Interface Control Logical Channel or Rx Interface Control Logical Channel.

Field	Description
Argument	Displays a list of arguments applicable for an ICLC command that you selected from the Command listbox. The listbox is therefore enabled only when you select Tx Interface Control Logical Channel or Rx Interface Control Logical Channel from the Control Logical Channel listbox.
Payload length (bytes)	Displays the payload length (in bytes) of the CLC type frame you selected in the Control Logical Channel drop-down list. Though, this payload length is as recommended in DigRF v4 specification, it is not rigid. You can change the payload length as desired. For Control frames with CLC IDs 010, 011, and 110, the payload is already set based on the expected length of control frame you specified in the General Settings -> Transmission tab.
Arbitrary	The Arbitrary section is available only when you have selected the Arbitrary option in the Data Format drop-down list. It provides the Data column, where you can manually specify the arbitrary values to fill the payload of the frame. By default, the Data column contents are shown in the DWord aligned Hex View (little endian) format. To change it to other format, right-click in the Data column, and then select one of the following menu commands: • DWord aligned Hex View (little endian) • DWord aligned Hex View (big endian) • Byte aligned Hex View • Nibble aligned Binary View

Port Selection Dialog Box

You use the Port Selection dialog box to select a port of the DigRF Exerciser module for creating a new session with the DigRF Exerciser module. This dialog box is displayed when you choose to create a new session from the Select type of session dialog box.

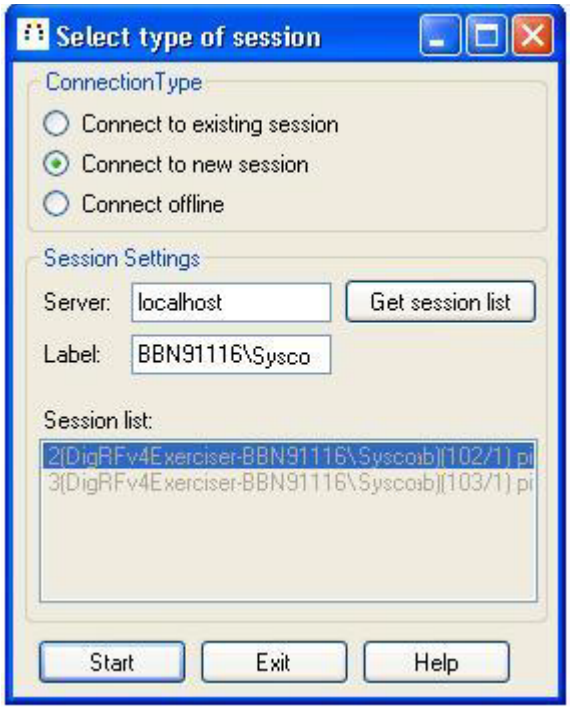


Field	Description
Module	Select the DigRF Exerciser module from the list of the DigRF Exerciser/Analyzer modules that you have added to the chassis. A module, which is already associated with a session, appears disabled. If the status column of a module displays Rebooting, it indicates that the exerciser module is restarting. Wait until it has restarted successfully to create a session.
Select Ports to use	Displays the port(s) available for the selected DigRF Exerciser module that you can use to create a new session.
OK	Click this button to create a new session with DigRF Exerciser module using the selected port. On clicking OK, a connection is established with the DigRF Exerciser module and the Protocol Exerciser for DigRF GUI instance is displayed with these connection settings. There might be a few seconds delay in launching the GUI with the new session settings.
Cancel	Click Cancel to close the dialog box.

Select Type of Session Dialog Box

You use the Select Type of Session dialog box to establish a connection with the DigRF Exerciser module hardware by either using an existing session or creating a new session on the system controller PC. Using this dialog box, you can also

choose to work offline on the Protocol Exerciser for DigRF GUI without connecting to the DigRF Exerciser module hardware.



Field	Description
Connection type	
Connect to existing session	Select this radio button if a session already exists for the DigRF Exerciser module and you want to connect to the module using that session.
Connect to New Session	Select this radio button if you want to create a new session with the DigRF Exerciser module on the system controller (server).
Connect offline	Select this radio button if you want to use the Protocol Exerciser for DigRF GUI without connecting to the DigRF Exerciser module. Some GUI features are disabled if you choose to connect offline.
Session settings	
Server	Specify the name of the system controller that hosts the Protocol Exerciser for DigRF GUI and on which you want to create a new session or use an existing session.
Get session list	Click this button to get a list of sessions that exist on the specified server.

Field	Description
Session list	Displays a list of sessions on the specified server. If you have selected the Connect to existing session radio button, you can select a session from this list to use that session for connecting to the DigRF Exerciser module.
Start	Click Start to start the Protocol Exerciser for DigRF GUI with the specified session settings.
Exit	Click Exit to close the dialog box.
Help	Click Help to get the context-sensitive help.

Menus

Action Menu

Field	Description
Run	Starts sending stimulus from DigRF Exerciser to DUT as per the configured stimulus traffic flow.
Stop	Stops sending stimulus from DigRF Exerciser to DUT.
Send Immediate	Immediately sends all the frames that you added in the SendImmediate tab of a traffic block as stimulus to DUT. DigRF Exerciser halts the running stimulus flow and sends these frames immediately in the defined sequence and then resumes the stimulus flow. Refer to the topic Sending Frames Immediately as Stimulus to know more.
Start GPIO	Starts the transmission on the GPIO interface of the DigRF Exerciser module as per the configured output pins and bit pattern. Refer to the topic Configuring and Using GPIO Interface for Transmission to know more.
Stop GPIO	Stops the transmission on the GPIO interface of the DigRF Exerciser module. Refer to the topic Configuring and Using GPIO Interface for Transmission to know more.
Reload CRI	Use this option to reset the CRI value that DigRF Exerciser uses to generate the CRI of stimulus frames. The CRI is reset to the reload value that you specified in the CRI Reload value field in the Transmission tab.

File Menu

Field	Description
New	Opens the Port Selection dialog box if the system controller is connected to the DigRF Exerciser module through a new or existing session. Creates a new DigRF setup to configure link and other stimulus settings if the system controller is not connected to the DigRF Exerciser module (offline mode).
Open	Opens an existing DigRF Setup file (.dxs file) to let you use the DigRF Exerciser stimulus configurations stored in this file.
Save	Saves the current DigRF Exerciser stimulus configurations in a .dxs file.

Field	Description
Close	In offline mode, it closes the current DigRF Configuration setup in the GUI. In an online mode, it closes the GUI and also provides option to remove the session with the DigRF Exerciser module.
Exit	Closes the GUI and provides option to either remove or retain the session with the DigRF Exerciser module.

DigRF Test Wizard GUI Reference

Common Blocks

DigRF Test Wizard - Session Initiation

You use the Session Initiation block to establish a connection with the DigRF Exerciser module either by using an existing session or creating a new session. A session is required for both stimulus as well as capture flows. Therefore, this block is common to both stimulus and capture flows. The session that you create with DigRF Exerciser for the stimulus flow is also used for capturing the data received from DUT in the capture flow.

Field	Description
Connect to Existing Session	Select this radio button if a session with the DigRF Exerciser module already exists and you want to use that session.
Create new session	Select this radio button if a session with the DigRF Exerciser module does not exist and you want to create a new session. The DigRF Exerciser should be in the Ready state to create a new session. The state of the DigRF Exerciser module is displayed in the State column.
Refresh	Click the Refresh button to displays the updated session information and the current state of the DigRF Exerciser hardware on the Session Initiation page.

DigRF Test Wizard - Interface Configuration

You use the Interface Configuration block to configure the DigRF interface between DigRF Exerciser and DUT (RFIC or BBIC). This interface is used to send DigRF stimulus to DUT and receive responses from DUT. Therefore, this block is common to both stimulus and capture flows. The DigRF interface that you configure for stimulus is also used for capturing the data received from DUT in the capture flow. Therefore, the settings such as speed, polarity, number of lanes etc that you set in this block are applicable for the transmission of stimulus from DigRF Exerciser as well as for the capture of data received by DigRF Exerciser.

Field	Description
Protocol	Select the DigRF protocol for which the interface should be created.

Field	Description
Test Type	Select the Rx Testing radio button if you want DigRF Exerciser to emulate a BBIC while sending stimulus to DUT (RFIC in this case), For the capture flow, Rx testing means that the data received from RFIC is captured. Select the Tx Testing radio button if you want DigRF Exerciser to emulate an RFIC while sending stimulus to DUT (BBIC in this case), For the capture flow, Rx testing means that the data received from BBIC is captured.
Number of Lanes	Select the number of lanes to be configured for the DigRF link between DigRF Exerciser and DUT. This number applicable for transmitter and receiver sides of the DigRF Exerciser. If you are creating a DigRF V3 interface, then the number of lanes is always set to 1.
Polarity	Select the lane polarity (Normal or Inverted) for the lanes configured for the DigRF link. You can set different polarity for each lane configured for the link. This polarity is applicable for the transmitter and receiver sides of DigRF Exerciser.
Speed Setting	
Speed	Select the speed mode for the transmitter and receiver sides of DigRF Exerciser, that is, for the stimulus as well as capture flows. All the lanes configured for the link will then use the selected speed mode for transmission. This field is applicable only when you are configuring a DigRF V4.60 or a DigRFV4.70 interface.

Field	Description
Set transmission speed as	Set the behavior for the transmission speed of DigRF Exerciser. You can either set it to be fixed throughout the stimulus or set it to change as per the transmitted/received speed change control frames. You can select from the following options: • Fixed speed - Indicates that the transmission speed of DigRF Exerciser remains fixed throughout the stimulus flow and even the speed change requests initiated by DigRF Exerciser or DUT during the stimulus flow does not change the speed. If you set the speed to be fixed, then you need to select this fixed speed from the Fixed speed listbox. • Determined by TRANSMITTED Tx Speed Change Messages - The transmission speed of DigRF Exerciser is set as per the TxData Speed change control frame transmitted by DigRF Exerciser during the stimulus. This field is applicable when DigRF Exerciser is emulating a BBIC. • Determined by TRANSMITTED Rx Speed Change Messages - The transmission speed of DigRF Exerciser is set as per the RxData Speed change control frame transmitted by DigRF Exerciser during the stimulus. This field is applicable when DigRF Exerciser is emulating a BBIC. • Determined by RECEIVED Tx Speed Change Messages - The transmission speed of DigRF Exerciser is set as per the TxData Speed change control frame received by DigRF Exerciser during the stimulus. This field is applicable when DigRF Exerciser is emulating an RFIC. • Determined by RECEIVED Rx Speed Change Messages - The transmission speed of DigRF Exerciser is set as per the RxData Speed change control frame received by DigRF Exerciser during the stimulus. This field is applicable when DigRF Exerciser is emulating an RFIC. This field is applicable only when you are configuring a DigRF V3 interface.
Fixed Speed	Select the speed at which the transmission is done from DigRF Exerciser to DUT. This field is enabled when you select Fixed speed as the transmission speed of DigRF Exerciser in the Set transmission speed as field. This field is applicable only when you are configuring a DigRF V3 interface.

Stimulus Flow Blocks

DigRF Test Wizard - Data Setup

You use the **Data Setup** block to set up the DigRF data (control and data frames) that you want DigRF Exerciser to send as stimulus to DUT.

This block has the following two sections -

- **Init Data** section to add only control frames typically to transmit control information to DUT for initialization. This section doesn't have any loop count attached to it thereby making it suitable for sending one time control information for initialization. This section is intended to initialize resources before sending any data frame.
- **Main Data Source** section to add the DigRF data frames to be sent as stimulus after sending the control frames from the **Init Data** section. You can send these data frames repeatedly as stimulus in a loop by specifying the loop settings in the next block of stimulus flow - Run Parameters.

Field	Description
Init data	
CLC listbox	Select a CLC type for which you want to add a control frame for stimulus.
<< Add	Click Add to add a control frame of the selected CLC type. Clicking Add displays the Control Frame Editor dialog box that you can use to specify the settings for the control frame.
Edit	Click Edit to edit the settings for the selected control frame that you added for stimulus.
Remove	Click Remove to delete the selected control frame that you added for stimulus.
Clear All	Click Clear All to delete all the control frames that you added for stimulus.
Main Data Source	

Field	Description
Use following data file (.BDF or LDF) file created by Signal Inserter	Select this radio button if you want to import the DigRF data frames for stimulus from a stimulus file created using the Signal Inserter tool. This stimulus file can have the .bdf or .ldf extension. Refer to the topic Generating DigRF Stimulus Using the Signal Inserter tool to know how to generate such a stimulus file for data frames. Click Browse to specify the location and name of this stimulus file. On execution of the stimulus flow, the wizard uses this file to send data frames to DUT.
Create data file from following input	Select this radio button if you want to create data frames for stimulus from the IQ data stored in an input signal file such as a Signal Studio input file.
Input file type	Displays a list of formats supported for the input signal file to be used for generation of data frames for stimulus.
Primary channel	Select the data channel to be used for the generation of the data frames from the specified input file.
Primary Input file	Click Browse to specify the name and location of the input file from which the data frames are to be generated for stimulus.
MIMO Secondary Channel	This checkbox is used to enable the Secondary input file and the Secondary Channel fields. Selecting this checkbox ensures that the data frames are generated from both the Primary Input file as well as the secondary input file. In the stimulus, the first data frame gets inserted from the primary input file and the second data frame from the secondary input file. This sequence remains the same throughout the stimulus flow.
Secondary Channel	Select the DLC that you want to use for the generation of data frames from the specified secondary input file.
Data format	Select the desired data format to be used for the generation of data frames from the specified secondary input file. The right box provides information on the IQ data length in bits and the number of IQ pairs for the selected data format. You can also customize the IQ data length and number of IQ pairs by selecting the Custom IQ Data Size and Custom Num IQ Pairs checkboxes. Enabling both or any one of these checkboxes disables the Data Format listbox. The data frames are then generated using the custom IQ data length and number of IQ pairs.
Secondary (MIMO) Input file	This field is enabled only when the MIMO checkbox is selected. Click Browse to specify the name and location of the secondary input file from which the data frames are to be generated for stimulus. In the stimulus, the first data frame gets inserted from the primary input file and the second data frame from the secondary input file. This sequence remains the same throughout the stimulus flow.

DigRF Test Wizard - Run Parameters

You use the Run Parameters block to:

- specify the iteration settings for sending the data frames configured in the Main Data Source section of the Data Setup block in the stimulus flow.
- send the control frames at runtime to DUT.

You can specify the number of times the sequence of data frames is sent as stimulus to DUT. You can also control the time period for which DigRF Exerciser should wait before starting the first iteration and the subsequent iterations of data frames in the stimulus flow.

Field	Description
Wait for	Specify the time period (in seconds) for which DigRF Exerciser should wait before starting the first iteration of the transmission of data frames as stimulus. The data frames are the frames that you configured using the Main Data Source section of the previous block - Data Setup.
Start next iteration every	Specify the time period (in seconds) for which DigRF Exerciser should wait before starting the next iteration of the transmission of data frames as stimulus. The data frames are the frames that you configured using the Main Data Source section of the previous block - Data Setup.
Iterations	Specify the number of iterations for the transmission of data frames as stimulus. The data frames are the frames that you configured using the Main Data Source section of the previous block - Data Setup.
Infinite	Select this checkbox if you want to create an infinite loop for the transmission of data frames as stimulus.
Send Immediate	You can use this tab to send control frame(s) immediately as stimulus to DUT during an ongoing stimulus flow. By sending a frame immediately, you can change the behavior of DUT at runtime or perform runtime debug as well while stimulating the DUT. When you send a frame immediately as stimulus, DigRF Exerciser halts the stimulus flow, sends that frame and then resumes the stimulus flow from the point at which it was halted.
CLC listbox	Select a CLC type for which you want to add a control frame to be sent immediately as stimulus.
<< Add	Click Add to add a control frame of the selected CLC type. Clicking Add displays the Control Frame Editor dialog box that you can use to specify the settings for the control frame.

Field	Description
Edit	Click Edit to edit the settings for the selected control frame that you added for sending immediately.
Remove	Click Remove to delete the selected control frame that you added for sending immediately.
Clear All	Click Clear All to delete all the control frames that you added for sending immediately.

Capture Flow Blocks

DigRF Test Wizard - Trigger Configuration

You use the Trigger Configuration block to:

- specify the capture memory settings for storing the captured data in the DigRF Exerciser capture memory.
- enable and specify the trigger condition(s) to start the data capture

Field	Description
Capture setting	
Maximum Trace size (%)	Specify the percentage of the total memory of DigRF Exerciser that should be allocated for storing the captured data. The total size of the capture memory of the DigRF Exerciser module is 512 MB. Out of the total 512 MB of memory, the captured data can be stored in 384 MB. The rest of memory is used by internal bookkeeping logic. You can allocate a percentage of this memory for storing Rx data received from DUT.
Maximum trace size before trigger (%)	Specify the percentage of the allocated capture memory of DigRF Exerciser that should be used for storing the data before a trigger condition is met. The remaining memory from the allocated memory is used for data storage after the trigger condition is met.
Trigger setting	
Start capture when any of the following condition is met	Select this checkbox to ensure that the data capture starts when a specified trigger condition is met. If this checkbox is not selected, the data capture starts immediately on starting the capture flow.
External trigger in signal is received	Select this checkbox to ensure that data capture starts when a trigger in signal is received on the DigRF Exerciser's Trigger In Connector component from another test equipment.
An incoming frame matches with following pattern	Select this checkbox to ensure that data capture starts when a DigRF frame received from DUT matches the pattern that you specified in the pattern matcher section.
Channel type	Select the channel type of the incoming frame from DUT that should trigger the data capture.
Control frame	If you selected the channel type as Control, then specify the details of the control frame. When DUT sends a control frame matching these details, the trigger condition is met and data capture starts.
Data frame	If you selected the channel type as Data, then specify the details of the data frame. When DUT sends a data frame matching these details, the trigger condition is met and data capture starts.

DigRF Test Wizard - Data Analysis

You use the Data Analysis block to specify how you want to display the captured data after it is captured. There are a number of tools that you can use to view and analyze the captured data. Some of these tools are a part of the Logic Analyzer GUI and some are available separately. Based on the Data analysis settings, the wizard invokes the specified tools and also performs the necessary configuration in these tools if required as per the capture flow.

Field	Description
View data in DigRF Analysis tool	Select this radio button if you want to view and analyze the captured data using one of the DigRF Analysis tools provided in the RDX test platform.
Show Packet Viewer	Select this checkbox if you want to view the captured data in the Packet Viewer tool. If this checkbox is selected, the wizard adds a Packet Decoder and Packet Viewer tools in the Logic Analyzer GUI to decode the captured DigRF packets and display these packets in a textual format in the Logic Analyzer GUI.
Show Signal Extractor	Select this checkbox if you want to extract the IQ data from the captured data using the Signal Extractor tool. If this checkbox is selected, the wizard adds a Signal Extractor tool in the Logic Analyzer GUI to extract the IQ data. You can view this extracted IQ data in a Waveform viewer in the Logic Analyzer GUI. The wizard can add the Signal Extractor tool only if you have the required license for this tool.
Launch VSA for signal Analysis	Select this checkbox if you want the Wizard to launch Agilent VSA GUI for the signal analysis of the captured data.
Use following configuration file	Specify the name and location of the configuration file that you want the Wizard to use for configuring the VSA GUI for signal analysis. If you do not specify a configuration file, then the wizard launches VSA in default mode and you are required to do further settings from the VSA GUI.
Save IQ Data	Select this radio button if you want to save the IQ data from the captured data in a specified txt file.
Waveform	Select the data format to be used for the IQ data that you want to save in the txt file. The default IQ parameters applicable for the selected data format are then used.
Custom IQ Parameters	Select this checkbox if you want to customize the IQ parameters for the data to be saved in the txt file. You can specify a custom IQ data size and Number of IQ pairs to be used for the IQ data in the file.
Browse	Click Browse to specify the name and location of the file in which you want to save the IQ data from the captured data.

8 Troubleshooting Stimulus and Capture related Problems

This topic lists some of the problems that you might encounter while using the DigRF Exerciser / Analyzer modules of RDX Test platform.

Problem	Cause	Solution
You have configured data capture settings in Logic Analyzer and the data capture has started. However, the captured data is not displayed in the Packet Viewer instance that you have added.	• The captured data is not yet acquired from the memory of DigRF Exerciser/Analyzer module used for data capture into the Logic Analyzer GUI. Or you have not connected to a session with the DigRF Exerciser/Analyzer module while acquiring the captured data from this module. • The configurations for the Packet Decoder instance added to decode the captured packets in Logic Analyzer are not correct.	• Click the  toolbar button the Logic Analyzer GUI to acquire the captured data for display and analysis. Ensure that a session is created between the Logic Analyzer GUI and the DigRF Exerciser/Analyzer module while acquiring the data. • Check if the **Protocol Family** and **Decode bus** settings are appropriately set in the Packet Decoder instance. If you are capturing packets on the TxData sublink (BBIC to RFIC), then select Tx as the Decode bus and for packets captured over the RxData sublink, select Rx.
While sending stimulus to the DUT, DigRF Exerciser is not sending ACK/NACK.	The stimulus configurations are not appropriately set to support the transmission of ACK/NACK from DigRF Exerciser.	Ensure that the following is set while configuring stimulus settings in the Protocol Exerciser for DigRF GUI: • the speed mode for the transmission from DigRF Exerciser is set to **HS-BURST**. If you have configured DigRF Exerciser to transmit in SYS-BURST mode, then DigRF Exerciser does not transmit ACK/NACK. • the **Turn off ARQ Protocol** checkbox is deselected in the **Transmission** tab of the General settings page. • the **Receive frame checks** are enabled in the **Receive** tab of the General settings page. If these checks are disabled, DigRF Exerciser does not check the received frames for specific errors and therefore, does not send NACKs for errored frames.

Problem	Cause	Solution
You have configured the stimulus and capture settings using DigRF Exerciser and stimulus results are displayed. However, the data received from DUT is not getting captured. The number of captured frames is displayed as 0 in Logic Analyzer GUI.	The capture settings might not be properly set in the Logic Analyzer GUI.	Check if the link direction configured for data capture in Logic Analyzer is correct. If you are using DigRF Exerciser for data capture: • **Tx** means data capture for Transmitter side of DigRF Exerciser • **Rx** means data capture for Receiver side of DigRF Exerciser If you are using DigRF Analyzer for data capture: • **Tx** means data capture for TxData sublink (BBIC to RFIC) • **Rx** means data capture for RxData sublink (RFIC to BBIC) Check if you have allocated DigRF Exerciser's memory for data capture. If it is left to 0%, then captured data will not be stored.
You have configured stimulus and data capture using DigRF Exerciser. The stimulus statistics is getting displayed. However, in data capture, only the data capture statistics is getting updated but the number of frames captured is displayed as 0.	The sequence in which the stimulus and capture is started is incorrect.	Start the stimulus and capture in the following sequence: 1. Start the data capture in the Logic Analyzer GUI by clicking the Start button in the Status page of the External Protocol Analyzer Setup dialog box. 2. Start the stimulus in the Protocol Exerciser for DigRF GUI.
In the Protocol Exerciser for DigRF GUI: While trying to import frames from a Signal Inserter stimulus file to the Init block in the traffic flow, the Import SI File button appears disabled.	The Init block has been set as the Control block.	Right-click the Init block in the traffic flow graph and deselect the **Use as Control Block** checkbox.

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Acknowledgements

The Agilent Protocol Exerciser for DigRF GUI uses Outlook Bar, a Graphical library created by Tim Dawson (Refer http://www.divil.co.uk/net/).