

**Oracle® Communications
Diameter Signaling Router**

IDIH ProTrace User's Guide

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Oracle® Communications IDIH ProTrace User's Guide

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Table of Contents

Chapter 1: Introduction.....	6
Overview.....	7
Scope and Audience.....	7
Manual Organization.....	7
Related Publications.....	8
My Oracle Support (MOS).....	8
Emergency Response.....	8
Locate Product Documentation on the Oracle Technology Network Site.....	9
Chapter 2: Introduction to ProTrace.....	10
Accessing IDIH from DSR.....	11
Trace Overview.....	11
Key Basic ProTrace Concepts.....	12
TDRs.....	12
Dictionaries.....	12
Queries.....	13
Setting User Preferences on IDIH Dashboard.....	13
Setting Time Format.....	14
Setting Mapping Preferences.....	14
Setting ProTrace Preferences.....	15
Chapter 3: Understanding the ProTrace Interface.....	16
Trace List Panel.....	17
Trace List Toolbar.....	17
Query List Panel.....	18
Query List Toolbar.....	18
Creating or Modifying a Query.....	19
Executing a Query.....	20
Trace Viewer.....	21
TDR Panel.....	21
TTR Events Panel.....	23
Changing the Page Layout.....	32
IDIH Trace Statistics.....	32

List of Figures

Figure 1: IDIH Trace Overview.....12

Figure 2: Trace List Toolbar.....17

Figure 3: Query List Toolbar.....18

Figure 4: Query Dialog.....19

Figure 5: TDRs List Toolbar.....22

Figure 6: Event List Panel.....23

Figure 7: Event Diagram.....25

Figure 8: Diameter Full Decoding Panel.....29

List of Tables

Table 1: Dictionaries.....	13
Table 2: TTR Events Visualization.....	25
Table 3: Diameter Full Decoding Panel.....	29

Chapter 1

Introduction

Topics:

- *Overview.....7*
- *Scope and Audience.....7*
- *Manual Organization.....7*
- *Related Publications.....8*
- *My Oracle Support (MOS).....8*
- *Emergency Response.....8*
- *Locate Product Documentation on the Oracle Technology Network Site.....9*

This section contains an overview of the available information for the ProTrace application of the Integrated Diameter Intelligence Hub feature. The contents include sections on the organization, scope, and audience of the documentation, as well how to receive customer support assistance.

Overview

ProTrace is a near real-time, end-to-end, multi-protocol call tracing application. ProTrace has the capability of performing scenario-less traces for in-progress and completed calls, transactions and sessions for the DSR.

ProTrace traces the calls, transactions and sessions based on Trace Transaction Records (TTRs), metadata and DSR configuration data which are reported in the form of summary records with each record containing information in accordance with the Diameter interface used to send or receive the message. ProTrace can perform an *in-progress* display of a traced transaction/call/data session. The capability to perform the scenario-less inter-protocol tracing is the ProTrace built-in feature eliminating the need for defining complex scenarios. This section provides the high level architecture of the ProTrace application.

ProTrace operates within a trace context and enables you to manage (create, modify and delete) as well as store queries for a particular interface.

Note: Each query contains a set of sub-queries for some dictionaries/interfaces (each dictionary describes one interface). If a query's interfaces are a subset of a trace's interfaces, then the query is compatible with that trace and can be executed on that trace.

The *ProTrace viewer* component serves as the end-user interface. This enables you to initiate and view either single or multiple traces (maximum five). Multiple users (the number of users is based on purchased licenses) can connect to ProTrace using a Web interface.

ProTrace provides the following functionality:

- Real-time call in-progress trace display with message sequence diagram as required by the network troubleshooting users, in as many network situations and contexts as possible.
- Off-line tracing on stored data with at least 24HR back-search window capability

Note: The amount of back search available depends on the amount of storage and the call volume of your network.

- Optimizes tracing process by taking advantage of enrichment techniques during capture.
- The ability to view transactions using TDR Viewer which can trace both IPv4 and IPv6 addresses.

Scope and Audience

This documentation is intended for personnel who maintain operation of the DSR. It provides information about ProTrace concepts. It is designed to be a general guide to working with ProTrace to monitor traces on the Integrated Diameter Intelligence Hub (IDIH).

Manual Organization

Introduction contains general information about this document, how to contact *My Oracle Support (MOS)*, *Locate Product Documentation on the Oracle Technology Network Site*.

[Introduction to ProTrace](#) provides an introduction to the ProTrace application

[Understanding the ProTrace Interface](#) provides information about the ProTrace user interface.

Related Publications

For information about additional publications that are related to this document, refer to the *Related Publications Reference* document, which is published as a separate document on the Oracle Technology Network (OTN) site. See [Locate Product Documentation on the Oracle Technology Network Site](#) for more information.

My Oracle Support (MOS)

MOS (<https://support.oracle.com>) is your initial point of contact for all product support and training needs. A representative at Customer Access Support (CAS) can assist you with MOS registration.

Call the CAS main number at **1-800-223-1711** (toll-free in the US), or call the Oracle Support hotline for your local country from the list at <http://www.oracle.com/us/support/contact/index.html>. When calling, make the selections in the sequence shown below on the Support telephone menu:

1. Select **2** for New Service Request
2. Select **3** for Hardware, Networking and Solaris Operating System Support
3. Select **2** for Non-technical issue

You will be connected to a live agent who can assist you with MOS registration and provide Support Identifiers. Simply mention you are a Tekelec Customer new to MOS.

MOS is available 24 hours a day, 7 days a week, 365 days a year.

Emergency Response

In the event of a critical service situation, emergency response is offered by the Customer Access Support (CAS) main number at **1-800-223-1711** (toll-free in the US), or by calling the Oracle Support hotline for your local country from the list at <http://www.oracle.com/us/support/contact/index.html>. The emergency response provides immediate coverage, automatic escalation, and other features to ensure that the critical situation is resolved as rapidly as possible.

A critical situation is defined as a problem with the installed equipment that severely affects service, traffic, or maintenance capabilities, and requires immediate corrective action. Critical situations affect service and/or system operation resulting in one or several of these situations:

- A total system failure that results in loss of all transaction processing capability
- Significant reduction in system capacity or traffic handling capability
- Loss of the system's ability to perform automatic system reconfiguration
- Inability to restart a processor or the system
- Corruption of system databases that requires service affecting corrective actions

- Loss of access for maintenance or recovery operations
- Loss of the system ability to provide any required critical or major trouble notification

Any other problem severely affecting service, capacity/traffic, billing, and maintenance capabilities may be defined as critical by prior discussion and agreement with Oracle.

Locate Product Documentation on the Oracle Technology Network Site

Oracle customer documentation is available on the web at the Oracle Technology Network (OTN) site, <http://docs.oracle.com>. You do not have to register to access these documents. Viewing these files requires Adobe Acrobat Reader, which can be downloaded at www.adobe.com.

1. Log into the Oracle Technology Network site at <http://docs.oracle.com>.
2. Under **Applications**, click the link for **Communications**.
The **Oracle Communications Documentation** window opens with Tekelec shown near the top.
3. Click **Oracle Communications Documentation for Tekelec Products**.
4. Navigate to your Product and then the Release Number, and click the **View** link (the **Download** link will retrieve the entire documentation set).
5. To download a file to your location, right-click the PDF link and select **Save Target As**.

Chapter 2

Introduction to ProTrace

Topics:

- *Accessing IDIH from DSR.....11*
- *Trace Overview.....11*
- *Key Basic ProTrace Concepts.....12*
- *Setting User Preferences on IDIH Dashboard....13*
- *Setting ProTrace Preferences.....15*

This chapter provides an introduction to the features of the ProTrace application.

Accessing IDIH from DSR

Users will be able to access IDIH using single sign-on which does not require the user to login again for IDIH, provided a primary DNS server is being used in conjunction with IDIH. However, using this mechanism, users will be able to access only the ProTrace application.

Note: Single sign-on must be configured prior to accessing IDIH from DSR. For information about how to configure single sign-on, refer to the *Operations, Administration, and Maintenance (OAM) User's Guide*.

To log into IDIH from DSR SOAM GUI:

1. Using a Web browser, type the **FQDN** for a DSR SOAM.
2. Log into the SOAM by entering the correct **User Name** and the corresponding **Password**.

Note: Check with the system administrator for the user name and password.

3. Navigate to **Diameter > Troubleshooting with IDIH > Maintenance > Traces**.
4. Click the **Launch IDIH** button.
5. Alternatively, select a trace and click **Analyze With IDIH**.

In the absence of a DNS server, the user may authenticate directly on the IDIH server using the "idihtrace" user ID. This user ID provides the same level of functionality as using single sign-on from the SOAM.

The procedure for accessing IDIH with the "idihtrace" user ID is almost the same as for signing in via single sign-on with the exception of replacing **FQDN** with **IP Address** in the above procedure.

Trace Overview

A trace is a set of conditions (subdivided into scope and content) which, when met, cause trace data to be forwarded to IDIH.

The DSR plays the role of determining which messages should be captured, based on trace criteria that are created and activated by the user. The trace criteria identifies the "scope" as well as the "content".

- "Scope" refers to the non-protocol-related elements (such as connections or peers) that are used to select messages for trace content evaluation.
- "Content" refers to the protocol-related elements (such as command codes, AVPs, etc.) that are used to refine the trace criteria.

As request and answer messages are processed by the DSR, they are analyzed for matching any of the active trace definitions, and if so, transfer message components along with supplemental information to the IDIH called trace data. The IDIH can assemble the trace data, and present it to the user leveraging graphical visualization interfaces for additional filtering and analysis.

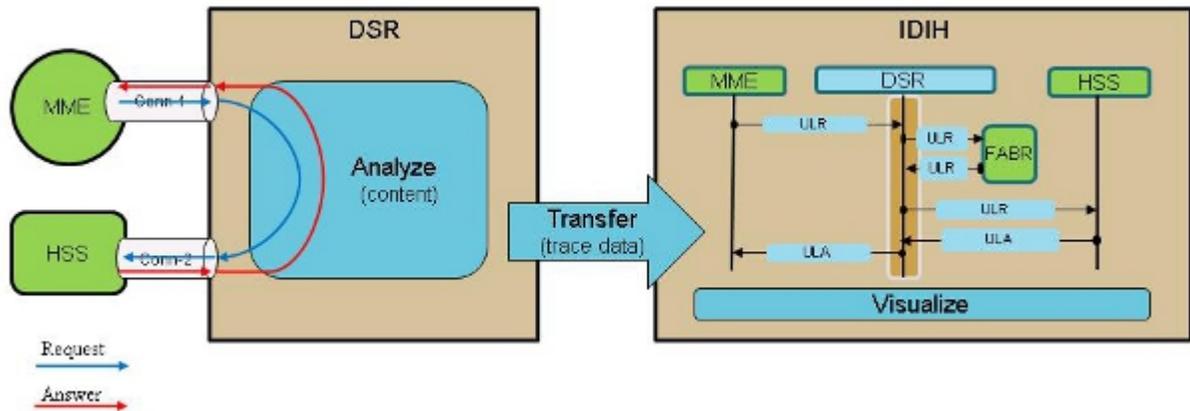


Figure 1: IDIH Trace Overview

IDIH does not guarantee a fixed number of days of data storage. Storage life is based on disk space. Some of the factors impacting storage life are trace parameters (very inclusive or very discriminatory) and record size.

During congestion, the DSR will suspend trace forwarding until the condition clears, at which time, trace forwarding will resume.

Note: Trace data lost during the time of congestion will not be recovered.

Key Basic ProTrace Concepts

TDRs, Dictionaries, and Queries are key concepts in ProTrace application. It is essential to understand these terms in order to understand how ProTrace application works..

TDRs

A TDR (Transaction Detail Records) is a database record which summarizes a diameter transaction (one request / answer message pair and associated TTR events) and DSR metadata associated with it. Every TDR is associated with a dictionary, which describes its structure.

One TTR is usually represented with more than one TDR, i.e. every TTR is split by IDIH Mediation server during the TTR processing into multiple TDR records each having one request / answer pair.

Dictionaries

A dictionary is metadata describing a set of key fields (along with their name, type, description, possible values etc.) which are captured for a single diameter transaction and summarize it. One dictionary describes transactions on one interface (Diameter S6a/S6d, Diameter Gx, etc.).

Each Diameter interface supported by the ProTrace application has its own dictionary. ProTrace supports the following dictionaries:

Table 1: Dictionaries

Dictionary	Interface
Diameter Base	Base
Diameter Default	All unsupported applications
Diameter Cx/Dx	Cx/Dx
Diameter Gq	Gq
Diameter Gx	Gx
Diameter Gxx	Gxx
Diameter Rf	Rf
Diameter Ro/Gy	Ro/Gy
Diameter Rx	Rx
Diameter S6a/S6d	S6a/S6d
Diameter S9	S9
Diameter Sh/Ph	Sh/Ph
Diameter SLg	SLg
Diameter SLh	SLh
Diameter STa	STa
Diameter SWm	SWm
Diameter SWx	SWx

Queries

Queries are always defined on a dictionary or set of dictionaries. A query contains a set of conditions, query expression and set of displayed fields for each dictionary on which it is defined:

- **Condition** contains a label consisting of a field, an operator, and a value. Only fields which are marked as "conditionable" can be added as query condition.
- **Expression** defines Boolean operation (with "AND" and "OR" operators) on the conditions.
- **Display fields** are fields which are displayed to the user when the query is executed. Display field can be any field from the dictionary which is marked as "displayable". Condition fields can be part of the display fields, but it is not required that condition fields are also display fields.

Setting User Preferences on IDIH Dashboard

Once inside IDIH, a user can set User Preferences. These include:

- Time specifications (date format, time zone, etc.)

- Enumeration values (numerals vs. text)

Setting Time Format

Follow these steps to set the time format:

1. Click **User Preferences** on the Application board.
The User Preferences screen is displayed.
2. Click the **Date/Time** tab.
The Date/Time screen is displayed. The red asterisk denotes a required field.
Note: Use the tips on the screen to help configure the time format.
3. Enter the format for these time-related displays.
 - **Date format**
 - **Time format**
 - **Date and time fields**
4. Select the formats for these time-related displays by using the drop-down arrow.
 - **Duration fields** - how the hours, minutes, seconds, and milliseconds of the Time format is displayed
 - **Time zone**
Note: The local time zone must be chosen to get local time.
5. To reset the time-related displays to default settings, click **Reset**.
6. Click **Apply** to save settings.

Setting Mapping Preferences

The user can set the Mapping settings using the User Preferences feature.

Follow these steps to set Mapping preferences.

1. Click **User Preferences** in the Application board.
The User Preferences screen is displayed.
2. Click the **Mapping** tab.
The Mapping screen is displayed.
3. Check **Translate ENUM values** to display text instead of numerals.
Enumeration is used by TDRs to display text values instead of numeric. Rather than showing the numeral for Alarm Severity, the user interface will show the actual word, such as "Major" or "Critical."
4. Check **IP Address to Node Name** to translate an IP Address to a textual Node Name.
5. To reset the Mapping values to the default, click **Reset**.
6. Click **Apply** to save the changes.

Setting ProTrace Preferences

Within ProTrace, a user can set Preferences. These include:

- Selecting a dictionary from which to derive and then select Default Fields for use in queries
- Whether or not to show texts for Toolbar Buttons
- Whether or not to use buttons for showing Ladder Diagram tips

Chapter 3

Understanding the ProTrace Interface

Topics:

- [Trace List Panel.....17](#)
- [Query List Panel.....18](#)
- [Trace Viewer.....21](#)

This chapter provides information about the ProTrace user interface.

Trace List Panel

With the ProTrace application, the trace list shows all traces configured by DSR; the list can also be filtered

The traces list contains 5 columns. Most of the column headings can be used to sort the displayed sessions list by clicking on the heading. Click once to sort in ascending order and again to sort in descending order for that column.

The column headings are:

- Trace Name - trace name
- Status - the completion status of the trace, which can be either "In-Progress" or "Completed".
- Start Time - the start date and time for the trace
- Stop Time - the end date and time of the trace
- TTR Count - the number of messages matched in a particular trace

Trace List Toolbar

The toolbar provides a means of selecting and organizing traces. Below is a description of each button on the toolbar.



Figure 2: Trace List Toolbar

Filter - clicking this button opens the *System Query Dialog* popup where the user can filter the list of sessions displayed by the various columns and their values.

First page - clicking this button opens the first page of sessions.

Previous page - clicking this button opens the previous page of sessions.

Next page - clicking this button opens the next page of sessions.

Last page - clicking this button opens the last page of sessions.

Set Size - use this button to set the number of selected trace records / total trace records displayed from 10-500 per page.

Refresh - clicking this button re-loads the current screen and shows any changes that have been made.

Delete - clicking this button deletes a selected trace.

Obtain Trace Conditions - clicking this button opens a popup window that provides additional details about a selected trace.

Run Default Query - clicking this button runs a query on the selected trace in the list and provides a detailed analysis for those traces.

In addition to these buttons, there is also a saved filters pull-down to select a saved filter, and a page count showing what page out of the total sessions pages being viewed.

Query List Panel

The Query List panel contains list of queries the user can execute on the selected trace. These queries are user's saved queries or queries shared by other users. The list has a toolbar where the user can quickly invoke operation on a selected query. It includes:

- Creating a new query
- Modifying selected query
- Deleting selected query
- Executing selected query

When the user selects a trace in Trace List panel, the queries in Query List is reloaded. Only queries which are "compatible" with selected trace are show.

The Query List panel table contains 4 columns. The table queries change depending on what view is selected based on which trace is selected, but the columns are constant. The column headings can be used to sort the list by clicking on the heading. Click once to sort in ascending order and again to sort in descending order for that column.

The column headings are:

- Query Name - that shows the name of the query
- Query Description - shows a description of a given query
- Owner - shows the user name that created the query
- Created - shows the date the query was created

Query List Toolbar

The toolbar provides a means of selecting and organizing queries. Below is a description of each button on the toolbar.



Figure 3: Query List Toolbar

Filter - clicking this button opens the *System Query Dialog* page where you can filter out all non-essential queries.

First page - clicking this button opens the first page of queries.

Previous page - clicking this button opens the previous page of queries.

Next page - clicking this button opens the next page of queries.

Last page - clicking this button opens the last page of queries.

Set Size - use this button to set the queries list size from 10-500 per page

Refresh - clicking this button re-loads the current screen and shows any changes that have been made.

Create New Query - clicking this button opens the Query Dialogue screen to add a specific query.

Modify Selected Query - clicking this button opens the current query for modification.

Delete Selected Query - clicking this button deletes the current query.

Run Selected Query - clicking this button runs a query of the selected trace in the list and provides a detailed analysis for the selected trace.

Note: The user can only view/operate on a single trace at a time.

Change Begin/End Time for the Query - clicking this button opens the *Query Settings* page where the user can modify the begin and end dates and times for a given query.

In addition to these buttons there is also a queries count showing how many queries are in the list and what range you are viewing.

Creating or Modifying a Query

To create a new query or modify existing query, click the **Create New Query** or **Modify Selected Query**. The Query Dialog box opens.

Query Dialog

Dictionary Diameter S13 has been loaded.

Name: Description:

Available Dictionaries:

Diameter S13 Displayed Fields

<input type="checkbox"/>	Field	Operator	Value
--------------------------	-------	----------	-------

Operator: AND OR Use parenthesis

Expression:

Figure 4: Query Dialog

The query must have at least one dictionary. To add a dictionary, select a dictionary from the **Available Dictionaries** pulldown list and click the (+) button. To remove a dictionary, click the (-) button.

Once the dictionary has been added to the query, the conditions can be added using the **Add** button. The query can have no conditions, otherwise the query will match all Transaction Detail Records (TDRs) for a given dictionary. Each dictionary has its own conditions, making it possible to search for TDRs from different dictionaries with different conditions.

When adding a condition, the corresponding label is added into the **Expression** field. It is added to the end of the expression with the selected **Operator** (AND or OR). Similarly, when the condition is removed from the query, the corresponding label is automatically removed from the expression and the expression is adjusted. When **Use Bracket** is selected, then the whole expression is closed in brackets before adding the new condition.

Note: The user can edit the expression to be more complex such as "(A AND B) or C"

The query is validated before it is saved or executed. The following things are verified:

- Name is filled (verified for Save operation only, for Query Execution operation the name can be empty)
- All conditions have correct operator and correct value (an empty value is not allowed and it must correspond to field type)

Note: The user can also use wild cards in the value field. To see descriptions of these wild cards, hover on the most right-hand "?" in the query dialog after selecting a field.

- Expression is well formed Boolean expression

Whenever any error occurs, the user is notified either in the Message Panel at the top of the Dialog box or next to the GUI element which caused the error (a condition or expression box).

Note: For filtering on source and destination node fields, provide either the IP address or select the node name from the list. Selecting the node name means filtering on the list of IP addresses assigned to the selected node. If the same IP Address is being reused across the nodes, filtered data would display other nodes as well.

By default, when a dictionary is added into the query, all displayable fields from that dictionary are selected as Displayed Fields. If desired, change the Display Fields in the **Displayed Fields** tab. There are 3 modes to choose from:

1. All fields (all fields are added into Displayed Fields)
2. Common (all common fields from all dictionaries are selected; if there is just one dictionary then all fields are selected)
3. Custom fields (the user can select fields of his/her choice)

The Displayed Fields are selected separately per dictionary. If there is more than one dictionary, then fields in the query result are merged together based on the field name. All fields with the same name are displayed in the same column.

Click **Save** to save a query for later use. The query appears in the Query List panel.

Click **Save As** to open a prompt asking for a new name. Confirms the name. A new query is created and saved for later use. The query appears in the Query List panel.

Now the query is ready for execution. Execute the query by clicking the **Apply** button.

Executing a Query

When a query is executed, it is always executed on the currently selected trace from the Trace List panel and Trace Viewer is displayed. A query can be executed in multiple ways:

1. By clicking the **Apply** button from the **Query Dialog** window (when creating or modifying a query)
2. By clicking the **Run Default Query** icon on the Trace List toolbar
3. By selecting the query in Query List panel and clicking the **Run Selected Query** icon in the Query List toolbar

Enter the time in which the search is about to be performed. The Begin and End time are pre-populated with the real begin and end date of the selected trace. Click on the icons next to the date and time text boxes and select the date in calendar and time in time selection widgets for better convenience.

By selecting the **Execute in New** button, the Trace Viewer is shown in a new browser window and the query is executed.

Trace Viewer

The Trace Viewer is displayed when the user executes a trace and contains the TDRs for the trace for the user to analyze.

The Trace Viewer is divided into three panels:

- TDRs List Panel
- Event List Panel (Event List or Event Diagram)
- Diameter Full Decoding Panel

ProTrace allows the user to organize the panels in 6 different layouts (positions of each panel). Some layouts contain only some panels. Each layout is depicted by an icon which shows how the panels are organized. For information about how to change the layout, refer to [Changing the Page Layout](#).

TDR Panel

The TDR panel contains list of transactions (TDRs) that matched a given query. If the query does not have any conditions, then the panel will include all TDRs captured for the selected trace and for interfaces selected by the query. The TDRs belonging to the same TTR are displayed next to each other with the same background color. The fields displayed in the result are defined in Query display fields. The result is divided into pages (the user can define the page size) and the user can navigate through the pages (first page, previous and next page).

The user is also able to perform the following actions:

- Use navigation buttons to go to first, previous or next page
- Reverse sorting (Ascending, descending)
- Set the page size (number of records per page) for TDR table
- Get the number of records which match the current query
- Display statistics of the current trace
- Modify the query and re-execute it in order to refine the transactions
- Export currently selected TTR in HTML format. The exported file contains a summary of TDR records, an event diagram, a list of TTR events, and a full decoding panel for every Diameter payload message.
- Change the layout of the panels

When the user selects **Search Message Copy**, a new query is created and executed. The query populates the Trace Viewer with TDRs that have the same **LinkedTTR** or **CorrelationID** values as the original TDR that was used to start the search.

When the original Answer message appears in the copied message, it is included in the group AVP with code 2156 and vendor ID 323. This AVP appears in the Full Decoding Panel as "MSG-Copy-Answer".

In the original TTR, apart from standard events, two new events will appear if a message is copied - "Message Copy Triggered" and "Message Copied". Depending on where the trigger point is set, there may be up to 4 "Message Copy Triggered" events. These events will have the scope set as "IR Data". "Message Copied" events will have the scope set as "IA Data". Each "Message Copy Triggered" event will have Message Copy Configuration Set name (MCCS) as its instance data, as well as where the Message Copy was triggered.

A copied TTR will start with a new Event "Copied Message". The "Copied Message" event's scope will be "IG" (Internally Generated). MCCS will be used as the instance data. MCCS will result in selecting the route list and subsequently the route group. These standard events will be seen, but their scope will be "IG Data".

TTR Events Panel

The TTR Event Panel displays a list of all TTR events associated with the selected transaction (TDR). Whenever the user selects a TDR in the TDR Panel, the TTR Event Panel is refreshed with the corresponding TTR events. The Event table has the following columns:

Rec #	Time	Event Type	Event Scope	Transport Type	Connection	Source Node	Source Port	Destination Node	Destination Port	Event Data	Application
1	28/07/2014 06:20:01:000	Message Received	IR	TCP	rmml_conn	rmml1 - 10.250.51.144	36137	ferb_dsr - 10.240.19.164	3668	-	3GPP S
2	-	Trace Match	IR Data	-	-	-	-	-	-	test_Sd_TTP-IR	-
3	-	ART Rule Not Found	IR Data	-	-	-	-	-	-	Default	-
4	-	PRT Rule Not Found	IR Data	-	-	-	-	-	-	Default	-
5	-	Dest-Host Routing	IR Data	-	-	-	-	-	-	-	-
6	-	Trace Match	ER Data	-	-	-	-	-	-	test_Sd_TTP-ER	-
7	28/07/2014 06:20:01:000	Message Sent	ER	TCP	hssi_conn	ferb_dsr - 10.240.19.164	10001	hssi1 - 10.250.51.145	10001	-	3GPP S
8	28/07/2014 06:20:01:000	Message Received	IA	TCP	hssi_conn	hssi1 - 10.250.51.145	10001	ferb_dsr - 10.240.19.164	10001	2001 - DIAMETER_SUCCESS	3GPP S
9	-	Trace Match	IA Data	-	-	-	-	-	-	Adhoc_ans_Sd_TTP-IA	-
10	-	Trace Match	EA Data	-	-	-	-	-	-	Adhoc_ans_Sd_TTP-EA	-

Figure 6: Event List Panel

the user can also click **Toggle Ladder Diagram** in order to view events in an Event Diagram.

- **Time** (the column is populated for payload events only. It contains the time when the message was received or sent)
- **Event Type and Event Scope**

Event Type	Event Scope
Message Received	IR (Ingress Request), IA (Ingress Answer)
Message Sent	ER (Egress Request), EA (Egress Answer)
Message Created	App Data (Application Data)
App Invoked	App (Application)
App Result	App Data
App Invocation Failed	IR Data, IA Data

Event Type	Event Scope
Trace Match	IR Data, ER Data, IA Data, EA Data
Linked TTR	
ART Rule Match	IR Data
PRT Rule Match	IR Data
Unavailability Action	IR Data, IA Data
Route List Selected	IR Data
Dest-Host Routing	IR Data
Alternate Implicit Routing	IR Data
Route Group Selected	IR Data
Mediation Rule Match	IR Data, IA Data, ER Data, EA Data
Request Rerouted	IR Data
Answer Timeout	IA
Answer Matching Failed	IA Data
Address Resolution Match	App Data
Routing Exception	App Data
DP Query Sent	App Data
DP Response Received	App Data
DP Query Failure	App Data
DP Response Timeout	App Data
SBR Query Sent	App Data
SBR Response Received	App Data
SBR Query Failure	App Data
SBR Response Timeout	App Data

- **Transport Type** ("TCP" or "SCTP" for payload events only)
- **Connection Id** (The name of the connection defined in DSR)
- **Source Node** ("*<Node name>* - *<IP address>*") for payload events; IP is translated and node name is displayed if there is a record in Local Node or Peer Node reference data at DSR for the given IP address)
- **Source Port** (TCP/STCP IP port number for payload events)
- **Destination Node** ("*<Node name>* - *<IP address>*") for payload events; IP is translated and node name is displayed if there is a record in Local Node or Peer Node reference data at DSR for the given IP address)
- **Destination Port** (TCP/STCP IP port number for payload events)

- **Event Data** (Event data from TTR event; Event Data for Answer payload events contains the result code from ResultCode AVP (code 268) or ExperimentalResultCode AVP (code 298) in form of "<Error Code> - <Error description>")
- **Application** (Diameter Application for payload events, empty for the rest)
- **Command Code** (Diameter message command code in form of "<Short name> - <Long name>" for payload events)

Event Diagram

The Event Diagram shows the TTR events in graphical form. It is just another form of information shown in TTR Event panel.

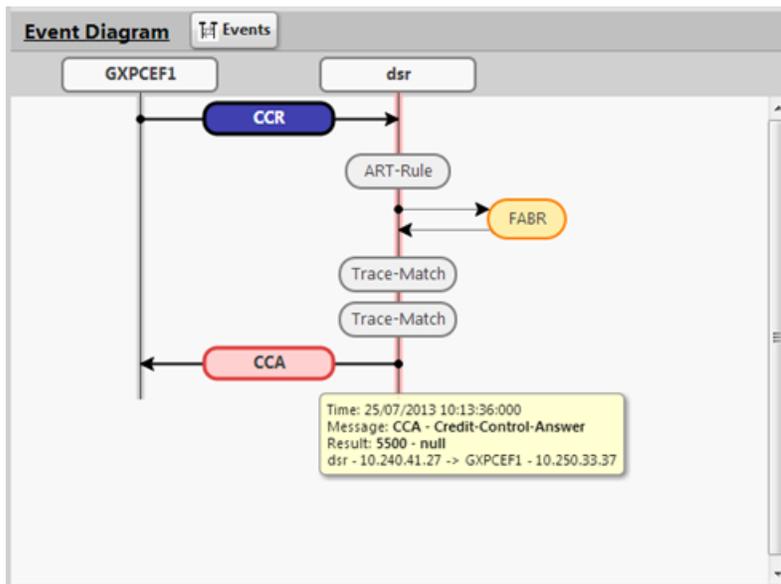


Figure 7: Event Diagram

The user can hover or click on a bubble of the ladder diagram which may show information about that particular bubble in the Diameter Full Decoding Panel.

The user can also click **Toggle Event Table** in order to view events in tabular form, which also allows for a selected row to appear in the Diameter Full Decoding Panel.

The following table defines how the TTR events are visualized in the ladder diagram:

Table 2: TTR Events Visualization

Event Type	Event Scope	Event Diagram Visualization	Title	Tooltip
Request Message Sent/Received	IR, ER	Blue bubble with arrow from source node to destination node	Command Code short name (for example ULR for Update Location Request)	Time, Command Code

Event Type	Event Scope	Event Diagram Visualization	Title	Tooltip
Answer Message Sent or Received with Success Result Code (RC < 3000)	IA, EA	Green bubble with arrow from source node to destination node	Command Code short name (for example ULA for Update Location Answer).	Time, Command Code, Result
Answer Message Sent or Received with Success Result Code (RC >= 3000)	IA, EA	Red bubble with arrow from source node to destination node	Command Code short name (for example ULA for Update Location Answer)	Time, Command Code, Result
Message Created	App Data	Gray bubble on DSR node	"Message-Created"	
App Invoked	App	Orange bubble next to DSR node with arrows from DSR to and from Application bubble	"<Name>" from Event Data	"Application: <Name>" (Event Data)
App Result	App Data	App Result appends a text to the corresponding Application's tooltip		"Result: <Event Data>" appended in previous Application's (App Invoked) tooltip
App Invocation Failed	IR Data, IA Data	App Invocation Failed makes the corresponding Application bubble red and appends text to its tooltip.		Appends "Invocation Failed: <Event Data>" red text in previous Application's tooltip
Trace Match	IR Data, ER Data, IA Data, EA Data	Gray bubble on DSR node	"Trace-Match"	"Matched Trace: <Event Data>"
Linked TTR		No visualization		
ART Rule Match	IR Data	Gray bubble on DSR node	"ART-Rule"	"ART Rule: <Event Data>"
PRT Rule Match	IR Data	Gray bubble on DSR node	"PRT-Rule"	"PRT Rule: <Event Data>"
Unavailability Action	IR Data, IA Data	Unavailability Action makes the previous event bubble red.		Appends "Unavailability Action" red text in the previous bubble's tooltip

Event Type	Event Scope	Event Diagram Visualization	Title	Tooltip
Route List Selected	IR Data	Gray bubble on DSR node	"Route-List"	"Selected List: <Event Data>"
Dest-Host Routing	IR Data	Gray bubble on DSR node	"Dest-Host-Routing"	
Alternate Implicit Routing		Alternate Implicit Routing makes previous metadata bubble red and appends a text in its tooltip.		Appends "Alternate Implicit Routing" red text in the previous metadata bubble's tooltip
Route Group Selected	IR Data	Gray bubble on DSR node	"Route-Group"	"Route Group: <Event Data>" (Event Data contains group name)
Mediation Rule Match	IR Data, ER Data, IA Data, EA Data	Gray bubble on DSR node	"Mediation-Rule"	"Matched Rule: <Event Data>" (Event Data contains rule name)
Request Rerouted	IR Data	Gray bubble on DSR node	"REQ-Rerouted"	"Attempts: #<Event Data>" (Event Data contains attempt #)
Answer Timeout	IA	Arrow from source node to destination node	"Answer Timeout"	No tooltip
Answer Matching Failed	IA Data	Red bubble on DSR node	"ANS-Match-Failed"	
Address Resolution Match	App Data	Address Resolution Match appends a text to the corresponding Application bubble.		"Address Resolution: <Event Data>" (Event Data formatted as a list)
Routing Exception	App Data	Routing Exception appends a text to the corresponding Application bubble.		"Routing Exception: <Event Data>"
DP Query Sent	App Data	DP Query Sent appends a text to the corresponding Application bubble.		"DP Query Sent: <Event Data>" (Event Data formatted as a list)
DP Response Received	App Data	DP Response Received appends a text to the		"DP Response Received: <Event Data>" (Event Data formatted as a list)

Event Type	Event Scope	Event Diagram Visualization	Title	Tooltip
		corresponding Application bubble.		
DP Query Failure	App Data	DP Query Failure appends a text to the corresponding Application bubble.		Appends red text "DP Query Failure: <Event Data>" (Event Data formatted as a list)
DP Response Timeout	App Data	DP Response Timeout appends a text to the corresponding Application bubble.		Appends red text "DP Response Timeout: <Event Data>" (Event Data formatted as a list)
SBR Query Sent	App Data	SBR Query Sent appends a text to the corresponding Application bubble.		"SBR Query Sent: <Event Data>" (Event Data formatted as a list)
SBR Response Received	App Data	SBR Response Received appends a text to the corresponding Application bubble.		"SBR Response Received: <Event Data>" (Event Data formatted as a list)
SBR Query Failure	App Data	SBR Query Failure appends a text to the corresponding Application bubble.		Appends red text "SBR Query Failure: <Event Data>" (Event Data formatted as a list)
SBR Response Timeout	App Data	SBR Response Timeout appends a text to the corresponding Application bubble.		Appends red text "SBR Response Timeout: <Event Data>" (Event Data formatted as a list)
Message Copied	IA	MSG-Copied bubble appears on DSR node	"MSG-Copied"	No tooltip
Copied Message	IG (Internally Generated)	Copied-MSG bubble appears on DSR node	"Copied-MSG"	Copied Message ID appears in the tooltip
Message Copy Triggered	IR, ER	MC-Triggered bubble appears on DSR node	"MC-Triggered"	No tooltip

Diameter Full Decoding Panel

When the user selects a payload event in the Events Panel or a balloon from the Event Diagram, the corresponding message is displayed fully decoded in the Full Decoding Panel. This view explains every byte of the selected diameter message.

The Diameter Full Decoding Panel is further divided into two panels. The first panel shows the payload bytes of the messages. The second panel displays the Diameter Message Header and all AVPs decoded into a readable format. It shows every field of the header and AVP as defined by the Diameter RFC. Each field of the message header and AVP is displayed on separate lines.

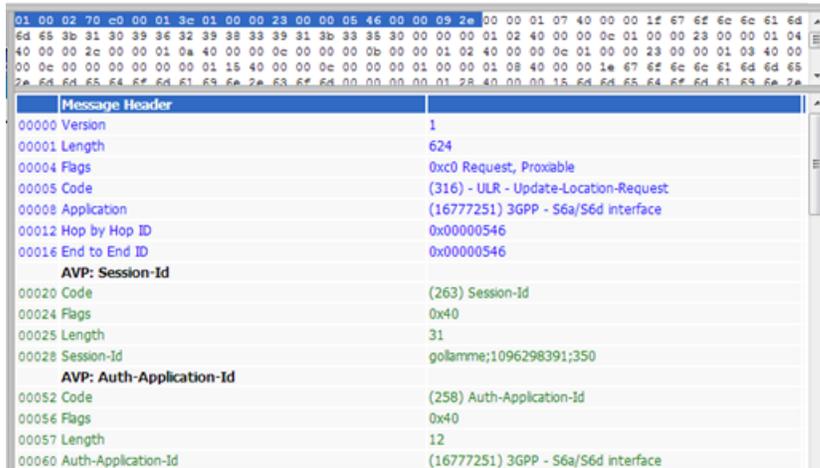


Figure 8: Diameter Full Decoding Panel

The detailed decoding list has the following columns:

- **Offset** (An offset address of the field from the beginning of the diameter payload. Version field of Diameter Message Header has offset 0)
- **AVP / Field Name**
- **Value and description** (Value and possible description)

Table 3: Diameter Full Decoding Panel

AVP Type	Display
Integer32/Unsigned32 Integer64/Unsigned64	Numeric value
Enumerated	Numeric value + description of the value if known
Grouped	Names of all child AVPs
UTF8String	UTF string from the bytes
OctetString	If all bytes are displayable (codes are from 32 to 128 ASCII) then it is displayed as UTF string, otherwise the hex decode is displayed
IPAddress	D.D.D.D or XXXX:XXXX:...:XXXX:XXXX depending on IP version (IPv4 or IPv6) (where D is decimal digit and X hexadecimal digit)
AppId	Application Id and Name if known
VendorId	Vendor Id and Name if known

Custom AVPs, Commands, and Vendors

The user can add custom AVPs, commands and vendors through an XML configuration file called diameter dictionary file. The Diameter decoder component, which is responsible for diameter message/AVP decoding, will look at its start-up at the specific location (at the Application server itself) and if it finds the dictionary file there, it will use it to decode diameter messages.

```
Appserver: /usr/TKLC/xIH/diameter/custom-avps.xml
```

If a change is made to this dictionary file, the application server must be restarted in order to pick-up the changes.

The custom diameter dictionary file must be valid XML file, which contains one single root element called "dictionary." All other tags defining custom commands, vendors and AVP must be included inside of this tag.

Adding Custom AVPs

Simple AVP Tag Format

The following format must be used to define new custom AVP:

```
< avp name="<avpName>"display="<displayText>" [vendor-id="<vendorId>" ]
code="<code>"type="<type>" />
```

where

- **avpName** must be unique AVP identifier in the dictionary file, if the vendorId is present then the name should be preceded by vendor-id (see the example below)
- **vendorId** is optional and if present then must be either defined in the custom dictionary file, or must be one of the predefined ones
- **type** must be one of the following predefined types:
 - OctetString
 - Integer32, Unsigned32, Integer64, Unsigned64
 - UTFString
 - IPAddress
 - TBCD

Example:

```
< avp
name=" 3GPP:3GPP-IMSI" display=" 3GPP-IMSI" code="1"vendor-id=" 3GPP" type="UTF8String" />
```

Enumerated AVP Tag Format

The following XML tag format must be used to define new enumerated AVP

```
:< avp name="<avpName>"display="<displayText>" [vendor-id="<vendorId>" ]
code="<code>"type=" type">
<enumcode="<value>"name="<enumDisplayText>">
. . .
</avp>
```

where

- **avpName** , **displayText**, **vendorId**, **code** and **type** are the same as in case of simple AVP format

- **value** is the numeric value and **enumDisplayText** is a text which is displayed in the full decoding window. If a named value is not defined, the decoder displays just simple numeric value

Example:

```
<avp name="Framed-Routing" display="Framed-Routing" code="10" type="Enumerated"
>
  <enum code="0" name="None" />
  <enum code="1" name="Broadcast" />
  <enum code="2" name="Listen" />
  <enum code="3" name="Broadcast-Listen" />
</avp>
```

Grouped AVP Tag Format

The following XML tag format must be used to define new custom grouped AVP:

```
< avp name="<avpName>" display="<displayText>" [ vendor-id="<vendorId>" ]
code="<code>" type="type" >
<avpref="<refAvpName>" >
.
.
.
</avp>
```

where

- **avpName** , **displayText**, **vendorId**, **code** and **type** are the same as in case of simple AVP format
- **refAVPName** must be name of an existing AVP define in the custom dictionary

Example:

```
<avp name="3GPP:User-Identity" display="User-Identity" code="700" vendor-id="3GPP"
type="Grouped">
  <avp ref="Public-Identity" />
  <avp ref="3GPP:MSISDN" />
  <avp ref="3GPP:Public-Identity" />
</avp>
```

Adding Custom Commands

Command Tag Format

The following XML tag format must be used to define new custom command code:

```
< command code="<code>" short-name="<shortName>" name="<commandName>" />
```

where

- **code** is the command code,
- **shortName** appears in the ladder diagram events,
- **commandName** appears in the full decoding of a message

Example:

```
< command code="316" short-name="UL" name="Update-Location" />
```

Adding Vendors

A

The following vendors are already defined and can be used without defining them again:

Vendor-Id	Vendor Code	Vendor
ER	193	Ericsson
3GPP	10415	3GPP Project
3GPP2	5535	3GPP Project
ETSI	13019	ETSI

If the new vendor needs to be added then the following tag must appear in the dictionary file:

```
< vendor vendor-id="<id>" code="<code>" name="<description>" />
```

Example:

```
< vendor vendor-id="VF" code="12645" name="Vodafone" />
```

Changing the Page Layout

The user can change the page layout of the TDR viewer (or Trace viewer) to re-arrange or hide the TDR, PDU, and Full Decode views. To change the layout, follow these steps.

Note: Changing the layout is persisted, so the next time TDR viewer is activated with a trace execution, the last layout used will be provided.

1. Click **Change Layout**.

The layout pop-up opens.

2. Select a **Layout**.

The page layout changes to match the user's choice. This will now be the default layout for this session type.

IDIH Trace Statistics

IDIH gathers statistics about Diameter transactions for active traces. The statistics have the following dimensions:

- TimeTag - end of the interval for which the record contains statistics
- TraceInstance - identifies trace to which this record belongs
- Node - IP address of the node
- DbLevel - MCL (Managed Object ChangeLevel)
- ResultCode - value of ResultCode AVP (code 268)
- ExperimentalResultCode - value of ExperimentalResultCode AVP (code 298)

and the following measures for the given matching dimension values:

- Count - total number of transactions
- Timeouts - number of time-out transactions

The statistics count the number of transactions for every combination of dimension values seen in received transactions. It counts transactions with result code only. If the TTR is missing an Answer message or the Answer message is missing a result code AVP, then the transaction is not counted.

The statistics are continuously generated and stored in an Oracle database. The complete statistics will be available up to 5 minutes after the trace has finished or has been stopped.

ProTrace reads the statistics and displays them to the user in the form of bar and pie charts.

- If the user clicks on a bar, it executes a new query and displays TDRs for the clicked node and category (all, errors, success, timeouts)
- If the user clicks a section in the pie chart, then it displays TDRs with the clicked result code for the selected node

The user can refresh the statistics presented by clicking the **Refresh Statistics** button.

The user also can return to the *TDR Panel Toolbar* by clicking the **Return to Traces** button.