

Oracle® Communications IDIH ProTrace



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Revision History

Date	Description
April 2023	No changes made in this release
April 2022	No changes made in this release
June 2016	Updated based on support for U-SBR
August 2011	Initial release

1

Introduction

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.

1.1 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 DSR 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.

ProTrace 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 a variety of functionalities:

- 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.

1.2 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).

1.3 Manual Organization

[Introduction](#) contains general information about this document.

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

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

2

Introduction to ProTrace

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

2.1 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**, and then **Troubleshooting with IDIH**, and then **Maintenance**, and then **Traces**.
4. Click **Launch IDIH**.
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.

2.2 Trace Overview

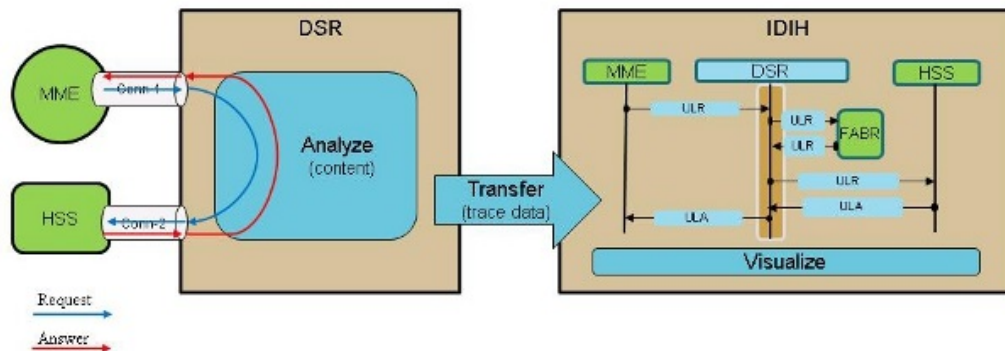
A trace is a set of conditions (subdivided into scope and content) which, when met, cause trace data to be forwarded to IDIH.

A DSR DA-MP plays the role of determining which messages should be captured based on trace criteria created and activated by the user. The trace criteria identifies the scope and content.

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

As DSR processes request and answer messages, they are analyzed for matching any of the active trace definitions. If a match is found, message components along with supplemental information, called trace data, are transferred to the IDIH. The IDIH assembles the trace data and presents it to the user leveraging graphical visualization interfaces for additional filtering and analysis.

Figure 2-1 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, DSR suspends trace forwarding until the condition clears, at which time, trace forwarding resumes.

 **Note:**

Trace data lost during the time of congestion is not recovered.

2.3 Traces and Network IDIH

IDIH allows trace filters and the resulting trace data to be correlated across multiple DSR sites in a network.

Users can see how an exchange traverses across a network of multiple DSR sites. If there are multiple DSR sites deployed with a network, visual depictions of how transactions traverse the various sites within the network from an end-to-end basis are often useful. IDIH allows trace filters to be set and data collected and visualized at each DSR site. However, problems arise if the network is comprised of multiple DSR sites and the same trace is needed at multiple sites within the network.

Network IDIH creates network traces to automatically apply trace criteria across an entire DSR network, as well as provides the ability to capture and correlate trace data from the DSR sites within the network.

Network traces complement site traces. A site trace captures data associated with a trace filter only at the site where the trace was defined, which is the default behavior provided by IDIH. A network trace captures data associated with a trace filter from any site within the network and a network trace can be created at any site and visually depicted at any site. The sites within the network trace domain must be provisioned prior for a network trace to function.

Whenever a new trace filter is created, the user selects if the trace is a site trace or a network trace. The network is configured to support a given number of simultaneous active network traces. When a network trace is activated, resources are allocated on each **DA-MP** within the network to gather data associated with the trace. Each site collects and forwards all trace transaction records (TTRs) that match the trace criteria to the IDIH at that site, up to the defined limits on duration or number of TTRs captured.

The results of a network trace can be visually depicted from any IDIH within the network. IDIH is launched from the DSR maintenance GUI from any site within the network. IDIH retrieves all **TTRs** associated with the trace from all sites, correlates them, and renders the results. IDIH performs further filtering of the trace results and gathers statistics associated with the trace results. IDIH displays each DSR node through which the captured request and answer routes within the network

2.4 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..

2.4.1 TDRs

A TDR (Transaction Detail Records) is a database record that summarizes a DSR 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, meaning every TTR is split by the IDIH Mediation server during the TTR processing into multiple TDR records each having one request/answer pair.

2.4.2 Dictionaries

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

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

Table 2-1 Dictionaries

Dictionary	Interface
Diameter Base	Base

Table 2-1 (Cont.) Dictionaries

Dictionary	Interface
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
Diameter Sd	Sd
Diameter Sy	Sy
Diameter S13	S13
Diameter Zh	Zh
RADIUS Rf	Rf
RADIUS STa	STa
RADIUS	RADIUS

2.4.3 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.

2.5 Setting User Preferences on IDIH Dashboard

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

- Time specifications (such as date format, time zone)
- Enumeration values (numerals vs. text)

2.5.1 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.

2.5.2 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.

2.6 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

3

Understanding the ProTrace Interface

This chapter provides information about the ProTrace user interface.

3.1 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 six 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:

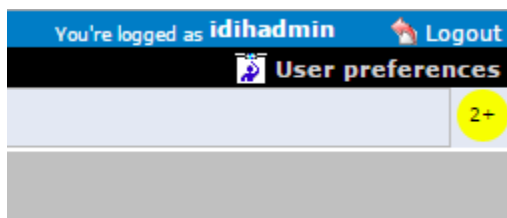
- Trace Name - trace name
- Status - the completion status of the trace, which can be either In-Progress or Completed.
- Type - the type of trace, which is either Site or Network based on trace records details and can be filtered
- Start Time - the start date and time for the trace
- Stop Time - the end date and time of the trace
- TTR Count - the number of messages matched in a particular trace

3.1.1 Alarm Status Indicator

When logged in to IDIH, either directly or from **DSR** launch, the portal header displays a count of current alarms, as shown in [Figure 3-1](#). The alarm status indicator is a count of the highest severity of all open alarms and the alarm status indicator (circle) is the color (user defined, idihadmin) of the highest severity. For example, if there are zero critical, two major, one minor, and three warnings, then the alarm status indicator contains 2+ and the color is the user-defined color for major severity. The + is used to indicate that there are additional alarms at a lesser severity. The + does not appear if, for example, there are zero critical, two major, zero minor, and zero warnings.

Initially, the alarm status is empty (non-visible). Then, after a short interval, the system queries for open alarms and updates the alarm status indicator. After the first update, the system updates the alarm status indicator every 30 seconds.

Figure 3-1 Alarm Status Indicator



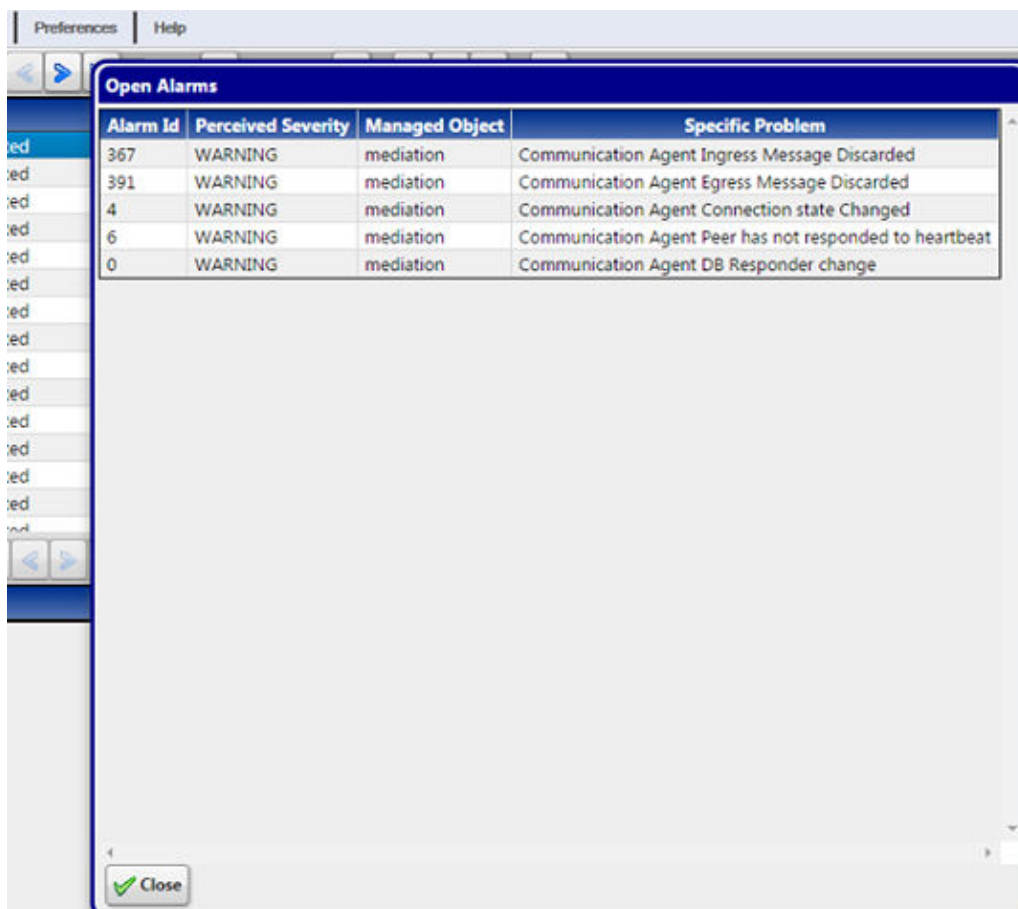
Selecting the alarm status indicator shows a brief description of the open alarms. The system displays the list of open alarms in tabular form, as shown in Figure 3-2. This list can be dismissed by clicking **Close** on the Open Alarm screen.



Note:

Only open alarms may be viewed. No other actions are provided such as clear or acknowledge.

Figure 3-2 Alarm List



3.1.2 Trace List Toolbar

The toolbar provides a means of selecting and organizing traces.

Figure 3-3 Trace List Toolbar



Filter - opens the System Query Dialog popup where you can filter the list of sessions displayed by the various columns and their values.

First page - opens the first page of sessions.

Previous page - opens the previous page of sessions.

Next page - opens the next page of sessions.

Last page - opens the last page of sessions.

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

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

Delete - deletes a selected trace.

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

Obtain Trace Info - displays a popup dialog displaying trace information for the selected row from the Trace List page. The information displayed includes the summary information for the selected trace, and all the Network IDIH sites and their counts for the selected trace.

Run Default Query - 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.

3.2 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 four 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

3.2.1 Query List Toolbar

The toolbar provides a means of selecting and organizing queries.

Figure 3-4 Query List Toolbar



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

First page - opens the first page of queries.

Previous page - opens the previous page of queries.

Next page - opens the next page of queries.

Last page - opens the last page of queries.

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

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

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

Modify Selected Query - opens the current query for modification.

Delete Selected Query - deletes the current query.

Run Selected Query - 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.

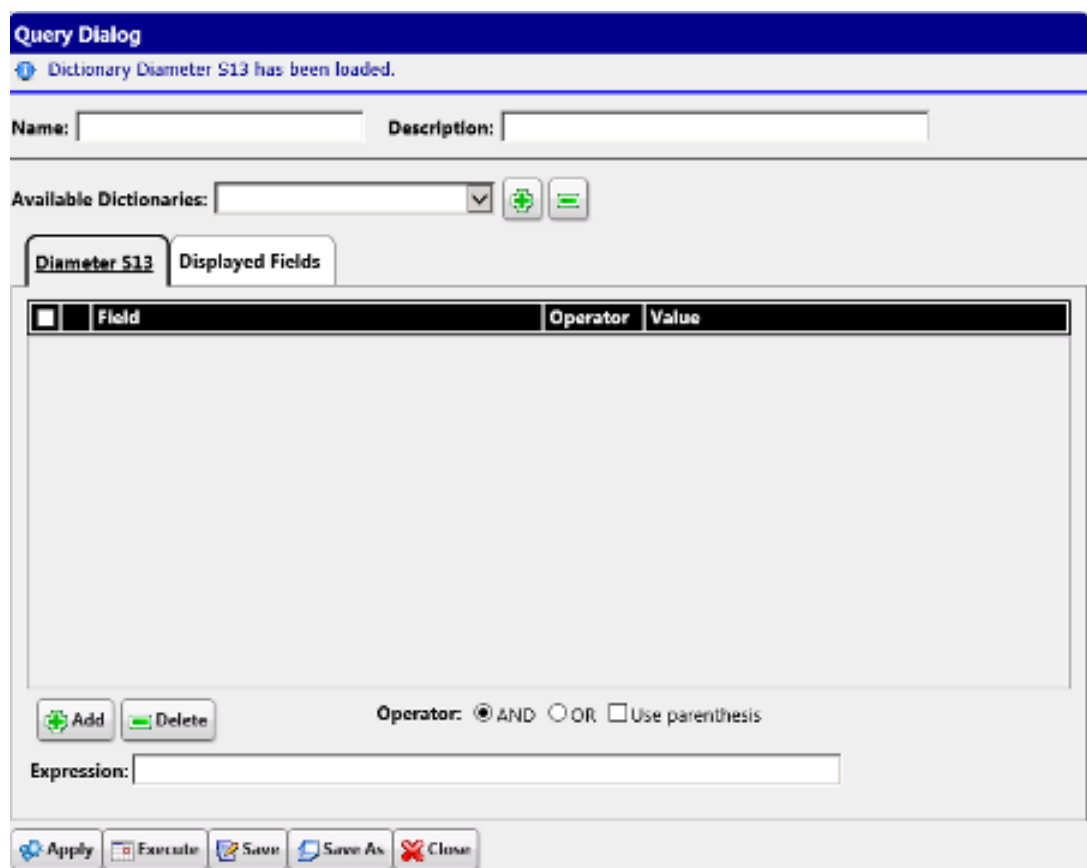
Change Begin/End Time for the Query - opens the Query Settings page where the user can modify the begin and end dates and times for a given query.

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.

3.2.2 Creating or Modifying a Query

To create a new query or modify existing query, click **Create New Query** or **Modify Selected Query**.

Figure 3-5 Query Dialog



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

Once the dictionary has been added to the query, the conditions can be added by clicking **Add**. The query can have no conditions, otherwise the query matches 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. Several 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 beside 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 **Apply**.

3.2.3 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 **Apply** from the Query Dialog window (when creating or modifying a query)
2. By clicking **Run Default Query** on the Trace List toolbar
3. By selecting the query in Query List panel and clicking **Run Selected Query** 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 beside the date and time text boxes and select the date in calendar and time in time selection widgets for better convenience.

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

3.3 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)
- ProTrace 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](#).

3.3.1 TDR Panel

The TDR panel contains lists of transactions (TDRs) that matched a given query. If the query does not have any conditions, then the panel includes all TDRs captured for the selected trace and for interfaces selected by the query. The TDRs belonging to the same TTR are displayed beside 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 a variety of 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 to refine the transactions
- Export a file that contains a summary of TDR records, an event diagram, a list of TTR events, and a full decoding panel for every Diameter, RADIUS, or RADIUS embedded within a Diameter payload message. There are multiple formats in which the file may be exported:
 - Export TTR as HTML - exports the file from the currently selected TTR in an HTML format
 - Export TTR as PCAP - exports the file from the currently selected TTR in a PCAP format that is directly downloaded to the user's server without a progress bar or a way to cancel the export
 - Export trace as PCAP - exports the contents of a trace into a PCAP format that is directly downloaded to the user's server, indicated by a progress bar that also allows the user to cancel the export. If the export is cancelled, ProTrace exports all information that was downloaded prior to the cancellation.

 **Note:**

ProTrace exports payload data in IPv4 or IPv6 based on the original transport type. TCP or SCTP transport is used in the export based on the original transport type. Source IP, source port, destination IP and destination port from the payload are used. When the payload size exceeds the maximum of TCP/SCTP packet size, the payload is segmented into multiple IP packets so that 3rd party tools can assemble and present it as a single diameter payload.

 **Note:**

Payloads sent from DSR to IDIH contain Diameter/RADIUS layer only (no IP or TCP/SCTP layers). Therefore, IDIH makes a best effort to simulate those layers when constructing the PCAP file for export. Trace export exports up to 1 MB of payload data. The rest of the payloads are ignored. The user can refine the query to accommodate all the payloads the user wants to export and re-export it again. When TLS or DTLS is used as the transport, the export displays TCP for TLS and SCTP for DTLS as the Transport value.

 **Note:**

When encoding and displaying RADIUS AVP User-Password, IDIH does not decode the password and display it in a readable format, including in the ProTrace Decode Panel, HTML export, and TDR/TTR PCAP export.

- Change the layout of the panels

The TDR list for a network trace highlights all TDRs related in the same fashion as highlighting is for site TDRs. All related TDRs are grouped and highlighted (white or blue), regardless if the TDRs are from a network trace or site trace. When TLS or

DTLS is used as the transport, ProTrace displays these two protocols in the Transport column.

3.3.1.1 TDR Panel Toolbar

The function buttons on the TDRs list toolbar are as follows:

Figure 3-6 TDRs List Toolbar



First page - opens the first page of queries.

Previous page - opens the previous page of queries.

Next page - opens the next page of queries.

Reverse Sorting - reverses the sort order of the xDR list.

Set Size - this shows how many TDRs are displayed per page, the user can modify the number of TDRs on the page by typing in another number and clicking the **check**. The user can set the page size from 10 to 5000 TDRs per page. A larger page size will take longer to display.

Pause refresh - stops automatic refresh so that you can work on filters or records without data changing.

Go Back to Trace List - returns to the Trace List.

Show Statistics - opens the Trace Statistics window and shows statistics associated with the selected trace. See [IDIH Trace Statistics](#) for further information.

Modify Query - opens the Query dialog screen of an existing query.

 **Note:**

A user can also add conditions to a query by right clicking an individual cell in the TDRs List and clicking **Add to Conditions**. These new conditions are added to the current query and are not applied until the icon is used to apply the changed query.

Change Begin/End time for the Query - allows the user to change the time a query begins or ends.

TTR Export - exports the TTR results. These results are exported in HTML format.

Search - searches for specific TDR records.

Search next - continues search of TDR records.

Change layout - enables the user to change the page layout using a variety of combinations. See [Changing the Page Layout](#) for further information.

Selected Trace - Shows the name of the Trace currently being analyzed.

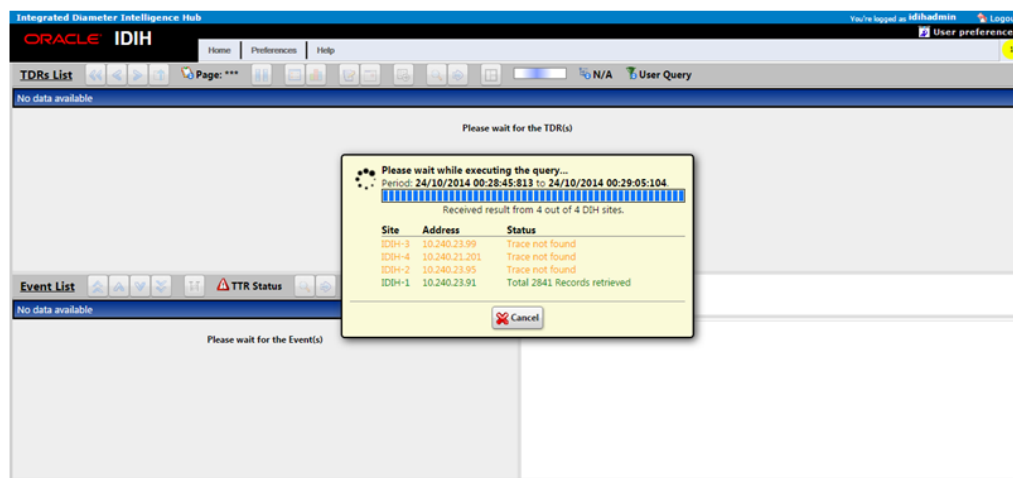
Query selected - placing the cursor over on this icon opens a small information pop-up showing the name, description, and network information of the query being run. This information is useful because it confirms the user is looking at the correct trace.

3.3.1.2 TDR List Retrieval

Network traces require TDR data to be retrieved from multiple sites and may take longer to process based on factors such as the number of sites and network latency. When retrieving network trace results from the **Analyze with IDIH** function on the DSR GUI or from the main ProTrace page and the trace is a network trace, then ProTrace displays a progress dialog, which displays a variety of information as shown in [Figure 3-7](#):

- Time Period
- Progress bar
- Network result status - x out of y processed, where x is the current number of processes and y is the total
- Network Table with individual IDIH site information (Name, address, and status)
- **Cancel**

Figure 3-7 TDR List Retrieval



3.3.1.3 Message Copy

When the TTR was copied during the Message Copy feature to **DAS**, it is indicated in the TDR. The TDR contains two fields which have references to either the copied TTR or to the original TTR. The fields are called **LinkedTTR** and **CorrelationID**. If these references exist in the TDR (these fields are not empty), then the TDR is highlighted with a different text color.

When the user right clicks on a TDR, a popup menu is displayed and the user can select **Search Message Copy**.

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 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 have the scope set as **IR** Data. Message Copied events have the scope set as **IA** Data. Each Message Copy Triggered event has Message Copy Configuration Set name (MCCS) as its instance data, as well as where the Message Copy was triggered.

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

3.3.2 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 a number of columns:

Figure 3-8 Event List Panel

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	msml_conn	hsc1 - 10.250.51.144	36137	fwlb_dsr - 10.240.19.164	3666	-	IGPP 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	hsc1_conn	fwlb_dsr - 10.240.19.164	10001	hsc1 - 10.250.51.145	10001	-	IGPP S
8	28/07/2014 06:20:01.000	Message Received	IA	TCP	hsc1_conn	hsc1 - 10.250.51.145	10001	fwlb_dsr - 10.240.19.164	10001	2001 - DIAMETER_SUCCESS	IGPP S
9	-	Trace Match	IA Data	-	-	-	-	-	-	Adhoc_ans_sd_TTP-IA	-
10	-	Trace Match	EA Data	-	-	-	-	-	-	Adhoc_ans_sd_TTP-EA	-

The user can also click **Toggle Ladder Diagram** 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**

Table 3-1 Event Diagram Properties

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
Trace Match	IR Data, ER Data, IA Data, EA Data
Linked TTR	
ART Rule Match	IR Data

Table 3-1 (Cont.) Event Diagram Properties

Event Type	Event Scope
ART Rule Not Found	IR Data
PRT Rule Match	IR Data
PRT Rule Not Found	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
Diameter Request processing routine invoked	IR Data
Diameter Answer processing routine invoked	IR Data
U-SBR Query send	IR Data
Callback invoked	IR Data
Subroutine name not found	IR Data
Runtime error	IR Data
Debug message	IR Data
U-SBR Query Result Received	IR Data
U-SBR Query Send Failed	IR Data

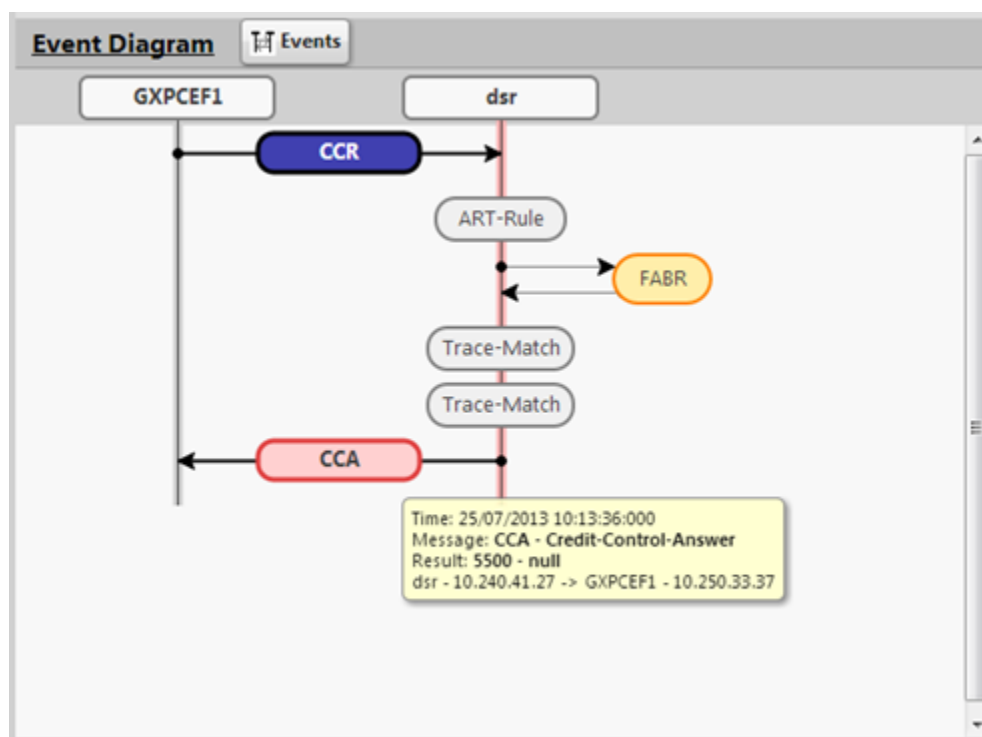
- **Transport Type** (TCP or SCTP for payload events only)
- **Connection Id** (The name of the connection defined in DSR)
- **Source Node** (<Node name> - <IP address> for payload events; IP is translated and node name is displayed if there is a record in Local Node or Peer Node reference data at DSR 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 the form of <Error Code> - <Error description>)
- **Application** (Diameter Application for payload events, empty for the rest)
- **Command Code** (Message command code in form of <Short name> - <Long name> for payload events)
- **Message Priority** (The numeric priority value from the priority services field in the diameter message)
- **DSR-DSR** (If the message transpired between two DSR nodes, then the column shows a YES value. If the message transpired between one DSR node and either a client (such as MME) or server (such as HSS), then the column shows a NO value. This value is required for N-IDIH to create a correct ladder diagram from the event list)

3.3.2.1 Ladder Diagram

The Ladder Diagram shows the TTR events in graphical form, providing an additional form of information shown in the TTR Event panel. Additionally, ProTrace will process and display Client Redirect events when received.

Figure 3-9 Ladder 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** to view events in tabular form, which also allows for a selected row to appear in the Diameter Full Decoding Panel.

[Table 3-2](#) defines how the TTR events are visualized in the ladder diagram:

Table 3-2 Ladder Diagram Visualization

Event Type	Event Scope	Event Diagram Visualization
Request Message Sent/Received	IR, ER	Blue bubble with arrow from source node to destination node
Answer Message Sent or Received with Success Result Code (RC < 3000)	IA, EA	Green bubble with arrow from source node to destination node
Answer Message Sent or Received with Success Result Code (RC >= 3000)	IA, EA	Red bubble with arrow from source node to destination node
Message Created	App Data	Gray bubble on DSR node
App Invoked	App	Orange bubble beside DSR node with arrows from DSR to and from Application bubble
App Result	App Data	App Result appends a text to the corresponding Application's tooltip
App Invocation Failed	IR Data, IA Data	App Invocation Failed makes the corresponding Application bubble red and appends text to its tooltip.
Trace Match	IR Data, ER Data, IA Data, EA Data	Gray bubble on DSR node
Linked TTR		No visualization
ART Rule Match	IR Data	Gray bubble on DSR node
ART Rule Not Match	IR Data	Red bubble on DSR node
PRT Rule Match	IR Data	Gray bubble on DSR node
PRT Rule Not Match	IR Data	Red bubble on DSR node
Unavailability Action	IR Data, IA Data	Unavailability Action makes the previous event bubble red.
Route List Selected	IR Data	Gray bubble on DSR node
Dest-Host Routing	IR Data	Gray bubble on DSR node
Alternate Implicit Routing		Alternate Implicit Routing makes previous metadata bubble red and appends a text in its tooltip.
Route Group Selected	IR Data	Gray bubble on DSR node
Mediation Rule Match	IR Data, ER Data, IA Data, EA Data	Gray bubble on DSR node
Request Rerouted	IR Data	Gray bubble on DSR node
Answer Timeout	IA	Arrow from source node to destination node
Answer Matching Failed	IA Data	Red bubble on DSR node
Address Resolution Match	App Data	Address Resolution Match appends a text to the corresponding Application bubble.
Routing Exception	App Data	Routing Exception appends a text to the corresponding Application bubble.
DP Query Sent	App Data	DP Query Sent appends a text to the corresponding Application bubble.
DP Response Received	App Data	DP Response Received appends a text to the corresponding Application bubble.

Table 3-2 (Cont.) Ladder Diagram Visualization

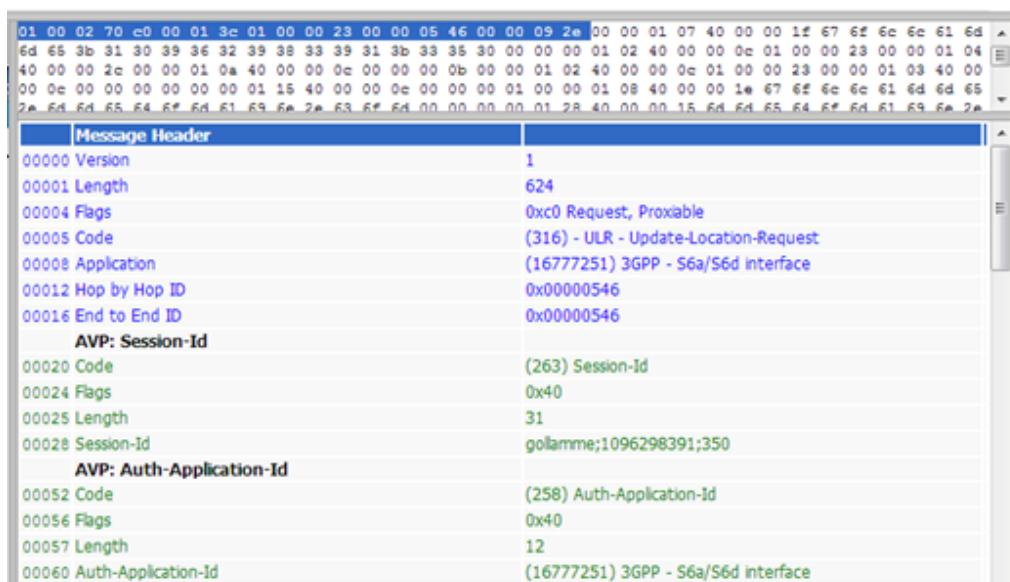
Event Type	Event Scope	Event Diagram Visualization
DP Query Failure	App Data	DP Query Failure appends a text to the corresponding Application bubble.
DP Response Timeout	App Data	DP Response Timeout appends a text to the corresponding Application bubble.
SBR Query Sent	App Data	SBR Query Sent appends a text to the corresponding Application bubble.
SBR Response Received	App Data	SBR Response Received appends a text to the corresponding Application bubble.
SBR Query Failure	App Data	SBR Query Failure appends a text to the corresponding Application bubble.
SBR Response Timeout	App Data	SBR Response Timeout appends a text to the corresponding Application bubble.
Message Copied	IA	MSG-Copied bubble appears on DSR node
Copied Message	IG (Internally Generated)	Copied-MSG bubble appears on DSR node
Message Copy Triggered	IR, ER	MC-Triggered bubble appears on DSR node
Request Redirected	IR Data	Gray bubble on DSR node
Diameter Request processing routine invoked	IR Data	Diameter Request processing routine invoked appends a text to the corresponding Application bubble.
Diameter Answer processing routine invoked	IR Data	Diameter Answer processing routine invoked appends a text to the corresponding Application bubble.
U-SBR Query send	IR Data	U-SBR Query appends a text to the corresponding Application bubble.
Callback invoked	IR Data	Callback invoked appends a text to the corresponding Application bubble.
Subroutine name not found	IR Data	Subroutine name not found appends a text to the corresponding Application bubble
Runtime error	IR Data	Runtime error appends a text to the corresponding Application bubble
Debug message	IR Data	Debug message appends a text to the corresponding Application bubble
U-SBR Query Result received	IR Data	U-SBR Query Result received appends a text to the corresponding Application bubble
U-SBR Query send failed	IR Data	U-SBR Query send Failed appends a text to the corresponding Application bubble

3.3.2.2 ProTrace 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 message.

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

Figure 3-10 ProTrace Full Decoding Panel



The detailed decoding list has certain columns:

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

Table 3-3 ProTrace 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

Table 3-3 (Cont.) ProTrace Full Decoding Panel

AVP Type	Display
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

3.3.2.3 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.

If a change is made to this dictionary file, the application server must be restarted 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.

AVP Example

```
<?xml version="1.0" encoding="UTF-8"?>
<dictionary>
  <vendor vendor-id="VF" code="12645" name="Vodafone" />
  <command code="316" short-name="UL" name="Update-Location" />
  <avp name="3GPP:3GPP-IMSI" display="3GPP-IMSI" code="1" vendor-
id="3GPP" type="UTF8String"/>
  <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>
  <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>
</dictionary>
```

3.3.2.3.1 Adding Custom AVPs

Simple AVP Tag Format

The format must be used to define new custom AVP:

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

where

- **name** must be a unique AVP identifier in the dictionary file, if the vendorId is present then the name should be preceded by vendor-id
- **display** is the text displayed for this AVP (usually the same as **name**)
- **vendor-id** 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 a predefined type:
 - OctetString
 - Integer32, Unsigned32, Integer64, Unsigned64
 - UTFString
 - IPAddress
 - TBCD
 - Enumerated
 - Grouped

Example:

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

Enumerated AVP Tag Format

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

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



```
. . .
</avp>
```

where

- **name**, **display**, **vendor-id**, **code**, and **type** are the same as in the case of simple AVP format
- **code** is the numeric value
- **name** is a text which is displayed in the full decoding window. If the **name** value is not defined, the decoder displays just the simple numeric **code** 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 XML tag format must be used to define new custom grouped AVP:

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

where

- **name**, **display**, **vendor-id**, **code**, and **type** are the same as in the case of simple AVP format
- **avp** contains the **ref** name, which must be the name of an existing AVP defined 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>
```

3.3.2.3.2 Adding Custom Commands

Command Tag Format

Custom commands are only required if there isn't a code previously defined in the default dictionary. The 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
- **short-name** is the text that appears in the ladder diagram events
- **name** is the text that appears in the full decoding of a message

Example:

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

3.3.2.3.3 Adding Vendors

Custom vendors are only required if there isn't a vendor previously defined in the default dictionary. Some vendors are already defined and can be used without defining them again:

Table 3-4 Vendors

Vendor ID	Vendor Code	Vendor
3GPP	10415	3GPP
3GPP2	5535	3GPP2
ATT	74	AT and T
ATTCCCE	2897	AT and T Capital Corp Ernest
ATTENS	9496	AT and T Enhanced Network services
ATTGNMC	2560	AT and T GNMC Amsterdam
ATTLINA	11976	AT and T Labs Intelligent Network analysis
ATTWireless	971	AT and T Wireless
BS	6431	Broadsoft
ER	193	Ericsson AB
ETSI	13019	ETSI
HP	11	Hewlett Packard
HW	2011	Huawei
IETF	0	IETF

Table 3-4 (Cont.) Vendors

Vendor ID	Vendor Code	Vendor
JuniperNetworks	1411	Juniper Networks
JuniperNetworksInc	2636	Juniper Networks Inc
Merit	61	Merit Networks
MTS	29732	MTS
MTSALLSTREAM	23398	MTS Allstream Inc
MTSSPA	18390	MTS SPA
Nokia	94	Nokia
ORACLE	111	ORACLE
ORANGEDK	3531	Orange DK
ORANGEJ	31908	Orange Jordan
ORANGENBV	27585	Orange Nederland BV
ORANGER	23320	Orange Romania SA
ORANGES	11365	Orange Slovakia
ORANGESUS	2083	Orange Services US
RivadaNetworks	44107	Rivada Networks
Sprint	1421	Sprint
SprintPCS	2792	Sprint PCS
Sun	42	Sun Microsystems
TKLC	323	Tekelec
USR	9086	US Robotics
Verizon	32902	Verizon
VerizonBusiness	25516	Verizon Business
VerizonCardOperator	23170	Verizon Card Operator
VerizonESG	14542	Verizon ESG
VerizonWireless	12951	Verizon Wireless
VF	12645	Vodafone

If the new vendor needs to be added, then the tag must appear in the custom AVP file:

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

Example:

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

where

- **vendor-id** is the vendor identified
- **code** is the vendor code

- **name** is the vendor name that appears in the full decoding of a message

Example:

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

3.3.2.3.4 Managing Custom AVPs

This section contains details necessary to add/modify custom AVPs and load them into the system.



Note:

General Unix/Linux knowledge is required for this section.

3.3.2.3.4.1 Login

This section describes the necessary steps to login to the application server and change to the correct dictionary for custom AVP.

1. Login or remote shell into the application as user **admusr**.

```
% ssh admusr@192.168.11.1
```

2. Change the user to **tekelec**

```
%sudo su - tekelec
```

3. Change the dictionary to custom AVP.

```
% cd diameter
```

3.3.2.3.4.2 Edit/Modify AVP File

This section describes the necessary steps to edit/modify the custom AVP file.

1. Login or remote shell into the application.

2. Copy example file to custom-avps.xml file

```
% cp custom-avps.xml.example custom-avps.xml
```

3. Edit custom AVP file.

```
% vi custom-avps.xml
```

3.3.2.3.4.3 Load AVP File

This section describes the necessary steps to load (install) the custom AVP file into the application server.

1. Login or remote shell into the application.

2. Load custom AVP file.

```
% ./xmlload -l custom-avps.xml
```

 **Note:**

Users must logout from the IDIH portal/system before changes can be recognized.

3.3.2.3.4.4 Unload AVP File

This section describes the necessary steps to unload (remove) the custom AVP file into the application server.

1. Login or remote shell into the application.
2. Unload custom AVP file.

```
% ./xmlload -d custom-avps.xml
```

3.3.3 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.

1. Click **Change Layout**.

The layout pop-up opens.

2. Select a **Layout**.

The page layout changes to match the user's choice.

 **Note:**

This new layout will now be the default layout for this session type.

3.3.4 IDIH Trace Statistics

IDIH gathers statistics about transactions for active traces. The statistics have various 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 five 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 double 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 double 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 **Refresh Statistics**.

The user also can return to the [TDR Panel Toolbar](#) by clicking **Return to Traces**.