Oracle® Communications Performance Intelligence Center

Feature Guide

Release 10.2.1

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ORACLE®

Oracle® Communications Performance Intelligence Center Feature Guide, Release 10.2.1

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Refer to Appendix section for instructions on accessing My Oracle Support and Oracle Help Center.

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1 INTRODUCING PERFORMANCE INTELLIGENCE CENTER

1.1 KEY BENEFITS

In a tough competive landscape CSPs need to implement new technologies while optimizing their cost. LTE is in their radar screen since a while now, but it is deployed based on economical and regulatory drivers and requires still a lot of efforts. Frequently LTE coverage is partial and it is needed to rely still on 3G when not 2G. Therefore network complexity is growing while price pressure is higher than ever.

In order to drive securely their daily tasks and make the right decisions CSPs need to thoroughly oversee their core network, with flexible tools delivering visibility and allowing to smoothly transition services from 3G/2G to LTE.

With no doubts there is a high value in the data that CSPs are managing and signaling can be monetized. From that point of view, a monitoring solution that can flexibly feed external application becomes a new applications enabler and helps to generate revenue differently than from traditional subscriptions.

1.2 ORACLE'S SOLUTION

Oracle Communications Performance Intelligence Center is a comprehensive suite of applications, which provides an in-depth understanding of the network and equips wireline and wireless CSPs with the tools required to make informed business investment and cost reduction decisions.

Performance Intelligence Center provides a set of tools needed to capture network traffic data and convert it into useful business intelligence for troubleshooting, managing traffic, services and QoS metrics in a flexible manner.

Performance Intelligence Center provides reliable real-time or historic information based on the most important source of service provider revenue – network signaling traffic. Performance Intelligence Center collects signaling data extracted from the network using carrier-grade platforms dedicated to this purpose. This data is correlated and processed to provide network, service, and subscriber information -- information that is critical to optimize revenue, increase profitability, reduce churn, deploy new services, and manage network migration.

Performance Intelligence Center is designed to meet the needs of many functions within the CSP's organization, including network operations, customer care, troubleshooting, roaming, marketing, revenue assurance, fraud, finance, business development, and security.

Performance Intelligence Center is network equipment vendor independent and can be deployed basically on any type of network, (GSM, CDMA, 3G /LTE/EPC, IMS) regardless of the core network vendor. Performance Intelligence Center is a non-intrusive monitoring system, and as such does not use any resources from network elements.

Service providers use Performance Intelligence Center to manage interconnection agreements, increase roaming revenue, ensure end-to-end QoS across the network, detect fraud, analyze subscriber behavior, and examine service usage. Moreover Performance Intelligence Center is of great help in supporting existing applications such as fraud management, interconnect accounting, or assessing service level agreements with key interconnect partners or high value accounts. Support of above services is being provided in a seamless manner across customer's wireline VoIP networks and wireless LTE, IMS and 3G facilities.

The Performance Intelligence Center set of applications helps leverage raw network traffic data into business/service-oriented triggers such as key performance indicators (KPIs), trends, alarms and

statistics. The Performance Intelligence Center platform is built using open interfaces and a Web-based graphical user interface, ensuring ease of use.

Performance Intelligence Center features extended integration with the EAGLE, offering an industry unique feature , made of a carrier grade probeless signaling data acquisition module. Performance Intelligence Center can also be deployed as a standalone solution with probes, or even in a mixed mode , which reduces operational expenses and allows CSPs to scale more quickly.

The Performance Intelligence Center platform supports major industry protocols such as,

- SS7/SIGTRAN (ISUP, MAP, IS41, INAP, CAP…),
- VoIP/NGN (SIP, H.323, H.248, MGCP…),
- GPRS (Gn, Gi, Gb…) UMTS (IuPS, IuCS)
- SAE/LTE and Diameter (Diameter interfaces , GTPv2, S1C, VoLTE…).

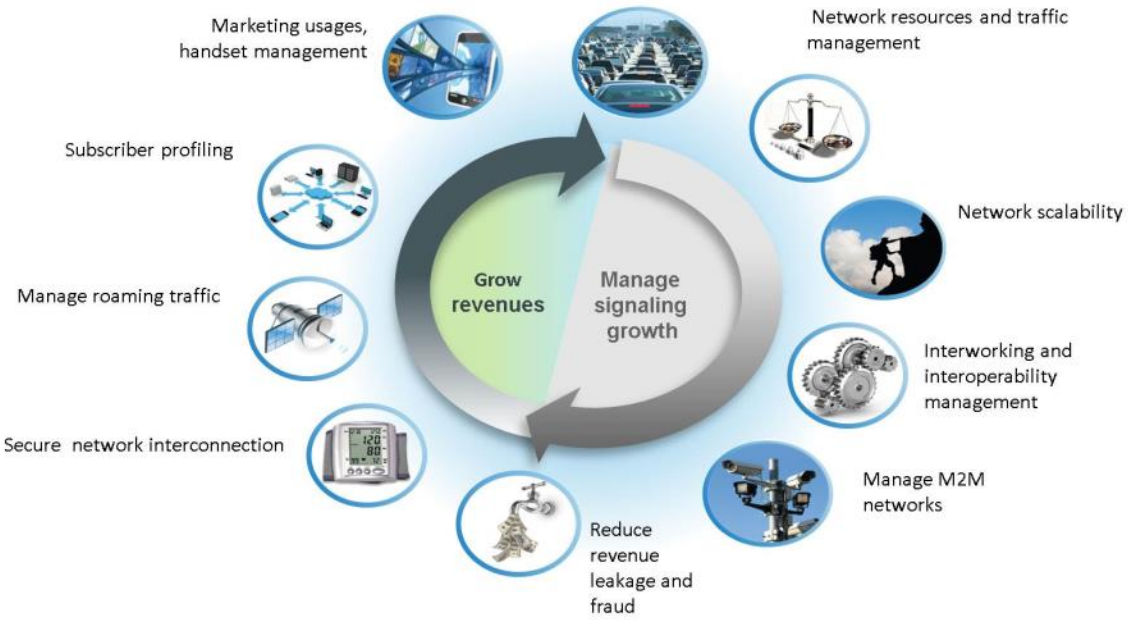

Figure 1 – Oracle Communications Performance Intelligence Center

Focused on performance management, Performance Intelligence Center provides applications to address troubleshooting, surveillance, and the creation of key performance indicators (KPIs).

2 PERFORMANCE INTELLIGENCE CENTER PRODUCT OVERVIEW

The architecture has 3 building blocks: Data acquisition and collection, mediation and applications. Data acquisition can be deployed into the service providers network using signaling interconnect points. The correlation and storage and applications platform are a powerful application processing engine enabling the user to derive "visibility" into traffic transiting their network.

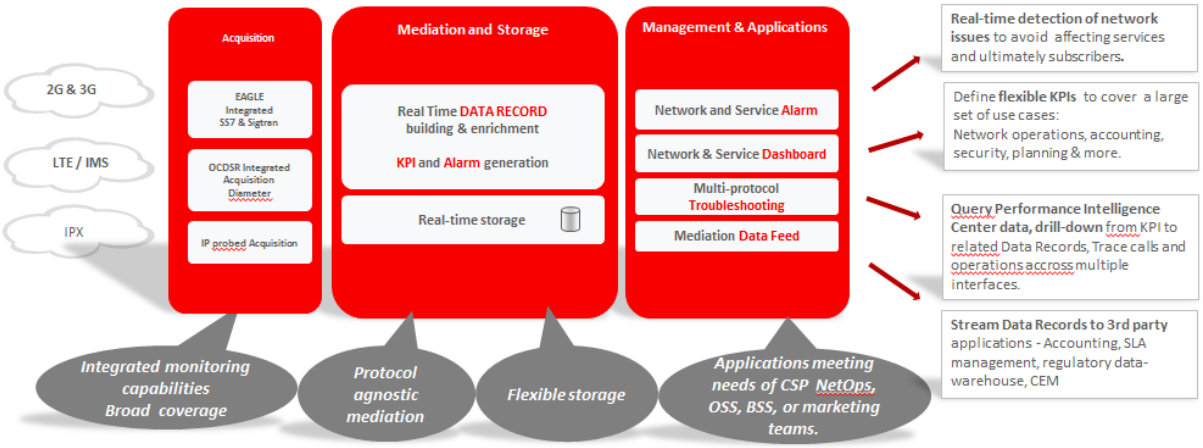

Figure 2 - Performance Intelligence Center architecture

2.1 DATA ACQUISITION LAYER

It is this layer of the architecture that collects the signaling data from across a network. Equipment is deployed that adapts to the customer network physical interface.

The main functions at this layer are:

- Network adaptation
- Frame capture
- Frame time stamping
- Frame filtering
- Frame routing

Two types of data acquisition is supported with Performance Intelligence Center:

- probeless meaning integrated with Core Service nodes as EAGLE
- stand-alone probe.

2.1.1 EAGLE Integrated Acquisition

The Performance Intelligence Center Integrated Acquisition receives the messages and events from the EAGLE and serves as a local processor for the acquisition and short term buffering of collected traffic. The Performance Intelligence Center Integrated Acquisition provides reliable connectivity to all links supported on the EAGLE. Through the interface between the Eagle and the Performance Intelligence Center Integrated Acquisition server, the Eagle configuration information is communicated to Performance Intelligence Center system for simplified provisioning.

2.1.2 Diameter Signaling Router Integrated Acquisition

Oracle Communications Diameter Signaling Router is a comprehensive platform that centralizes routing, traffic management and load balancing, creating an architecture that enables IMS and LTE networks to grow incrementally to support increasing service and traffic demands.

Performance Intelligence Center features a Diameter monitoring solution integrated to Diameter Signaling Router. This integrated solution provides compelling advantages as:

- It presents automatic link configuration of Performance Intelligence Center thanks to configuration automatically forwarded by Diameter Signaling Router to Performance Intelligence Center management and configuration application, avoiding time consuming manual configuration in Performance Intelligence Center.
- It provides enriched data records, on top of the host name (e.g. HSS) captured from the signaling. It enables enhanced troubleshooting with peer node name details showing up in Multi-protocol Troubleshooting application.

Diameter Signaling Router Integrated Acquisition is based on standalone Acquisition probe as described in §2.1.3.

This configuration is fully dedicated to Diameter Signaling Router monitoring and only Diameter Signaling Router Diameter traffic can be monitored by Diameter Signaling Router Integrated Acquisition probe.

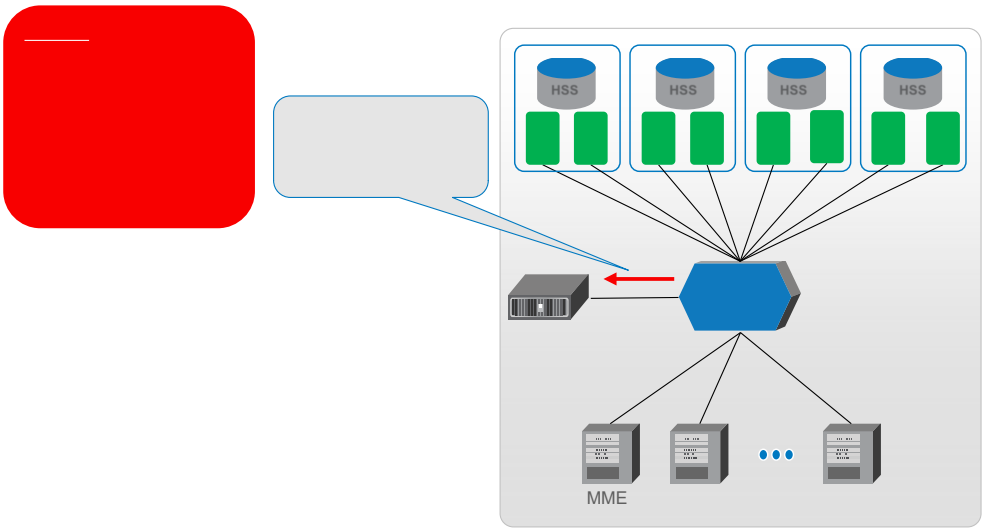

Figure 3 – Diameter Signaling Router Integrated Acquisition

2.1.3 Stand-alone Acquisition

Stand-alone Acquisition does support data capture at networks not currently using EAGLE, to capture at IP acquisition points. It requires a passive (non intrusive) probe and is being used to monitor IP based traffic including SIGTRAN, GPRS/UMTS/LTE traffic , Gb, Iu over IP and SIP.

For Ethernet, Performance Intelligence Center Probed Acquisition supports 4x 1GE ports or 4x 10GE ports. All ports are SFP+ compatible. SFP modules are available for 1GE/10GE Base-T Ethernet, 1000 BASE-SX, 1000BASE-LX, 10G BASE-SR, and 10G BASE-LR.

Stand-alone acquisition is compatible with TAPs and port mirroring.

T1/E1 legacy SS7 links are available through a SIGTRAN converter and Gb over E1 through GboIP converter.

2.2 MEDIATION LAYER

The correlation and storage subsystem contains a library of signaling XDR protocol builders which correlate in real time signaling messages into XDR depending on protocol. Key performance indicators (KPI) can be defined by the user and are then processed in this portion of the system. These KPI are then provided to the customer in reports and alarms that can be triggered based on thresholds. Performance Intelligence Center Mediation also manages the storage of raw PDU, XDR and KPI.

For data retention, the XDR storage can support up to 365 days and PDU storage duration is up to 100 days to insure long-term troubleshooting and call analysis. As far as KPI storage is concerned, duration goes up to 2 years, for extended analysis.

It is also possible as an option on a per mediation site basis to store xDR and/or PDU on Customer IT Storage Infrastructure (Cloud). In that case, limits in xDR/PDU/KPI storage duration is only limited by the storage space allocated by the Customer.

Unlike Performance Intelligence Center internal storage whose access is strictly limited to Performance Intelligence Center Users and Applications, Databases in Customer IT Storage Infrastructure can be queried by non Performance Intelligence Center Users and Applications according to access and processing resources allocated by the Customer.

2.3 APPLICATIONS LAYER

Performance Intelligence Center has a variety of applications which can be combined together for a single point system with multiple business solutions. The cornerstone element is Performance Intelligence Center Management which enables users to access applications with a web browser interface. In addition, Performance Intelligence Center system maintenance and data resources are centralized for simplified administration.

A basic system would consist of:

- Centralized configuration management to configure the Performance Intelligence Center system
- Security application to configure users and profiles to control access to applications and data
- Performance Intelligence Center Multiprotocol Troubleshooting as Performance Intelligence Center XDR viewer: Single/multi protocol and single/multi session filtering and decode
- Performance Intelligence Center Management KPI application: Open KPI generation for ultimate visibility into traffic and resources

- Self-surveillance applications by means of system alarming.

The other applications listed below are optional applications:

- Performance Intelligence Center SS7 Management: Near real-time SS7 and SIGTRAN network monitoring with stats and state information
- Performance Intelligence Center Multiprotocol Troubleshooting call tracer: multi-protocol, multi-network message trace and decode
- Performance Intelligence Center Network and Service Alarm: alarm definition and reporting for Performance Intelligence Center and network
- Performance Intelligence Center Network and Service Alarm forward: send alarms to external fault management platform or email addresses
- Performance Intelligence Center Dashboard: graphical display of KPIs; dashboard creation for output of the Performance Intelligence Center Management KPI application

Data Export

- Generic export modules used to export XDR/KPI records via NFS or Oracle.

2.4 RELIABILITY

The Performance Intelligence Center is architected in such a way that if Performance Intelligence Center Management fails, it will not impact the function of the acquisition and mediation layers of the system. Each component of acquisition and mediation layer has its own configuration data replicated locally from the master database.

Events that were being managed by the failed instance will be re-processed when the instance restarts. However, events being processed by the failed instance will be discarded if the alarm has been terminated otherwise they will be managed by the failed instance when it re-starts.

For the Performance Intelligence Center Mediation, optional redundancy mechanisms with automatic server failover are provided. This will assure no loss of insertion data in the case of server failure

2.5 BACKUP CAPABILITIES

The Performance Intelligence Center management provides the ability to backup the following:

- All configuration data for Performance Intelligence Center Integrated or stand-alone Acquisition and Performance Intelligence Center Mediation
- All configuration and network topology data associated with all applications
- Application configuration data (Performance Intelligence Center Dashboard, Performance Intelligence Center network and service alarm

The database backup is performed on the Performance Intelligence Center Management storage array. This backup is scheduled on a daily basis. The last 7 backups are maintained for restore possibility.

There is no XDR/PDU backup/restore. Only alternative is to use export to an external Oracle data warehouse or to use xDR/PDU storage on Customer IT Storage Infrastructure. Backup restore is, in these cases, under the responsibility of the customer. Only XDRs are concerned, no PDU can be

backed up by this workaround solution (except in case PDU storage is done on Customer IT Storage Infrastructure).

2.6 MONITORED INTERFACES

Performance Intelligence Center supports a very broad array of protocols. Performance Intelligence Center is protocol agnostic. It covers the needs for carriers operating networks that are wireless (CDMA/TDMA, GSM, LTE/EPS, IMS), wire line, circuit, or packet based, or a combination of these. Adding new protocols to be supported is accomplished through the addition of protocol builders via a plug-in to cover the new interfaces to monitor, and to adapt platform HW size to process and store added traffic .

This enables the following situations to be handled:

- Monitoring of a CSP's entire SS7 network
- Monitoring on both SS7 and SIP sides of a VoIP gateway used for interconnection with a long-distance VoIP carrier
- Monitoring 2G, 3G and 4G network signaling
- Monitoring VoLTE

The advantages of this architecture are:

- A single system
- Same IP probe as for the widely-deployed SS7, GPRS, UMTS, LTE & VoIP solutions
- No specific training required for IP: the same applications as for SS7 are used
- Ability to easily set traffic statistics & QoS indicators whatever the protocol on the interconnection

The following sections will go through the network collection points available on Performance Intelligence Center. For a complete list of supported protocols please see Appendix B List of supported Protocols.

2.6.1 PSTN Networks

For the TDM world the key protocols supported are the following:

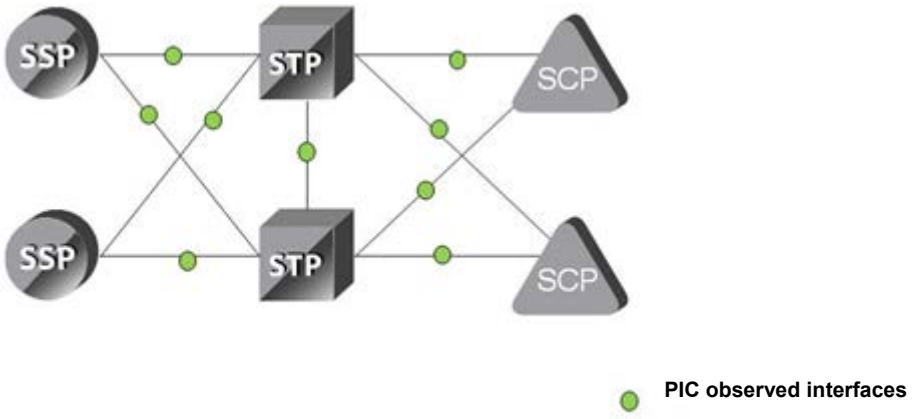

Figure 4 - PSTN monitored interfaces

2.6.2 NGN & VoIP Networks

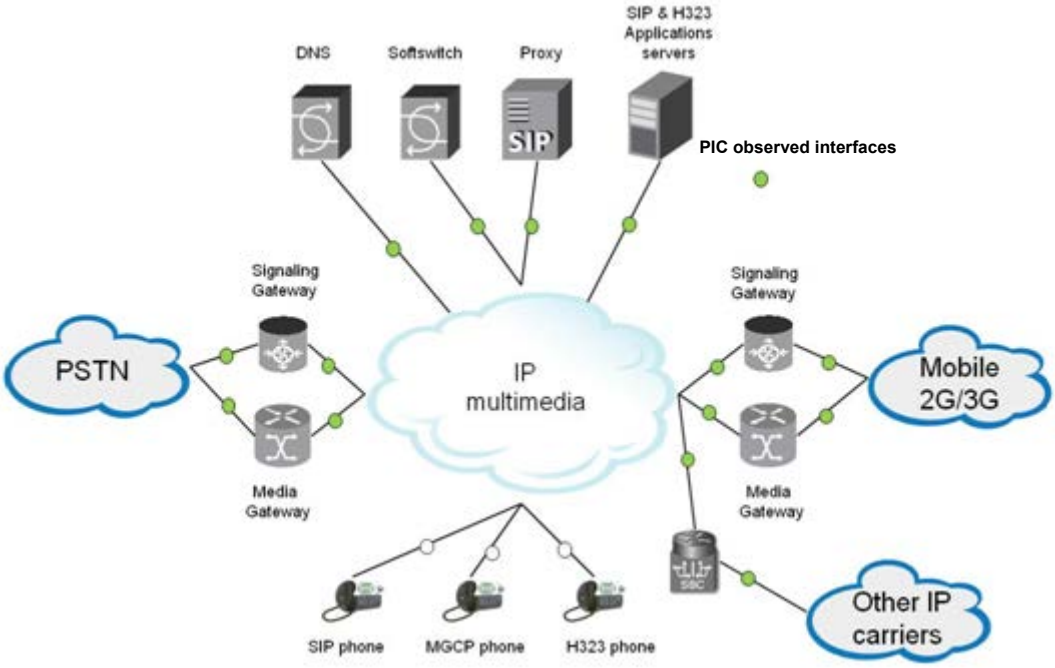

Figure 5 - NGN and VoIP monitored interfaces

2.6.3 GSM/GPRS/3G Networks

The diagram below shows the different interfaces supported for GSM/GPRS/3G networks:

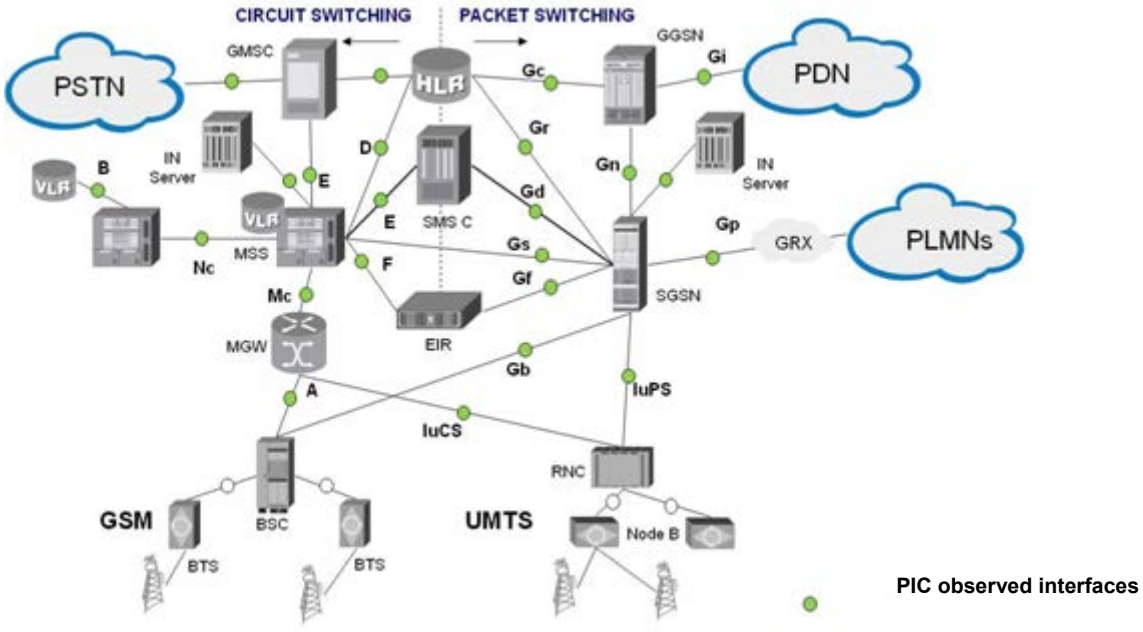

Figure 6 - GSM/GPRS/3G monitored interfaces

This section presents the benefits of monitoring the interfaces supported by Performance Intelligence Center.

A interface

Degradation can be noticed by subscribers due to mobility, handover, localization and radio problems (for example). Some air interface problems are also easily detected without a need to install probes at all the numerous Abis interfaces.

This interface also carries SMS & USSD information.

B interface

This interface is used to analyze efficiency of VLR management of subscriber mobility.

C interface

This interface is used to analyze efficiency of HLR management of subscriber mobility.

D interface

This interface is used to analyze efficiency of HLR management of subscriber mobility.

E interface

This interface is used to analyze SMS and handover efficiency when a user moves from one MSC to another.

F interface

Handset identification efficiency analysis can be monitored at this interface.

G interface

Location area update procedures data exchanged between VLRs are monitored when using standard MAP protocol.

J interface

Efficiency on user services exchanged between SCP and HLR can be performed at this interface.

Mc interface

Mc is of great interest to be monitored as it gathers information on RAN 2G and 3G interfaces with core network in addition to protocol between MSC server and MGW. Protocols encountered here are BSSAP, RANAP, H.248, Q.931/IUA.

Nc interface

On this interface we will find typically BICC, SIPT/I protocol managing calls between MGWs in the network.

Gb Interface

It provides information on:

- Data transport network availability
- Routing and QoS: circuit management, paging, radio status, flow control, flush LL, LLC discard…
- Mobility management efficiency: attach, detach, RA update, PTMSI reallocation, authentication/ciphering…
- Session management efficiency: activation, deactivation, modify PDP context, SMS…

Iu-PS and Iu-CS interfaces over IP

It enables observation of the following information:

- RNC relocation, RAB management, paging, security…
- Call control – call setup, release…
- Mobility management – attach, detach, RA update, LA update…
- Session management – PDP context activation, deactivation…..
- SMS traffic efficiency
- USSD traffic efficiency

Gn interface

GPRS/UMTS PDP Context management and related QoS

Gp interface

The Gp interface presents the data flow and session management interface with other PLMNs for data roaming in and out.

The same analysis as the one carried out on the Gn interface can be performed.

Gi interface

Radius protocol traffic for authorization and authentication and DHCP for IP address allocation can be observed on Gi interface.

Gr interface (GPRS/UMTS)

This interface allows ciphering parameters capture to decode ciphered Gb and also monitoring of major procedures such as location update, authentication….

Gs interface (GPRS/UMTS)

Gs interface can be used in some cases for efficiency management of the location information and paging related to mobiles that are attached to both GPRS and GSM circuit networks.

Gd interface (GPRS/MAP)

Interface allowing SMS traffic QoS measurement.

Gf interface (GPRS/UMTS)

Interface for handset authentication efficiency measurement.

Gy interface (GPRS/UMTS)

Credit control interface between GGSN and OCS. Enables to control and to trace requested, granted and used service units.

IN/CAMEL interface (GSM/GPRS/UMTS)

Interface for IN server efficiency management (essentially for prepaid and hot billing monitoring)

2.6.4 CDMA Networks

The diagram below shows the different interfaces supported for CDMA networks:

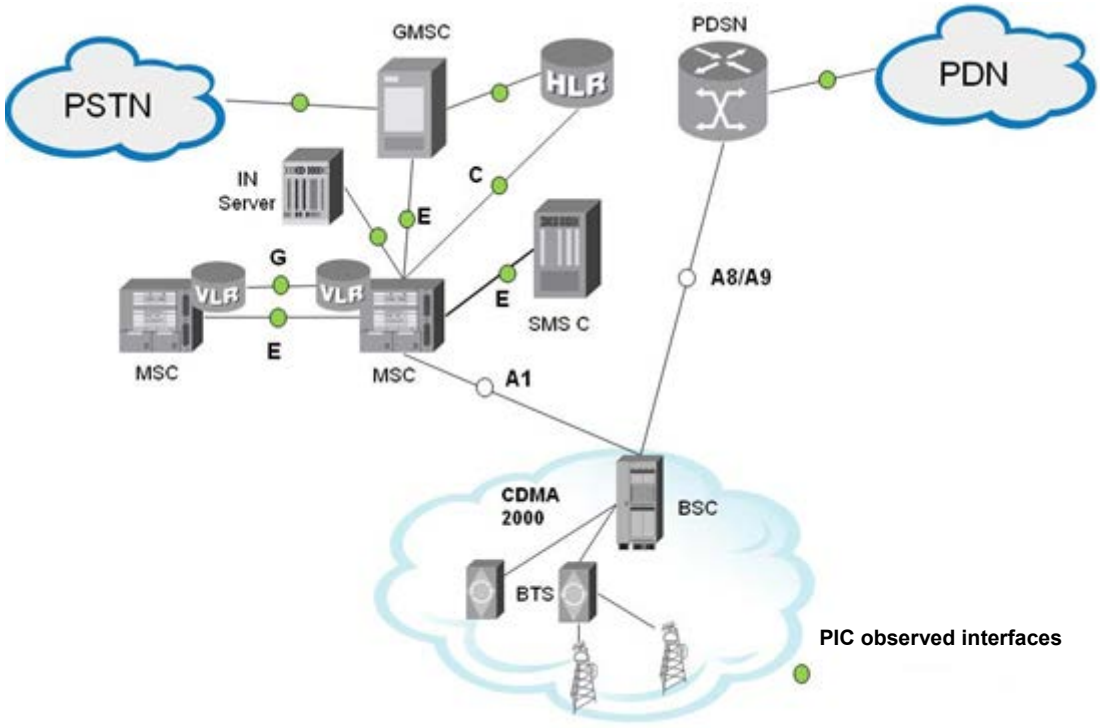

Figure 7 - CDMA monitored interfaces

2.6.5 IMS Networks

The diagram below shows the different interfaces supported for IMS networks:

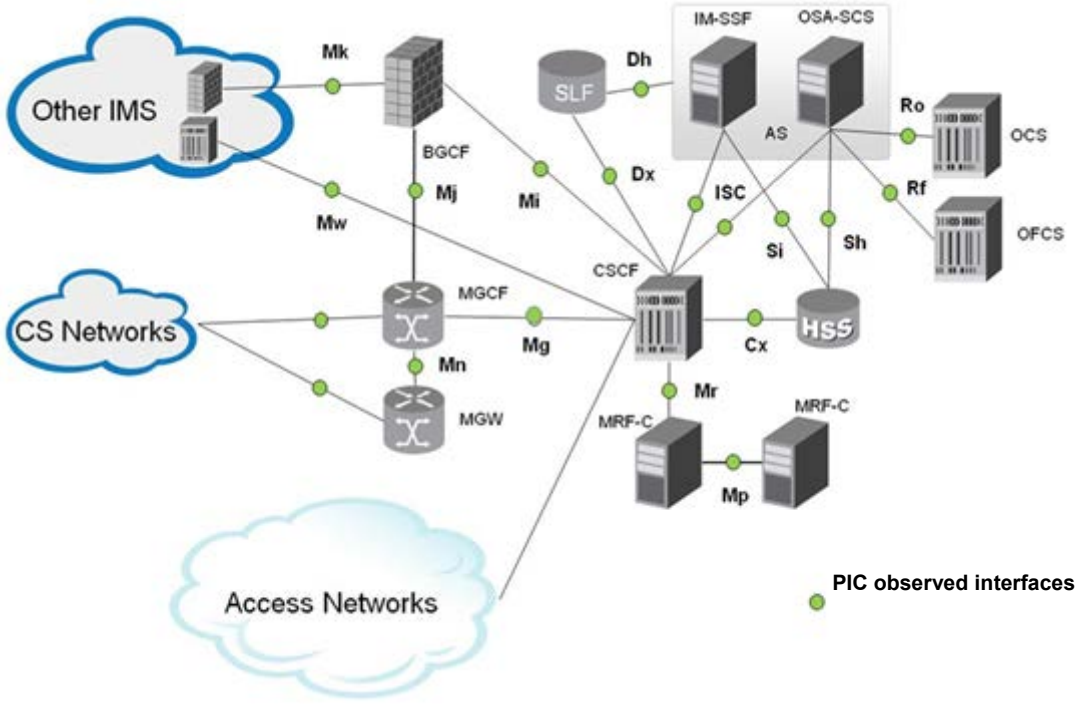

Figure 8 - IMS monitored interfaces

2.6.6 LTE/SAE Networks

The diagram below shows the different interfaces supported for LTE/SAE networks:

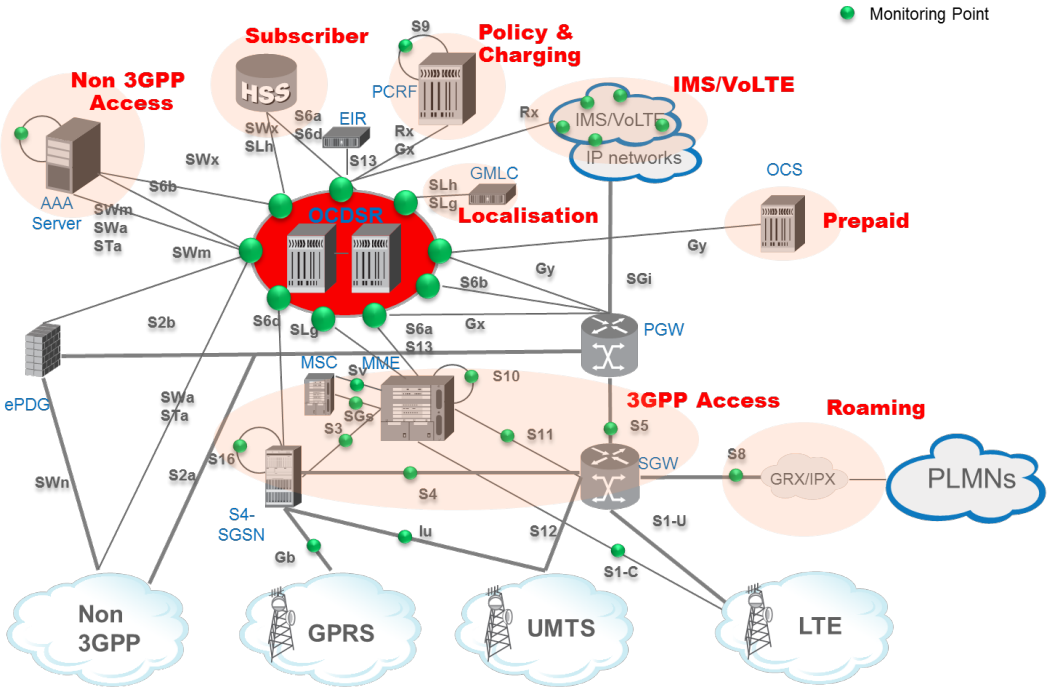

Figure 9 - LTE/SAE monitored interfaces

3GPP ACCESS

S1-C interface non cyphered interface

S1-C is a RAN fundamental interface for monitoring as it provides information on:

- Inter MME handover
- ERAB (establishment, modification, release)
- NAS EMM: mobility management (attach, detach, tracking area update, service request)
- NAS ESM: default/dedicated bearer context activation, modification, deactivation; PDN connect/disconnect request by UE, UE requested bearer resource allocation/modification

GTPv2 C – Tunnel management (S4, S11, S5, S8 interfaces)

GTPv2C tunnel management is dedicated to mainly:

- PDN sessions-default bearer management (create/modify/delete session)
- Dedicated bearer management (create, update, delete)
- UE initiated activate/deactivate bearer resource command
-

GTPv2 C – Mobility Management (S3, S10, S16 interfaces)

GTPv2C is dedicated to mainly:

- Forward relocation (handover, relocation, SRVCC)
- MM/EPS bearers context transfer
- UE identification transfer
- MME/SGSN detach coordination

Among others, monitoring this interface enables to trace all the traffic of a mobile including inter-technology handover, which is very frequent in mobile 4G network and is a big potential source of QoE (Quality of Experience) degradation.

SGs interface

SGs is a critical interface enabling an LTE mobile to setup/receive a call through CSFB (Circuit Switched Fallback) mechanism by the time VoLTE is used by the network.

Sv interface

Sv is a key interface in VoLTE between MME and MSS assuring inter-RAT handover within the critical SRVCC procedure (Single Radio Voice Call Continuity) during an established call. Sv interface monitoring enables to get a full overview of PS to CS and CS to PS handover and IMS session transfer requested further to an SRVCC procedure.

SUBSCRIBER

S6 interface

S6 interface provides information on:

- Location management (update/cancel location)
- Subscriber data
- Authentication

S13 interface

S13 interface is used for tracking stolen handsets

POLICY AND CHARGING

Gy interface

Credit Control interface between GGSN/PGW and OCS. Enables to control and to trace efficiency of request, granted and used service units.
Monitoring this interface provides useful information about credit control process in a multi-service environment.

Gx interface

Gx interface between GGSN/PGW and PCRF is a key interface for flow based charging.
Monitoring Gx provides information on the following processes:

- PGW requests PCC rules from PCRF
- PCRF forwards a PCC rule to PGW
- PGW forwards events to PCRF (e.g. RAT change, end of subscriber credit…)

Rx interface

Rx interface supports the QoS and media resources reservation/modification in VoLTE from IMS network to access network.

ROAMING

S8 interface

S8 interface transports user data in roaming in/out situation. S8-C provides QoS information on PDN session management (create/modify/delete session) and dedicated bearer management (create, update, delete) for roaming IN and OUT.

S9 interface

This interface is the companion interface of Gx interface, supporting monitoring of business sensitive roaming traffic . This interface is required to exchange policy and charging information in roaming situation, between 2 CSPs. Monitoring this interface delivers added value to service providers in that it enables to trace policy and charging information exchanged between the visited network and the home network.

LOCATION SERVICE

SLg and SLh interfaces

Monitoring GMLC (Gateway Mobile Location Center) server interface: SLg between MME and GMLC and SLh between GMLC and HSS/HLR.

NON 3GPP ACCESS

Monitoring AAA server

AAA server is a key service node to deliver access to 3GPP network from WiFi including VoWiFi with the following interfaces relevant for monitoring:

- **SWa** (untrusted) : mobile authentication & authorization
- **STa** (trusted) : mobile authentication & authorization
- **SWm** (untrusted): tunnel authentication and authorization.
- **SWx** : Mobile authentication & authorization through HSS
- **S6b**: PGW address information to AAA server

2.6.7 VoLTE

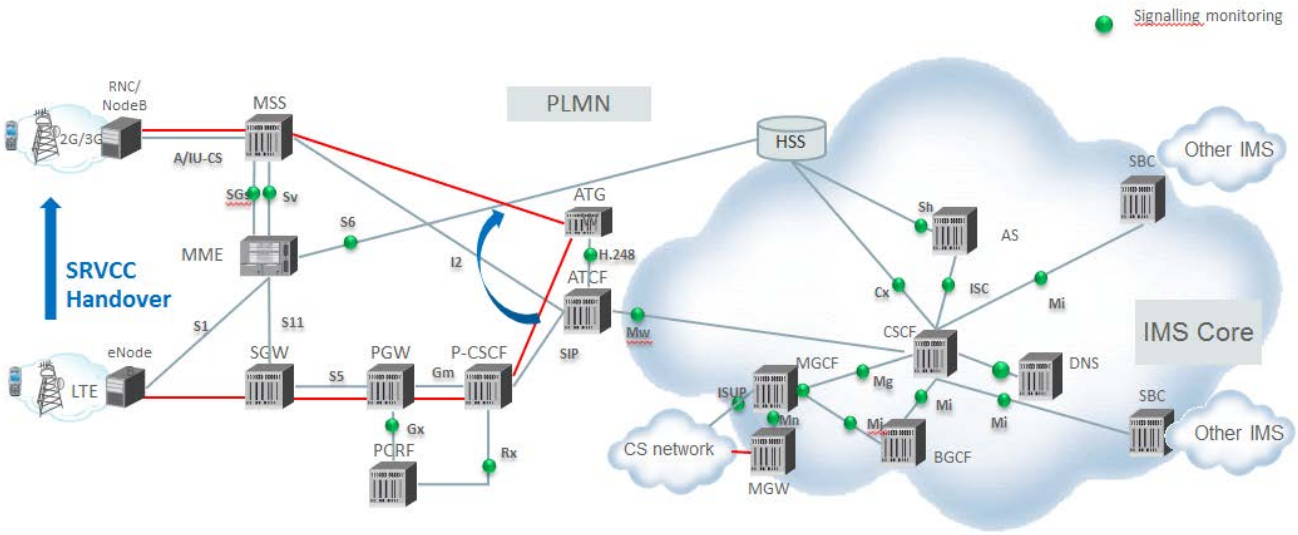

Figure 10 – VoLTE main interfaces

Performance Intelligence Center system is able to monitor VoLTE network end to end through related interfaces as depicted in figure 10. See details on each type of interfaces in the above sections.

3 DETAILED TECHNICAL DESCRIPTION

The Performance Intelligence Center system is comprised of a data acquisition layer to gather the messaging traversing the network, a data mediation/storage component that correlates in real time each message based on the associated protocol, a storage and key performance indicators processing component to store the various data pieces including any customer defined KPI, and finally the applications.

Once deployed the Performance Intelligence Center platform can be utilized by many departments to cover different needs and can host a variety of applications. Regardless of the protocols being monitored, most of the applications work the same way.

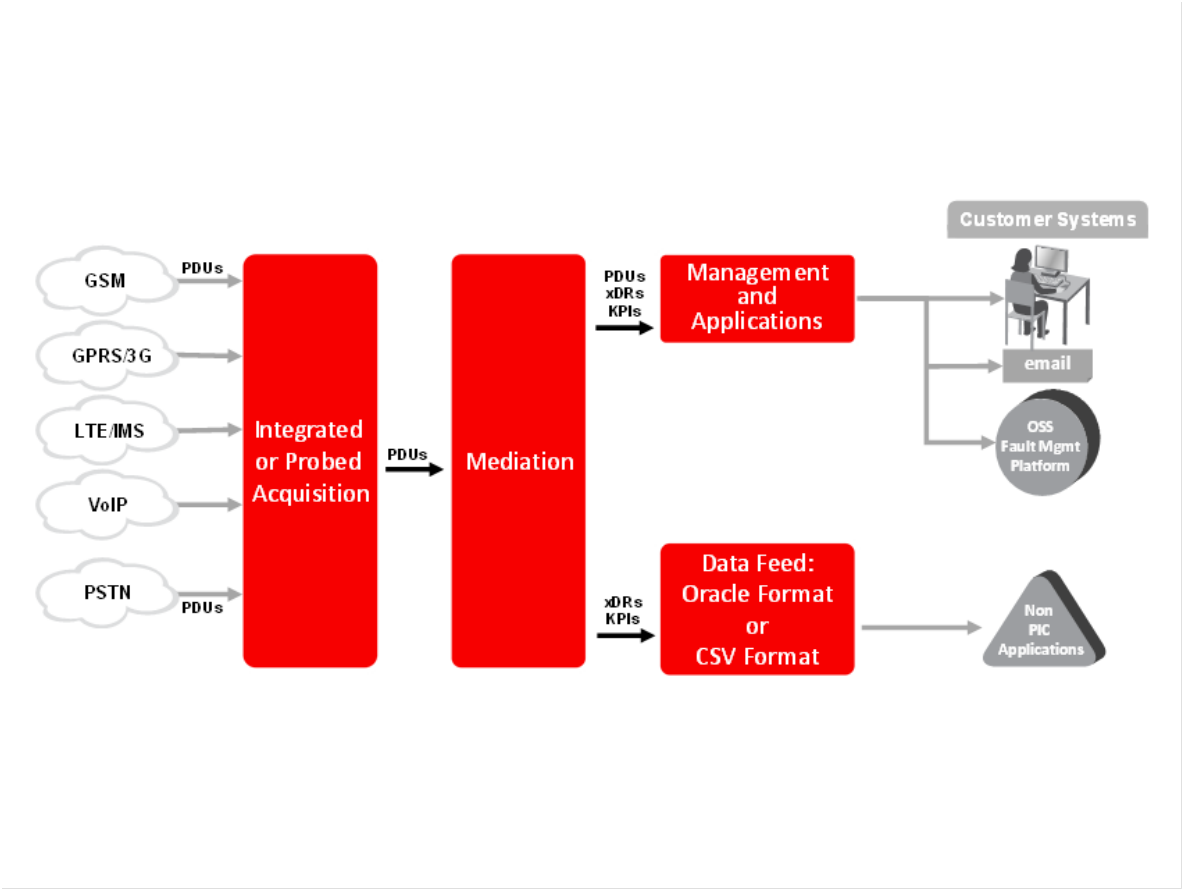

Figure 11 - Performance Intelligence Center building blocks

3.1 PERFORMANCE INTELLIGENCE CENTER MANAGEMENT

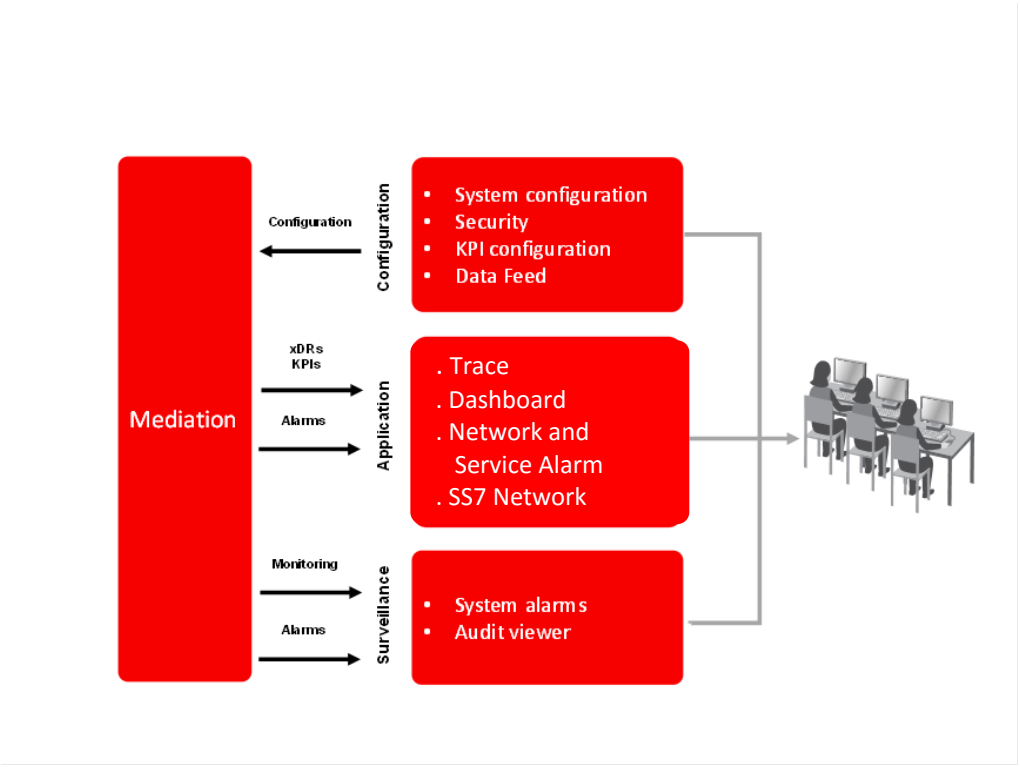

Figure 12 - Performance Intelligence Center Management applications

3.1.1 Performance Intelligence Center Management framework

Today's enterprises gain competitive advantage by quickly deploying applications that provide unique business services. Business applications must scale complete 24 x 7, enterprise-wide services, accessible by a number of clients simultaneously.

3.1.1.1 OVERVIEW

Performance Intelligence Center Management forms the core of a wide range of applications offered by Oracle.

Performance Intelligence Center Management manages the configuration of a Performance Intelligence Center system. This allows a centralized configuration and does not need to be entered in multiple locations.

NTP provides system time synchronization between all elements of Performance Intelligence Center. Performance Intelligence Center Management supports NTP synchronization from external NTP server.

3.1.1.2 MAJOR BENEFITS

Web-based GUIs (Graphical User Interfaces)

- No installation on client workstation
- Anyone with access privileges can access the applications via URL

- Highly scalable

Reduced cost of maintenance

- Centralized configuration
- Consistency guaranteed across the applications as they all utilize the same source for their data
- Import configuration using csv files

All elements and applications look to Performance Intelligence Center Management for their configuration, i.e. the data acquisition layer and the mediation layer.

- Reduced time and cost of deployment
- Easily administered (central administration and monitoring)

Performance Intelligence Center provides a set of system alarms that can be viewed by the user in the system alarm tool that is provided as part of the base Performance Intelligence Center Management.

Performance Intelligence Center system self-surveillance is provided via system alarm management application.

Secured and highly configurable access to features and data

- Authentication: verification of users' identities
- Authorization: access control to resources and applications
- Confidentiality: privacy to protect sensitive data

Performance Intelligence Center Management Server can also be virtualized, using VMware or KVM hypervisor (see section 3.6).

3.1.2 Performance Intelligence Center Management Base Configuration Features

3.1.2.1 CENTRALIZED CONFIGURATION

The centralized configuration application is used to configure the Performance Intelligence Center system. From a single location you can configure the complete system in a very efficient way. The configuration application manages a central database containing all configuration information. Configuration information can be separated in two parts:

- data that all applications can utilize like the network topology
- configuration dedicated for frames flows to XDR generation and storage.

The central database avoids unnecessary duplication of the configuration. The data consistency is guaranteed by the use of one single data model in one place

The configuration data is stored in an Oracle database with all standard features associated to standard database: export, backup, etc.

Performance Intelligence Center EAGLE, Diameter Signaling Router Integrated Acquisition, Performance Intelligence Center Probed Acquisition, and Performance Intelligence Center Mediation synch-up from the central database simplifying the data recovery and upgrades.

Note: management and administration of the Operation Monitor probe and Operation Monitor Mediation Engine is performed through Operation Monitor Management Application, independently from Performance Intelligence Center.

The central configuration is integrated with the Performance Intelligence Center Management platform. It has a web based graphical user interface and provides a strong security layer while access to the configuration is simplified.

Using a browsing tree on the left pane in addition to perspectives for different aspects of the configuration task makes it easy to configure the Performance Intelligence Center system.

The central configuration supports the import of configuration data using csv files.

The configuration consists in defining the PDU or IP frame filtering and routing from the acquisition to the correlation function of the mediation layer up to the storage.

It is also the definition of network views which allow the monitored network to be zoned logically. It can be based on geographical locations, partners, customers, etc. They are used by next-generation applications like the web-based Performance Intelligence Center Multiprotocol Troubleshooting. They support hierarchy. That is, a network view can contain other network views

The user can create Network Views for:

- Sessions: grouping of multi-protocol XDR sessions
- Links: grouping of links (e.g. SS7 linksets or Gb links)

3.1.2.2 SECURITY

Performance Intelligence Center Management offers a highly configurable security policy to ensure that data and applications are accessed only by the users that have access privileges. The security application is there to configure the user's profiles. A profile is a convenient way to assign roles to users. Roles are divided in two categories:

- Feature access roles to control access to features (fixed and cannot be changed)
- Privacy roles to control access to data (roles can be added to match any organization)

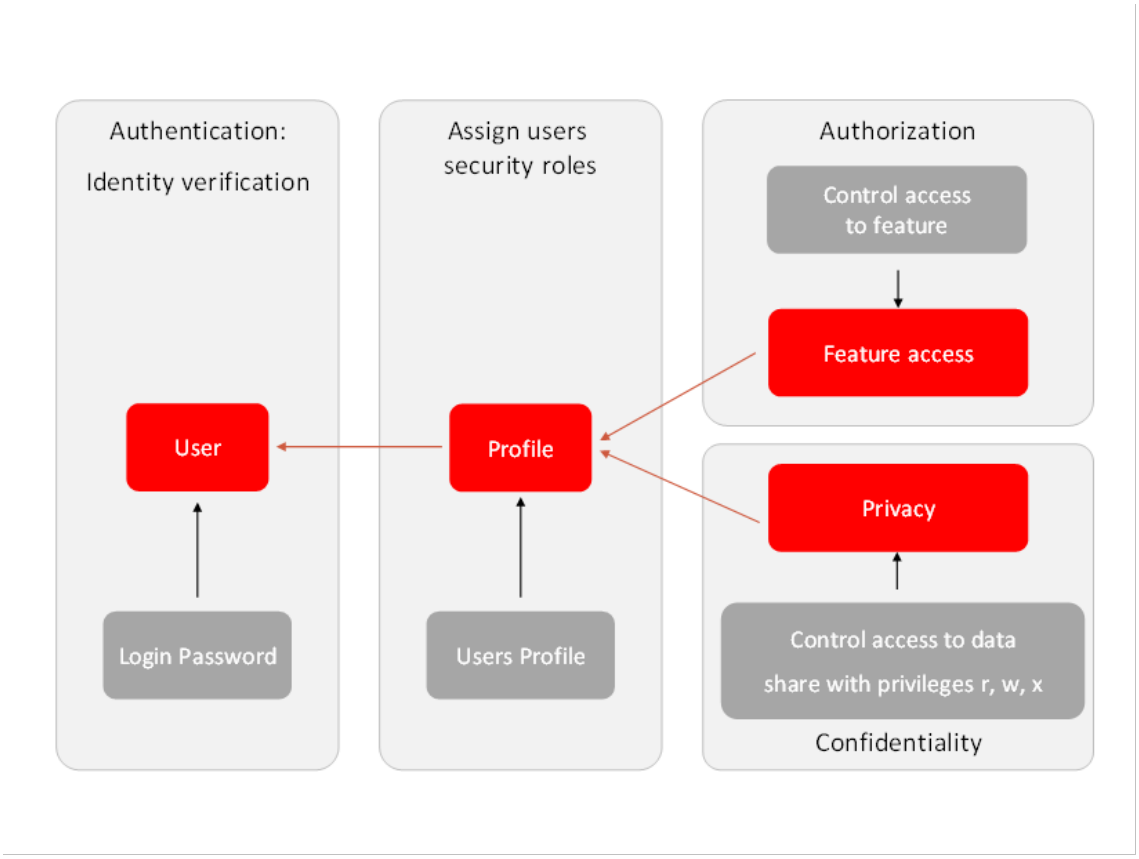

Figure 13 - Performance Intelligence Center Management applications security configuration

A subset of data can be protected from public access by defining a privacy role for that subset. Then, only users granted with that privacy role will be allowed to see the data. This applies to sessions containing XDRs, dashboards, queries, maps, etc. Those objects can be shared using "rwx" rights. *R* means that the object can be listed. *X* means that the object can be viewed. *W* means that configuration of the object can be changed.

The picture below shows an example of sharing a dashboard to different privacy roles.

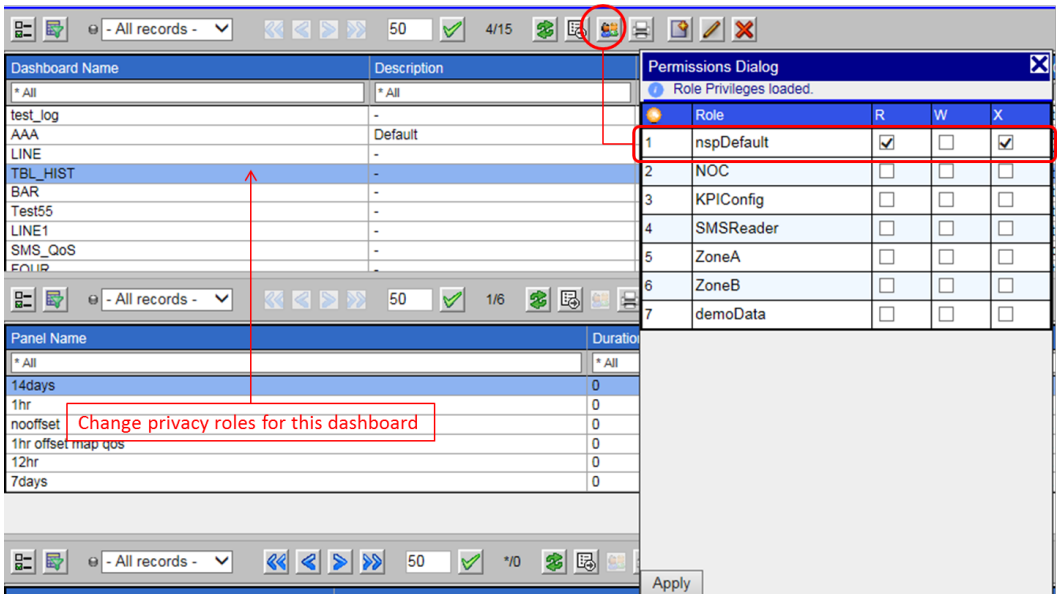

Figure 14 - Data privacy

The security application allows an Performance Intelligence Center Management administrator to set the security policy for password management. This includes but is not limited to: password length and strength, password aging …

In addition, this application provides the verification of the number of users simultaneously logged into the system. The number of tokens is positioned based on the quote. If 10 simultaneous users were bought, 10 tokens will be available. The platform will check each time a user logs in or logs out to maintain the pool of tokens. This is the platform that handles this, for the benefit of all the applications.

3.1.2.3 KPI & ALARM CONFIGURATION

Defining real-time alarms on any traffic conditions, setting thresholds and implementing KPIs (Key Performance Indicators) and KQIs (Key Quality Indicators) are critical elements to be taken to monitor networks efficiently.

With Performance Intelligence Center Management KPI application, you can define specific KPIs/KQIs and alarm to be generated for a given traffic flow. Post-processing treatment will help manage alarm-related information for a given time interval over a specific period for maintenance purposes and troubleshooting.

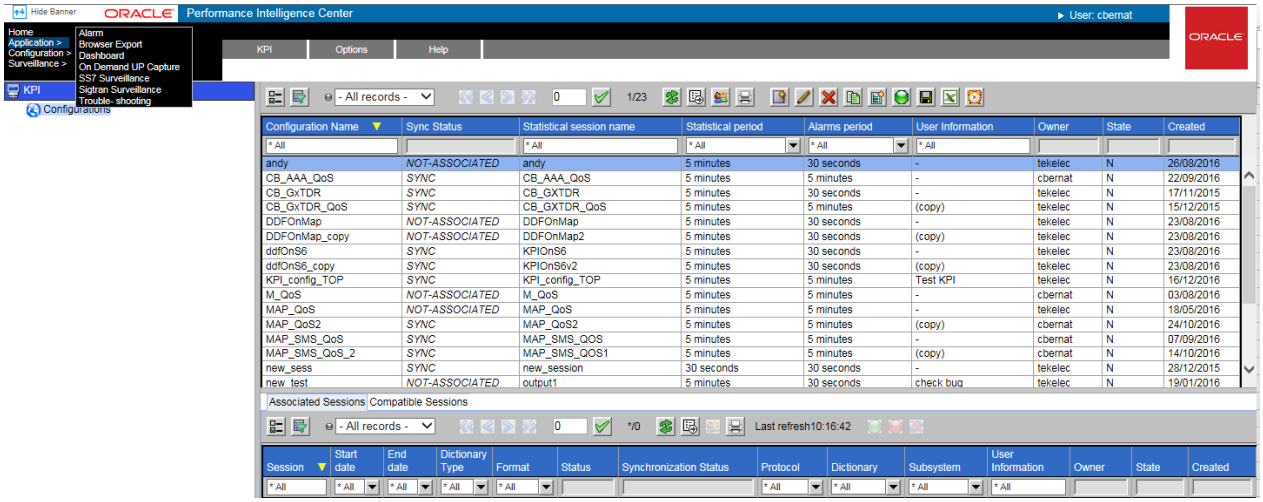

Figure 15 - Performance Intelligence Center Management KPI application main screen

Performance Intelligence Center Management KPI application configurations are matrix where you can filter traffic you want to calculate statistics on.

Columns are used to calculate indicators like ASR, NER or anything you need. Rows are typically used to segregate traffic for countries, regions, equipment…

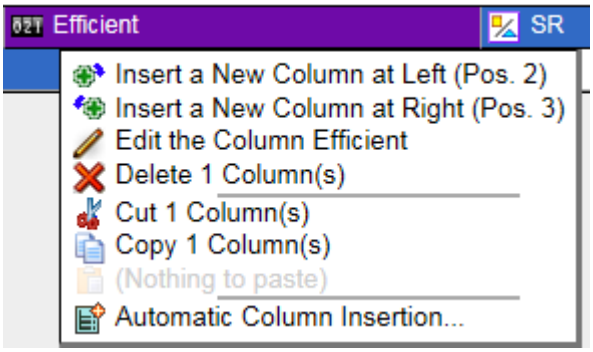

Figure 16 - Performance Intelligence Center Management KPI application configuration column edition example

An addition, useful feature makes it possible to use a task scheduler based on predefined thresholds in order to enable alarm monitoring for specific periods e.g. night time or day time and adapt the thresholds accordingly. The aggregation period is defined by configuration (30 sec, 1, 5, 15, 30 min, 1 hour, 1 day or 1 week).

Different types of measure types are available.

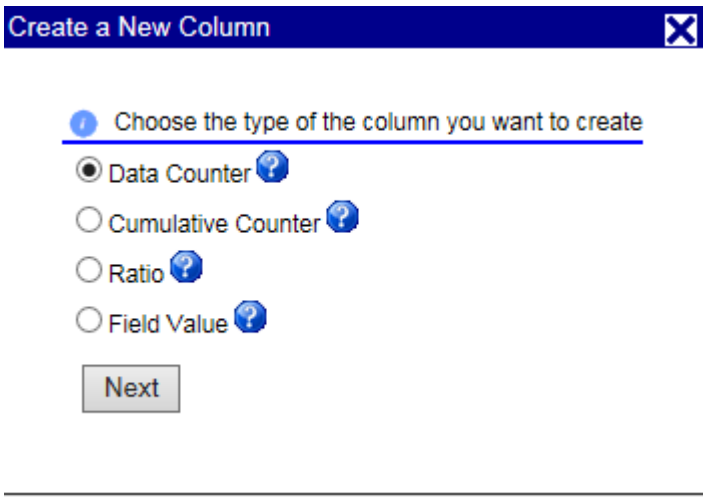

Figure 17 - Performance Intelligence Center Management KPI application configuration measure edition example

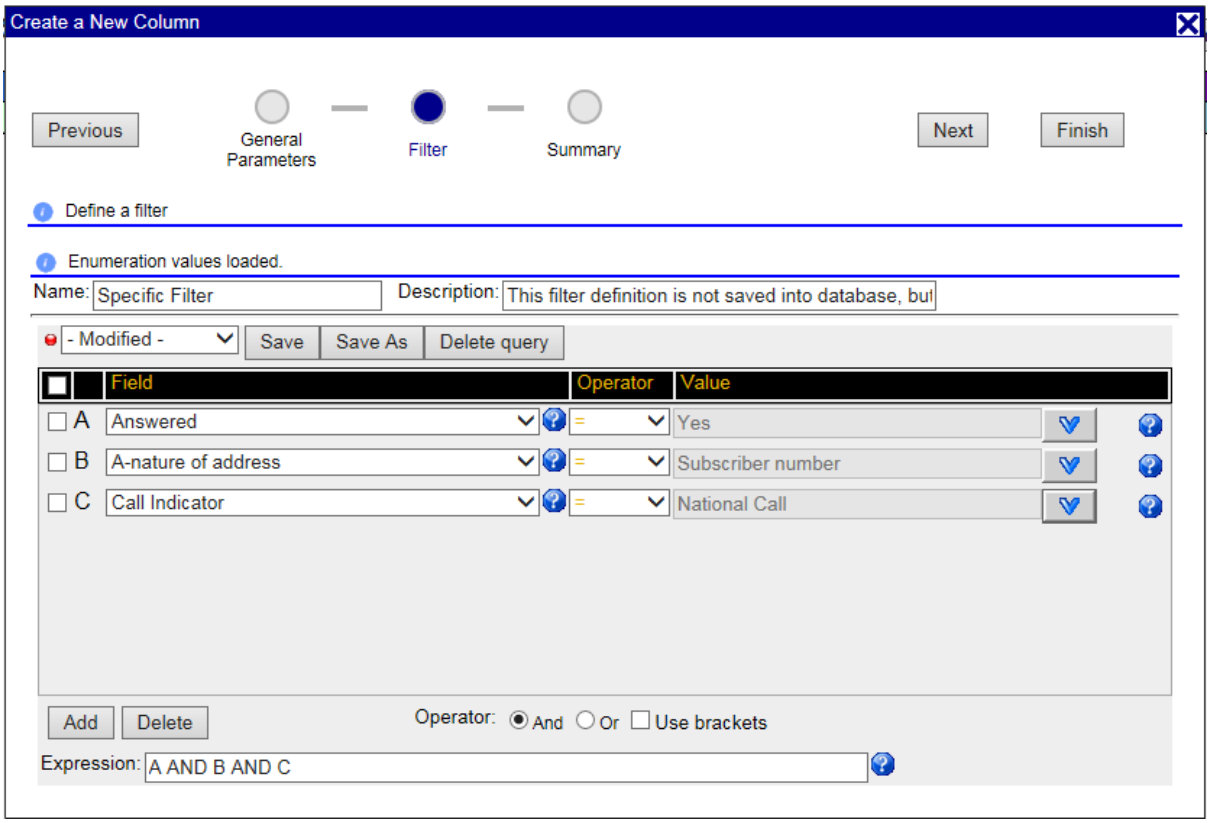

Figure 18 - Example of filtering capabilities

Figure 19 - Possible lines definition

Designing generic models for wide-ranging statistics generation is carried out via dialog boxes and interfaces which combine user-friendly and multi-protocol handling functions. The ability to customize result displays makes it possible to obtain specific purpose network related alarms and thus helps you manage your QoS in a proactive manner.

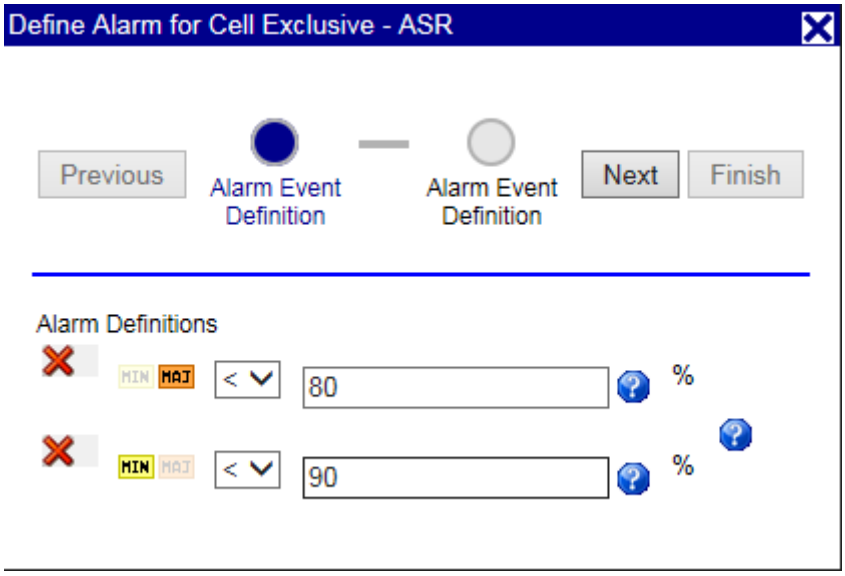

Figure 20 - Example of alarm definition

It is possible to setup alarms when a KPI crosses a threshold. For each KPI, 2 levels of alarms can be defined, minor or major, each with a different threshold. For example, you can configure the system to generate a minor alarm if the ASR for the calls to Germany drops below 90% and a major alarm if it drops below 80%. The alarms are managed by the Network and Service Alarm application described later in this document.

Performance Intelligence Center Management KPI application enables the CSP to easily customize KPIs in order to get a good knowledge of the behavior of its network. KPIs can be defined on each interface as well as network wide: traffic volume, procedures efficiency, transaction duration and top N analysis.

With the troubleshooting drill-down capabilities, finding the root cause of service failure or network inefficiency is only 2 clicks away. From Performance Intelligence Center Network and Service Alarm it is possible to drill down from an alarm to a KPI chart to check if the failure is transient or is the result of a long term trend. The other drill down is from an alarm to the browsing of the KPI results for this statistic, and from there, the application can query the XDRs that have been used to generate the KPI. See corresponding section for more details.

3.1.3 Performance Intelligence Center Management Self-Surveillance Features

3.1.3.1 System Alarms

The Performance Intelligence Center Management offers a built–in application for the surveillance of the Performance Intelligence Center system. It provides system alarms related to problems & faults in the acquisition system (hardware) and operation of applications (software) to the user at a glance showing the color coded alarms. Alarms collected are aggregated by objects and by alarm type so that a repeating alarm is just one line in the list

All system alarms from the applications of the Performance Intelligence Center system are collected by the Performance Intelligence Center Management in near real time and provided to the user in a constantly refreshed web page.

The application includes alarm management capabilities:

- Users can filter or order the list
- User can acknowledge and manually terminate an alarm

- User can add a comment to an alarm

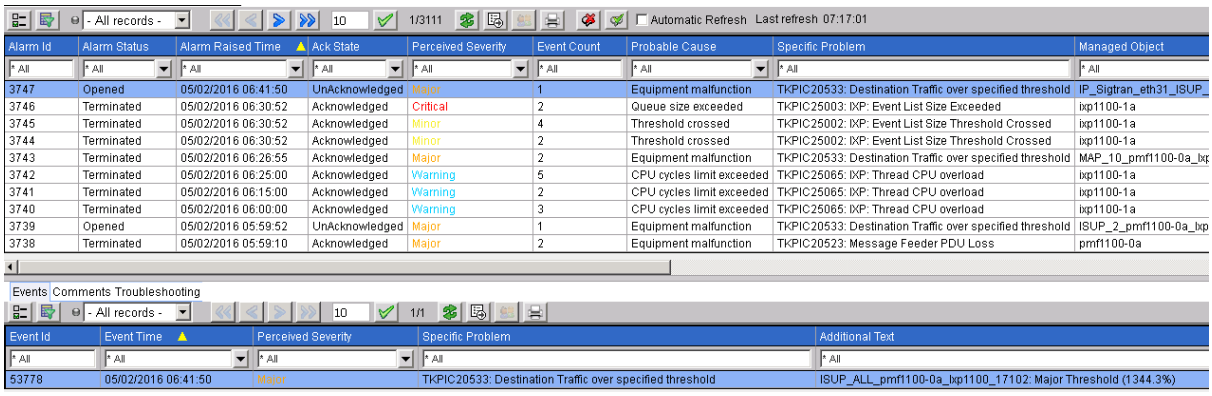

Figure 21 - System alarm main screen

3.1.3.2 AUDIT VIEWER

The audit viewer is an application that allows users with a specific profile to check the activities on the system. Some of the information available includes a list of who has been changing a KPI configuration, who ran queries with a specific phone number, who logged in and out etc.

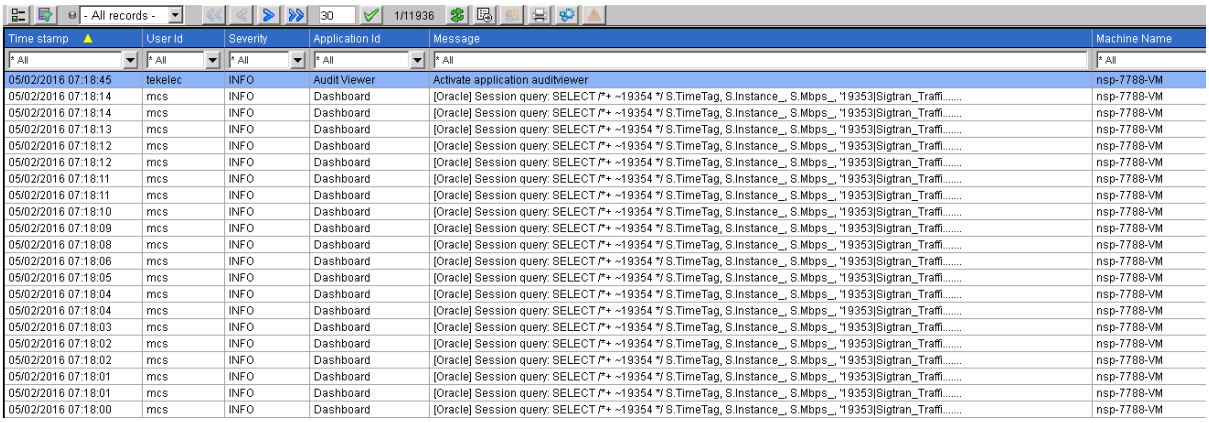

Figure 22 – Audit viewer example

Every application that runs on the Performance Intelligence Center Management is logging user's actions on audit viewer.

3.1.3.3 CAPACITY MANAGEMENT

Capacity management is a statistical session generated with a dedicated XDR builder. It provides very detailed self-surveillance data which can be better analyzed after selection and aggregation.

Derived statistical data are produced in real time (periodicity at the minute, 15 minutes and hour). These statistical results are stored as regular XDR that can be manage with standard Performance Intelligence Center tools.

They globally provide system activity information and traffic in real time and historical mode. It can be used to check the traffic managed according to the licenses.

Standard KPI configurations are provided and need mandatory installation steps. In addition optional customized KPI configurations could be added for more perspectives.

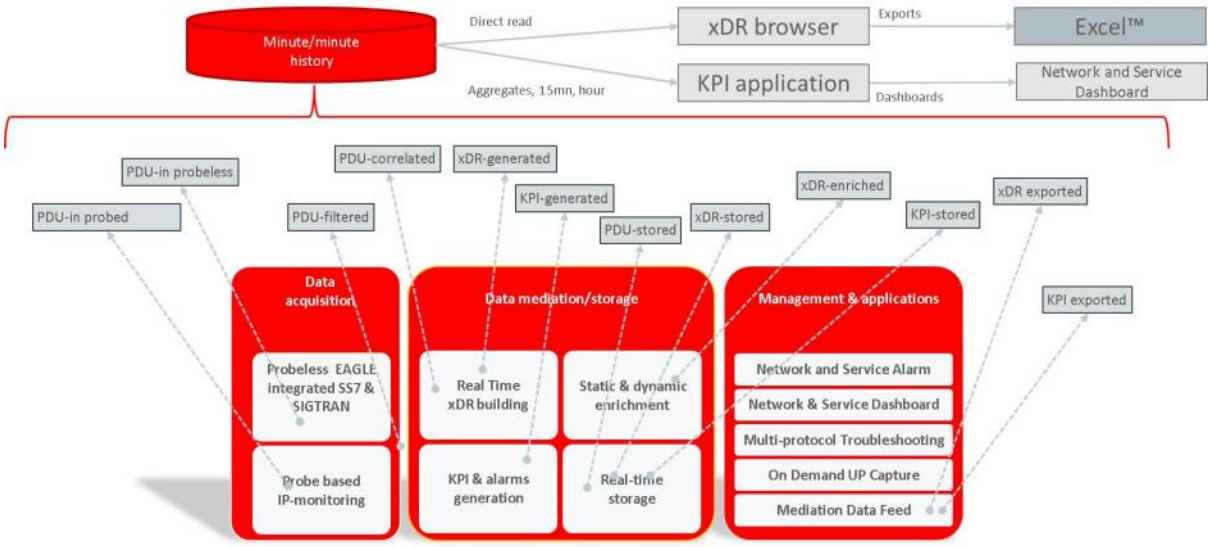

Figure 23 – Capacity management scope

3.1.4 Protect Subscriber's privacy

Performance Intelligence Center Management offers subscribers' privacy protection. There are two cases to consider. One for the SMS hiding, and one for the general case

3.1.4.1 SMS HIDING

In the general case, SMS is not a field of the XDR. The SMS is in the protocol decoding. Depending on user's role, the SMS is decoded or not. See table below.

There is a dedicated builder for MAP protocol where the SMS can be a field in the XDR, with clear text. The builder is called MAP_SM.

Table 1 – SMS Hiding

	SMS in decoding	**SMS in XDR**	**Other private data**
Builder	MAP, MAP_SM	MAP_SM	any
Hide	field hiding	field hiding	field hiding
Anonymous	Builder parameter	Builder parameter	N/A

There is an option of the MAP builder to replace SMS by * straight in the PDU.

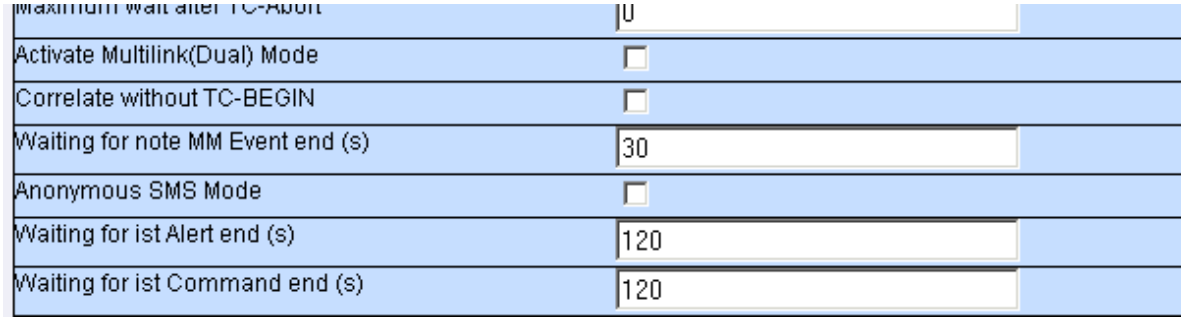

Figure 24 – MAP builder configuration for anonymous SMS

In Performance Intelligence Center Multiprotocol Troubleshooting, depending on user's authorization, SMS is visible and/or decoded.

Table 2 – SMS decoding per user's authorization

	Business User		**Business Power User**		**Business Manager**	
	MAP (protocol)	MAP_SM (XDR)	MAP (protocol)	MAP_SM (XDR)	MAP (protocol)	MAP_SM (XDR)
SMS in clear	n/a because don't see decoding	☑	☒	☑	☑	☑

3.1.4.2 FIELD HIDING

Field hiding applies to any protocol and is configurable using the Performance Intelligence Center Management central configuration. Hiding applies to XDRs, PDUs and protocol decoding. It is configured for a protocol and applies to the system.

Field hiding applies in Performance Intelligence Center Multiprotocol Troubleshooting in different sections. Values are replaced by '*'.

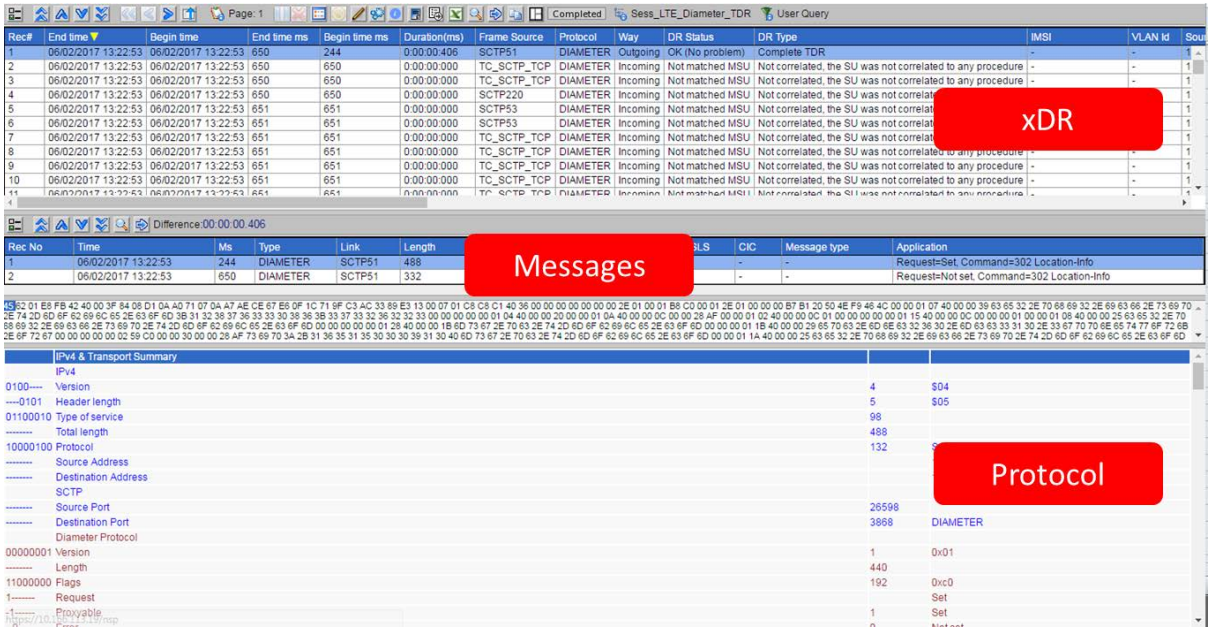

Figure 25 – Performance Intelligence Center Multiprotocol Troubleshooting main window for XDR, PDU and protocol

For XDR fields, it can be hidden from the right, the left for a number of characters or completely.

For PDUs, this is the same as XDRs. In addition, some values inside a “application” field are hidden based on protocol hiding.

For protocol, hiding is based on keywords (2nd column in protocol part in picture above) and all other fields are hidden.

Table 3 – Field hiding per user’s authorization

	Business User		**Business Power User**		**Business Manager**	
	Display	Hide	Display	Hide	Display	Hide
XDR	☑	☑	☑	☑	☑	☒
PDU	☒	N/A	☑	☑	☑	☒
protocol	☒	N/A	☑	☑	☑	☒

3.2 PERFORMANCE INTELLIGENCE CENTER MANAGEMENT OPTIONAL APPLICATIONS

3.2.1 Performance Intelligence Center Multiprotocol Troubleshooting – XDR and KPI Browsing

Note: this feature is not optional but linked to the tracing feature described in the following chapter.

Tracking call and transaction failures in near-real time requires rapid access to various levels of information such as XDR (CDR, TDR, IPDR ...), message and protocol decoding. This is why we developed Performance Intelligence Center XDR viewer to extract all data pertaining to a given call / transaction in order to perform call / transaction traces over a network at predefined times if needed. Performance Intelligence Center XDR viewer enables a top-down visualization of transactions/calls from XDR level to protocols analysis.

Additional features enable users to apply specific-purpose filters so that the CSP's traffic can be further analyzed. Post-processing treatment of call-related files will help generate accurate reports for troubleshooting purposes.

You can focus your search, for a given time interval on the available XDR database. Refined conditions can be applied by means of a set of filters, most of which do not require the need to refer to a protocol specification. With its user-friendly display functions, you can select parameters (transaction, protocol, ..) and configure your own report layouts (column widths, lists sorted out in ascending or descending order, hide unnecessary fields, etc.)

The query parameters combined with security features allow individuals with limited telecom skills to use XDR. It is now possible for a user to simply use queries that have been predefined for him/her by entering the required information parameter when running the query, like a phone number, an IMSI… to get all of the corresponding XDRs.

The queries can be performed with extended capabilities:

- Through filters applied to any XDR field
- Allows complex combination of several fields across multiple protocols
- Parameterized queries let the user enter a value for a field
- Allows queries to search on historic data as well as near real time

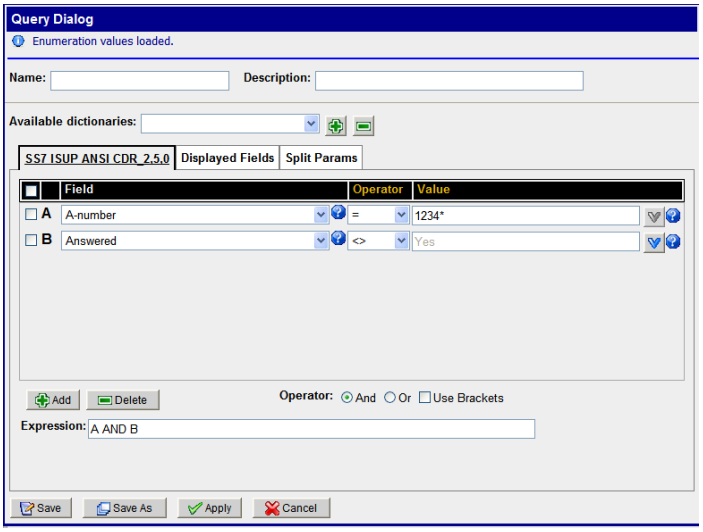

Figure 26 - Extended filtering capability

The Performance Intelligence Center XDR viewer gives access to network view and link view: to query several sessions across multi protocols on several XDR storages. Three levels of display are available: the XDRs, message sequence of the call attempt / transaction, and protocol decode to display the messages in full. I.e. there is a possibility to get full decoding of each MSU/PDU. A full decoding is available with a simple click on a message.

On top of XDR viewing, the Performance Intelligence Center XDR viewer allows statistics visualization (Q752 sessions, call/transaction efficiency, traffic, etc.). These statistics can be exported into a csv file and opened with Microsoft Excel in order to generate curves and tables for further analysis. Other supported formats include HTML, XML and text files.

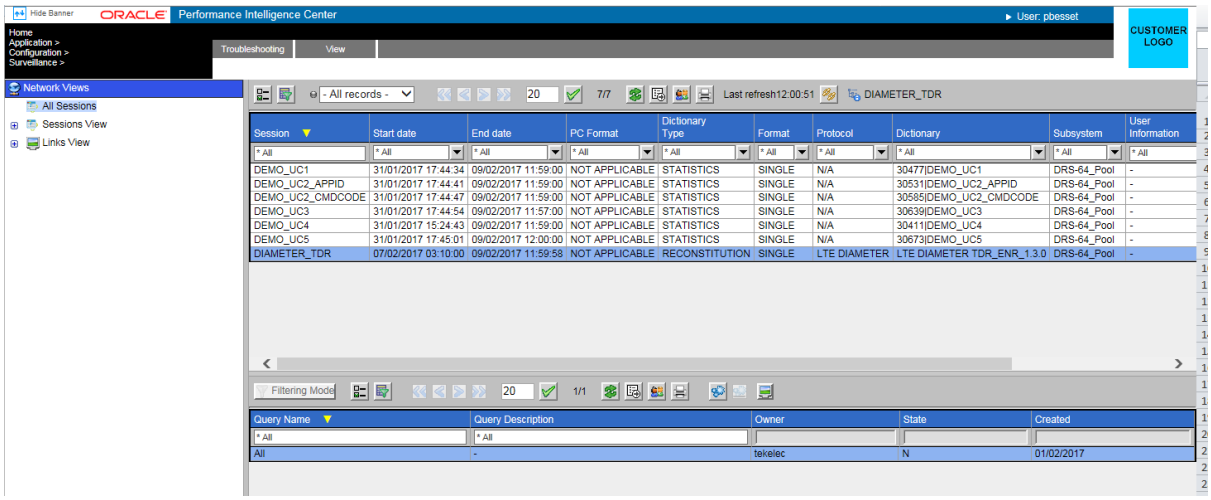

Figure 27 - Performance Intelligence Center XDR viewer overview

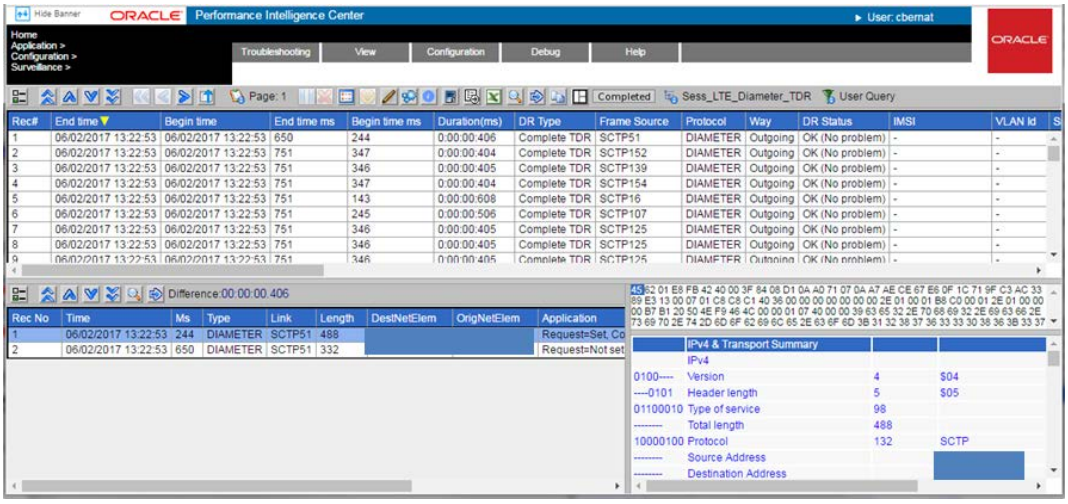

Figure 28 - Example Performance Intelligence Center XDR viewer output

3.2.2 Performance Intelligence Center Multiprotocol Troubleshooting – Call Tracing

For troubleshooting, the ability to perform call/transaction/session multi-protocol end-to-end tracing is mandatory for the following scenarios:

- Network-related tracing, where for a global network, problem the user must be able to search on a specific failure cause, to extract a list of calls/transactions/sessions impacted by this problem, and then be able to trace on a chosen number.
- Customer-related tracing, where by the customer, the user can enter for example the IMSI, without any previous query filter, and immediately get the details of calls/sessions related to this customer

Any protocols supervised by Performance Intelligence Center, related to a call/transaction/session, can be traced as part of an end to end network wide call trace.

Performance Intelligence Center Multiprotocol Troubleshooting is a scenario-less application. It is based on embedded intra-protocol rules and inter-protocol tracing that is part of an Oracle patent. What this means to the customer is that the users of the system do not need to have the protocol knowledge of how to map Protocol A to Protocol B when attempting to perform a network-wide call trace. The logic to perform this trace is built into the Performance Intelligence Center Multiprotocol Troubleshooting application itself. Performance Intelligence Center Multiprotocol Troubleshooting supports Intra-protocol traces functionality for all protocols supported by Performance Intelligence Center. For example, a customer-related trace of a mobile can be done just by selecting a network view, entering an IMSI, and clicking on “trace now”. Another feature of Network diagram is to display time delay linked to each network elements through which signaling passes.

Performance Intelligence Center Multiprotocol Troubleshooting handles & displays transactions/calls/sessions in an in-progress mode, including a Message Sequence Diagram. This requires partial CDR option for SIP and ISUP CDRs.

Performance Intelligence Center Multiprotocol Troubleshooting has the capability to filter on display (ex: in GPRS, where several protocols can be on the same interface, the application can hide some protocols on display only.)

Other functions of Performance Intelligence Center Multiprotocol Troubleshooting include:

- Handling of some level 2 / level 3 messages in order to handle events like changeovers, alignment, SCTP path failures, as well as network management messages like TFA, TFP, etc.
- Handling of SIGTRAN transport protocol layers messages.
- Two modes (“real time” and “historical”) are supported by Performance Intelligence Center Multiprotocol Troubleshooting

A trace can be performed either:

- On a sub-network when a global network-related problem is analyzed, but with knowledge of the concerned area
- On an entire network for some customer-related tracing. Example: for tracing in real-time a roamer (identified by an IMSI) who is supposed to enter the network, the point of entry being unknown

In addition to above-mentioned filters defined by administrator or user with specific rights, other users can define additional filters for their own needs.

To configure a trace, the user selects a network view which relates to the concerned data sessions, protocols, and/or related dictionaries.

Before starting a Network-related trace, the User starts a query filter based on any field from the concerned protocol dictionary. Then, in the list of XDRs matching the filter, the user selects an XDR to start a trace with a “start now” or a “begin time” (can be historical), and ends with an “end time” or “continue until cancelled”.

A real-time customer-related trace starts with a filter based on customer identifier like MSISDN or IMSI, or terminal identification like IMEI. The trace starts with a “start now” or a “begin time”, and ends with an “end time” or “continue until cancelled”.

Any protocol supervised by Performance Intelligence Center can be traced at the same time. So it will be easy to find every operation concerning a subscriber's activities on wire line and wireless networks. Exchange of signaling units and user packets between different elements using different protocols can be highlighted for further investigation purposes. As probes can be located in different areas of the network, end-to-end call tracing will be performed in order to provide a centralized view of the network.

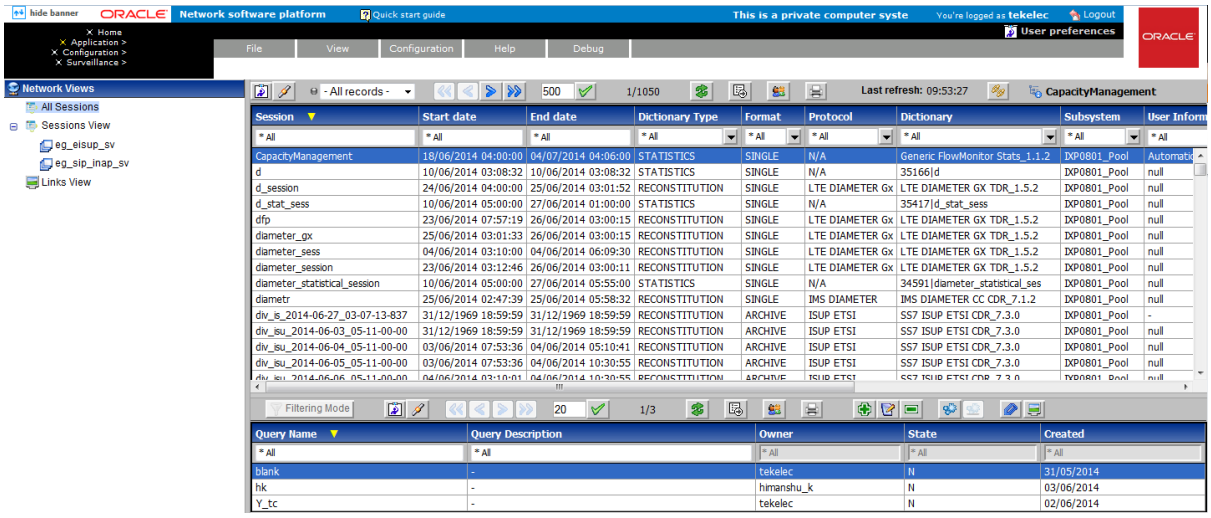

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Figure 29 - Performance Intelligence Center Multiprotocol Troubleshooting screen capture

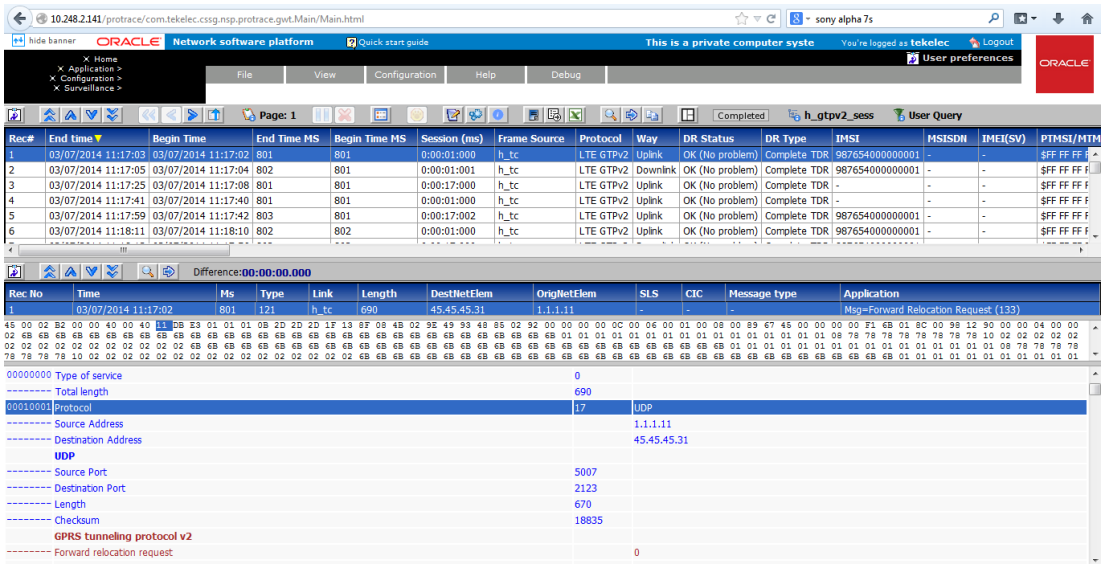


Figure 30 - Example of Performance Intelligence Center Multiprotocol Troubleshooting output

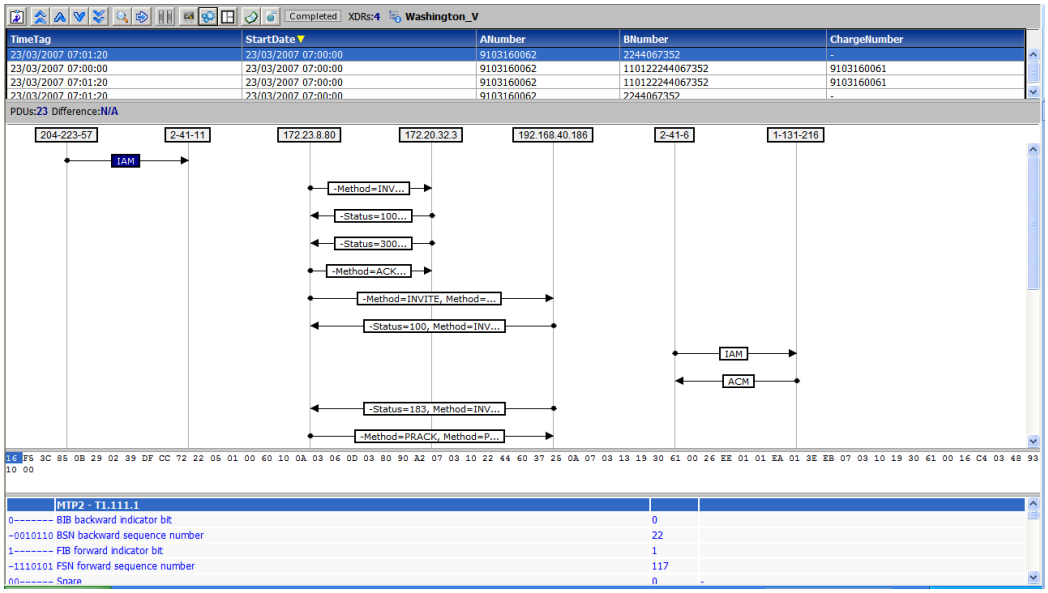


Figure 31 - Ladder diagram

Trace export:

It is possible to export a trace in the following formats:

- Native ZIP
- CSV
- TXT
- HTML
- XML
- PCAP (SIGTRAN and Diameter)

3.2.3 Performance Intelligence Center Dashboard

With Performance Intelligence Center Dashboard, users can create a large variety of live and offline dashboards (indicator displays), line, pie or bar charts and table panels. Automatic refresh functionality is available in the case of live traffic.

Every indicator defined by the Performance Intelligence Center Management KPI application can be displayed by Performance Intelligence Center Dashboard. These include for instance ISUP or SIP service quality monitoring in real-time. Users can check INAP, MAP, Diameter transaction volumes, efficiency or duration. Checking load sharing is also something that Performance Intelligence Center Dashboard can do. For instance that can be useful in the context of diameter traffic among several HSS. And the list of examples can also comprise intertechnology use case like CS Fallback.

Failures and overloads appear instantly. Trends can be easily estimated according to the shape of the curves. Offset representations make it easy to compare between real-time and offline data.

The User Authentication feature provides access rights to specific functions and/or specific data. Depending on their profile, users are able to create or utilize dashboards in order to access vital network information.

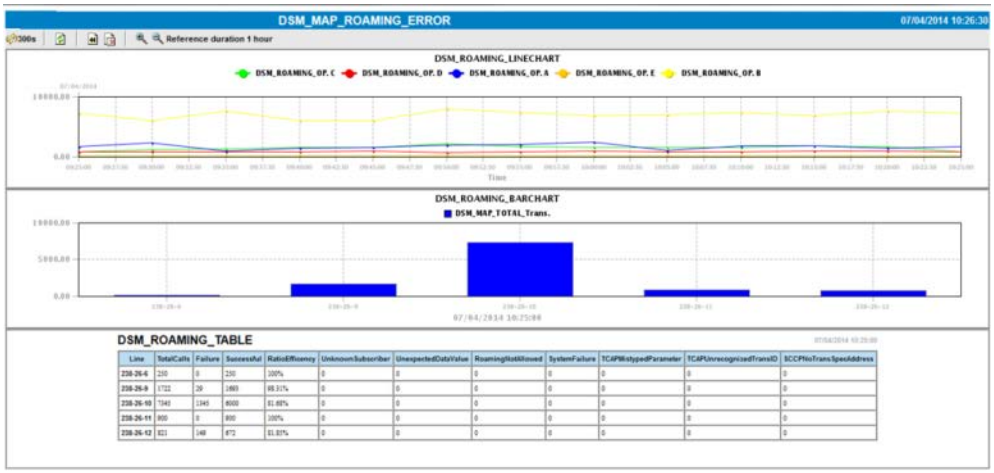


Figure 32 - Example of Performance Intelligence Center Dashboard output

3.2.4 Performance Intelligence Center Network and Service Alarm

Performance Intelligence Center Network and Service Alarm manages predefined or KPI related alarms. Key network elements such as signaling links, linksets, nodes and dedicated services are supervised by means of a feature-rich platform with alarm handling capabilities based on standard components.

Defined KPIs can be tagged in order to enable quick filtering in order to focus on specific problems. In addition to the tag, any alarm attribute can be used as a filtering criteria.

By tags can be composed of several keys in order to enable powerful grouping. As example let's consider 2 tags:

- RoamingISUP
- RoamingMAP

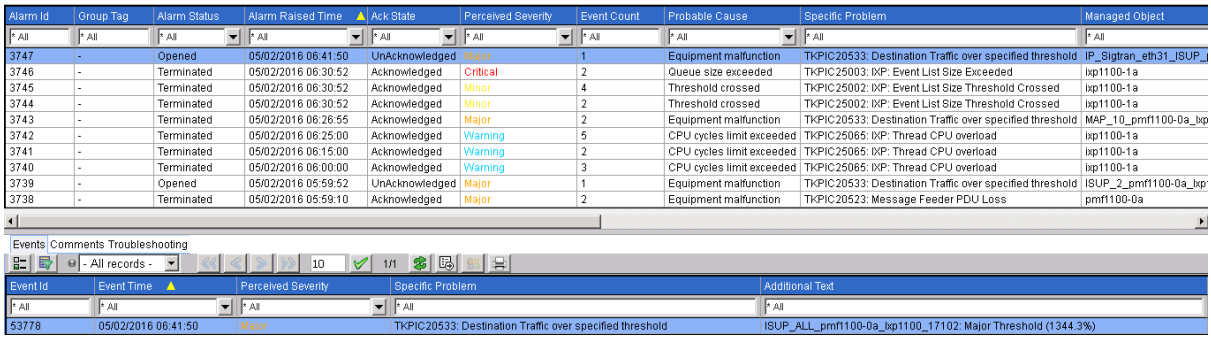
By using wild cards in the filtering it is possible to all roaming alarms, or only ISUP or MAP.

It is possible to get an alarm summary per the differents tags.

It is possible for people in charge of managing alarms to acknowledge or manually terminate an alarm. Their login as well as date and time will be stored for future reference.

The User Authentication feature provides access rights to specific functions and/or specific data. Depending on their profile, users will be able to create or utilize filters in order to access vital network information.

In the viewer section, they will only see objects they have authorization for, and thus only see their corresponding alarms and not the complete set. This allows a better focus on managing the part of the network or service or SLA they are responsible for.



Alarm Id	Group Tag	Alarm Status	Alarm Raised Time	Ack State	Perceived Severity	Event Count	Probable Cause	Specific Problem	Managed Object
3747	-	Opened	05/02/2016 06:41:50	UnAcknowledged	Major	1	Equipment malfunction	TKPIC20533: Destination Traffic over specified threshold	IP_Sigtran_eth31_ISUP_
3746	-	Terminated	05/02/2016 06:30:52	Acknowledged	Critical	2	Queue size exceeded	TKPIC25003: IXP: Event List Size Exceeded	ixp1100-1a
3745	-	Terminated	05/02/2016 06:30:52	Acknowledged	Minor	4	Threshold crossed	TKPIC25002: IXP: Event List Size Threshold Crossed	ixp1100-1a
3744	-	Terminated	05/02/2016 06:30:52	Acknowledged	Minor	2	Threshold crossed	TKPIC25002: IXP: Event List Size Threshold Crossed	ixp1100-1a
3743	-	Terminated	05/02/2016 06:26:55	Acknowledged	Major	2	Equipment malfunction	TKPIC20533: Destination Traffic over specified threshold	MAP_10_pmf1100-0a_ixp
3742	-	Terminated	05/02/2016 06:25:00	Acknowledged	Warning	5	CPU cycles limit exceeded	TKPIC25065: IXP: Thread CPU overload	ixp1100-1a
3741	-	Terminated	05/02/2016 06:15:00	Acknowledged	Warning	2	CPU cycles limit exceeded	TKPIC25065: IXP: Thread CPU overload	ixp1100-1a
3740	-	Terminated	05/02/2016 06:00:00	Acknowledged	Warning	3	CPU cycles limit exceeded	TKPIC25065: IXP: Thread CPU overload	ixp1100-1a
3739	-	Opened	05/02/2016 05:59:52	UnAcknowledged	Major	1	Equipment malfunction	TKPIC20533: Destination Traffic over specified threshold	ISUP_2_pmf1100-0a_ixp
3738	-	Terminated	05/02/2016 05:59:10	Acknowledged	Major	2	Equipment malfunction	TKPIC20523: Message Feeder PDU Loss	pmf1100-0a

Events Comments Troubleshooting

- All records -

Event Id	Event Time	Perceived Severity	Specific Problem	Additional Text
53778	05/02/2016 06:41:50	Major	TKPIC20533: Destination Traffic over specified threshold	ISUP_ALL_pmf1100-0a_ixp1100_17102: Major Threshold (1344.3%)

Figure 33 - Example of Performance Intelligence Center Network and Service Alarm output

3.2.5 Inter-Application Link on KPI alarms

Performance Intelligence Center includes inter-applications links in order to improve root causes analysis process. Several drill down capabilities are available.

From any alarm on a Performance Intelligence Center Network and Service Alarm, the user can drill down details of the evolution of KPI generating this alarm. The graphical display helps to distinguish e.g. problems due to a sport event from those that are due a longer trend. Drill to KPI details provides additional measures complementing the information provide by the indicator triggering the alarm.

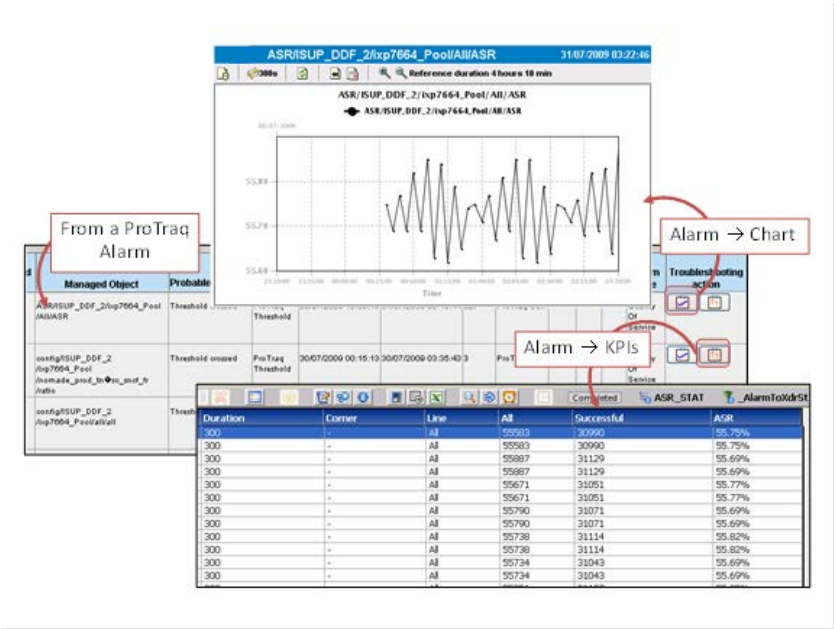
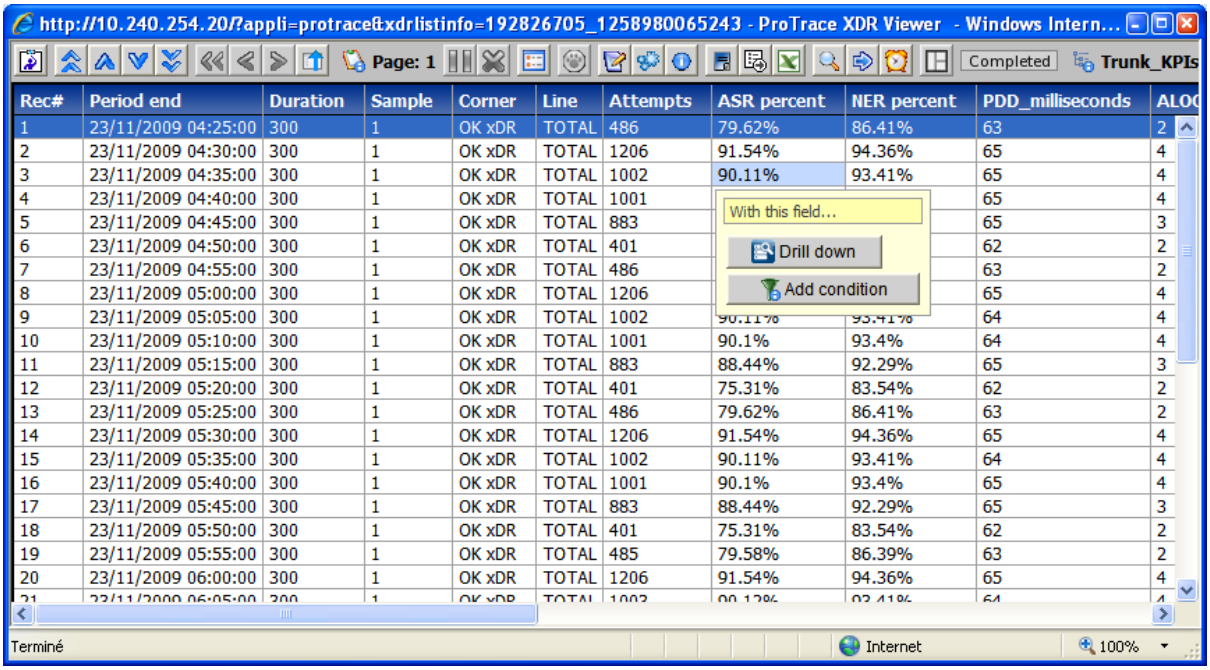


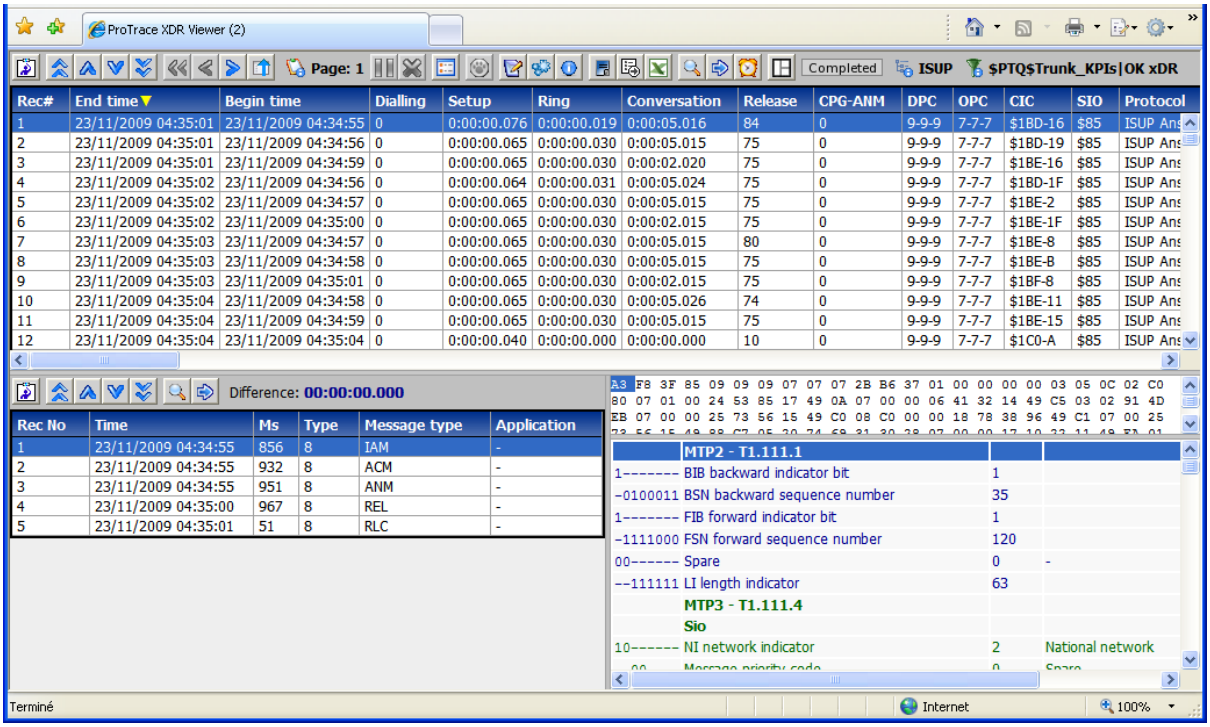
Figure 34 - Drill-down from Performance Intelligence Center Network and Service Alarm KPI Alarm to Performance Intelligence Center Dashboard or to Performance Intelligence Center XDR browser



Rec#	Period end	Duration	Sample	Corner	Line	Attempts	ASR percent	NER percent	PDD_milliseconds	ALOC
1	23/11/2009 04:25:00	300	1	OK xDR	TOTAL	486	79.62%	86.41%	63	2
2	23/11/2009 04:30:00	300	1	OK xDR	TOTAL	1206	91.54%	94.36%	65	4
3	23/11/2009 04:35:00	300	1	OK xDR	TOTAL	1002	90.11%	93.41%	65	4
4	23/11/2009 04:40:00	300	1	OK xDR	TOTAL	1001			65	4
5	23/11/2009 04:45:00	300	1	OK xDR	TOTAL	883			65	3
6	23/11/2009 04:50:00	300	1	OK xDR	TOTAL	401			62	2
7	23/11/2009 04:55:00	300	1	OK xDR	TOTAL	486			63	2
8	23/11/2009 05:00:00	300	1	OK xDR	TOTAL	1206			65	4
9	23/11/2009 05:05:00	300	1	OK xDR	TOTAL	1002			64	4
10	23/11/2009 05:10:00	300	1	OK xDR	TOTAL	1001	90.1%	93.4%	64	4
11	23/11/2009 05:15:00	300	1	OK xDR	TOTAL	883	88.44%	92.29%	65	3
12	23/11/2009 05:20:00	300	1	OK xDR	TOTAL	401	75.31%	83.54%	62	2
13	23/11/2009 05:25:00	300	1	OK xDR	TOTAL	486	79.62%	86.41%	63	2
14	23/11/2009 05:30:00	300	1	OK xDR	TOTAL	1206	91.54%	94.36%	65	4
15	23/11/2009 05:35:00	300	1	OK xDR	TOTAL	1002	90.11%	93.41%	64	4
16	23/11/2009 05:40:00	300	1	OK xDR	TOTAL	1001	90.1%	93.4%	65	4
17	23/11/2009 05:45:00	300	1	OK xDR	TOTAL	883	88.44%	92.29%	65	3
18	23/11/2009 05:50:00	300	1	OK xDR	TOTAL	401	75.31%	83.54%	62	2
19	23/11/2009 05:55:00	300	1	OK xDR	TOTAL	485	79.58%	86.39%	63	2
20	23/11/2009 06:00:00	300	1	OK xDR	TOTAL	1206	91.54%	94.36%	65	4

Figure 35 - Table display of KPI from Performance Intelligence Center Network and Service Alarm drill down

Further drill down allows an XDR and protocols decoding level analysis.



Rec#	End time	Begin time	Dialling	Setup	Ring	Conversation	Release	CPG-ANM	DPC	OPC	CIC	SIO	Protocol
1	23/11/2009 04:35:01	23/11/2009 04:34:55	0	0:00:00.076	0:00:00.019	0:00:05.016	84	0	9-9-9	7-7-7	$1BD-16	$85	ISUP Ans
2	23/11/2009 04:35:01	23/11/2009 04:34:56	0	0:00:00.065	0:00:00.030	0:00:05.015	75	0	9-9-9	7-7-7	$1BD-19	$85	ISUP Ans
3	23/11/2009 04:35:01	23/11/2009 04:34:59	0	0:00:00.065	0:00:00.030	0:00:02.020	75	0	9-9-9	7-7-7	$1BE-16	$85	ISUP Ans
4	23/11/2009 04:35:02	23/11/2009 04:34:56	0	0:00:00.064	0:00:00.031	0:00:05.024	75	0	9-9-9	7-7-7	$1BD-1F	$85	ISUP Ans
5	23/11/2009 04:35:02	23/11/2009 04:34:57	0	0:00:00.065	0:00:00.030	0:00:05.015	75	0	9-9-9	7-7-7	$1BE-2	$85	ISUP Ans
6	23/11/2009 04:35:02	23/11/2009 04:35:00	0	0:00:00.065	0:00:00.030	0:00:02.015	75	0	9-9-9	7-7-7	$1BE-1F	$85	ISUP Ans
7	23/11/2009 04:35:03	23/11/2009 04:34:57	0	0:00:00.065	0:00:00.030	0:00:05.015	80	0	9-9-9	7-7-7	$1BE-8	$85	ISUP Ans
8	23/11/2009 04:35:03	23/11/2009 04:34:58	0	0:00:00.065	0:00:00.030	0:00:05.015	75	0	9-9-9	7-7-7	$1BE-B	$85	ISUP Ans
9	23/11/2009 04:35:03	23/11/2009 04:35:01	0	0:00:00.065	0:00:00.030	0:00:02.015	75	0	9-9-9	7-7-7	$1BF-8	$85	ISUP Ans
10	23/11/2009 04:35:04	23/11/2009 04:34:58	0	0:00:00.065	0:00:00.030	0:00:05.026	74	0	9-9-9	7-7-7	$1BE-11	$85	ISUP Ans
11	23/11/2009 04:35:04	23/11/2009 04:34:59	0	0:00:00.065	0:00:00.030	0:00:05.015	75	0	9-9-9	7-7-7	$1BE-15	$85	ISUP Ans
12	23/11/2009 04:35:04	23/11/2009 04:35:04	0	0:00:00.040	0:00:00.000	0:00:00.000	10	0	9-9-9	7-7-7	$1C0-A	$85	ISUP Ans

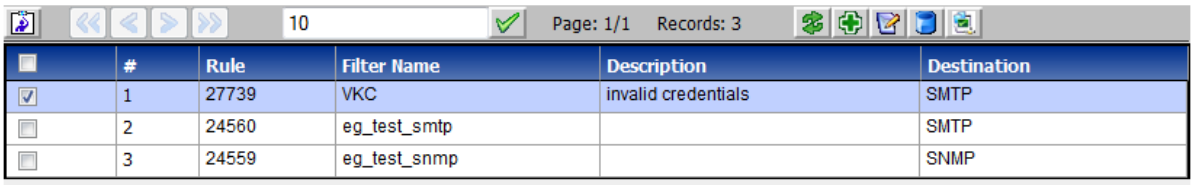
Rec No	Time	Ms	Type	Message type	Application
1	23/11/2009 04:34:55	856	8	IAM	-
2	23/11/2009 04:34:55	932	8	ACM	-
3	23/11/2009 04:34:55	951	8	ANM	-
4	23/11/2009 04:35:00	967	8	REL	-
5	23/11/2009 04:35:01	51	8	RLC	-

Figure 36 - XDR analysis and protocol decoding from Performance Intelligence Center Network and Service Alarm drill down

3.2.6 Alarm forwarding

To provide CSPs with real time monitoring of the networks, it is important that all alarms are sent to one single application. The alarm forwarding allows a seamless integration into OSS / fault management platform.

Alarm forwarding allows the generation of e-mails too. Up to 10 rules can be defined to forward emails. With each rule an email distribution list can be defined. For instance alarms on servers can be sent to a department and alarms on SLA can be sent to a different department



#	Rule	Filter Name	Description	Destination
1	27739	VKC	invalid credentials	SMTP
2	24560	eg_test_smtp		SMTP
3	24559	eg_test_snmp		SNMP

Figure 37 - Example of alarm forwarding filters

Also for some critical alarms it could be convenient to receive them by email at your desk or on your mobile handset.

In accordance with ITU X.733 recommendations, Performance Intelligence Center Network and Service Alarm can forward traffic, service and system alarms to an upper global fault management platform or to a mailbox. With Performance Intelligence Center Network and Service Alarm events forwarding discriminator, you can define rules to allow the actual forwarding, filter alarms based on user-defined rules, and to forward filtered alarms. This is an ideal combination of functions to manage protocol errors, errors in message signal units, hardware failure notifications and to make network administrators aware of real-time QoS indicators.

An SNMP agent in accordance with ITU X.721 recommendation is available and its MIB can be shared in order to integrate Performance Intelligence Center alarms into an umbrella system.

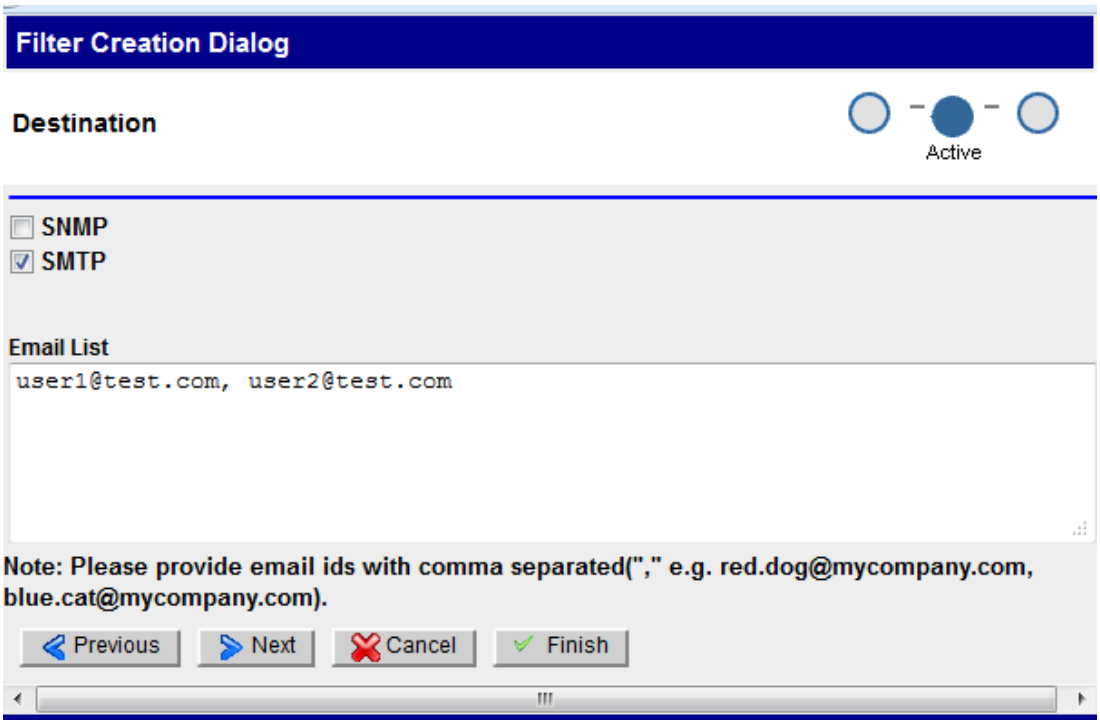


Figure 38 - Example of alarm forwarding configuration for destination

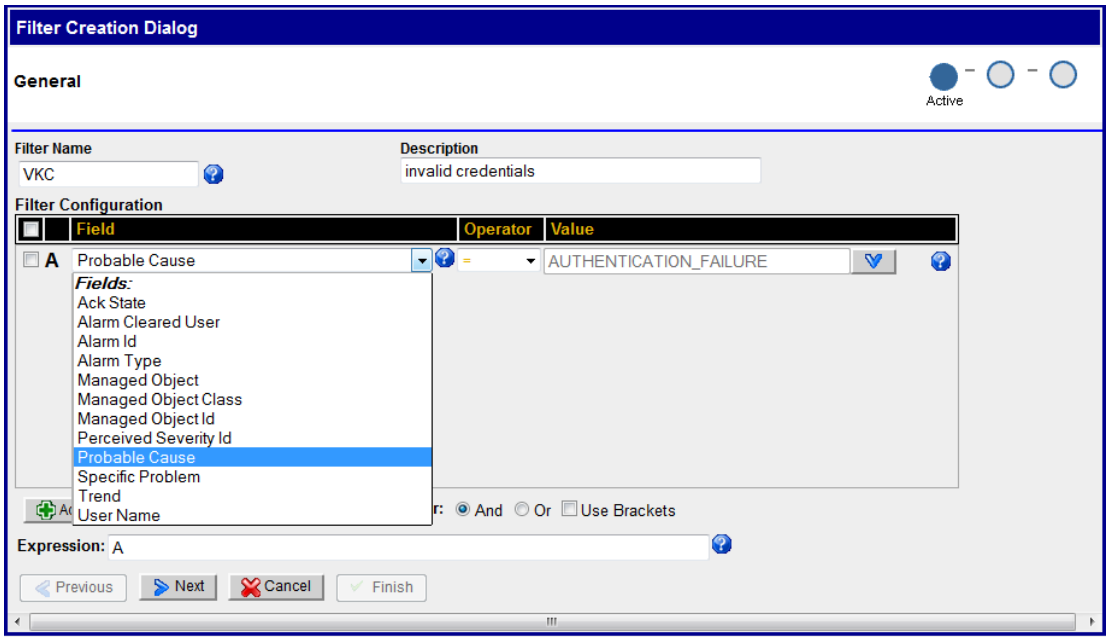


Figure 39 - Example of alarm forwarding configuration for filtering

3.2.7 Performance Intelligence Center SS7 Surveillance– SS7 network diagnostic (Integrated Acquisition)

Performance Intelligence Center SS7 Surveillance is an application developed to analyze SS7 link information from the Performance Intelligence Center Integrated Acquisition for low speed links (LSLs) and high speed links (HSL).

Performance Intelligence Center SS7 Surveillance provides immediate visual notification, and details, of any L2/L3 events that could impede or prevent the transport of SS7 traffic in a CSP's network. The CSP is provided with immediate indication of revenue threatening situations and can move quickly to initiate corrective actions. Further, the effectiveness of any corrective actions will be immediately displayed thereby providing an additional level of confidence that the problem has really been fixed.

Functioning as a near real-time application, Performance Intelligence Center SS7 Surveillance indicates status of nodes, linksets and links that make up a network. It provides continuous assessment of overall network health by displaying the link(s)/node(s) status and link state counters within a network. Following is the architecture overview:

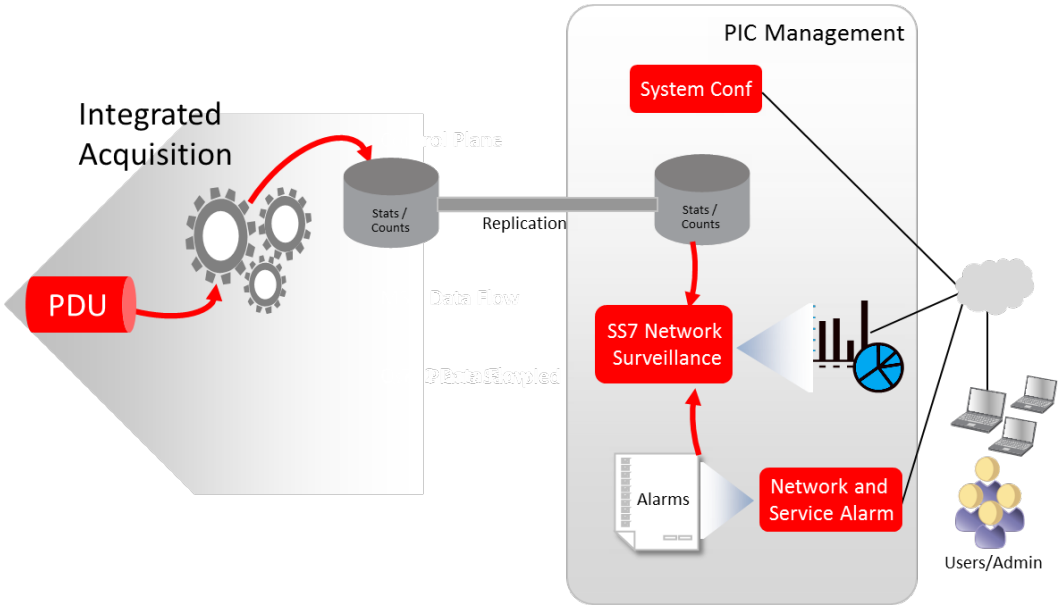


Figure 40 - Performance Intelligence Center SS7 Surveillance Architecture

Performance Intelligence Center SS7 Surveillance is a Performance Intelligence Center Management resident application that can either be invoked directly from the portal or via an inter-application link from Performance Intelligence Center Network and Service Alarm. The application provides a number of features.

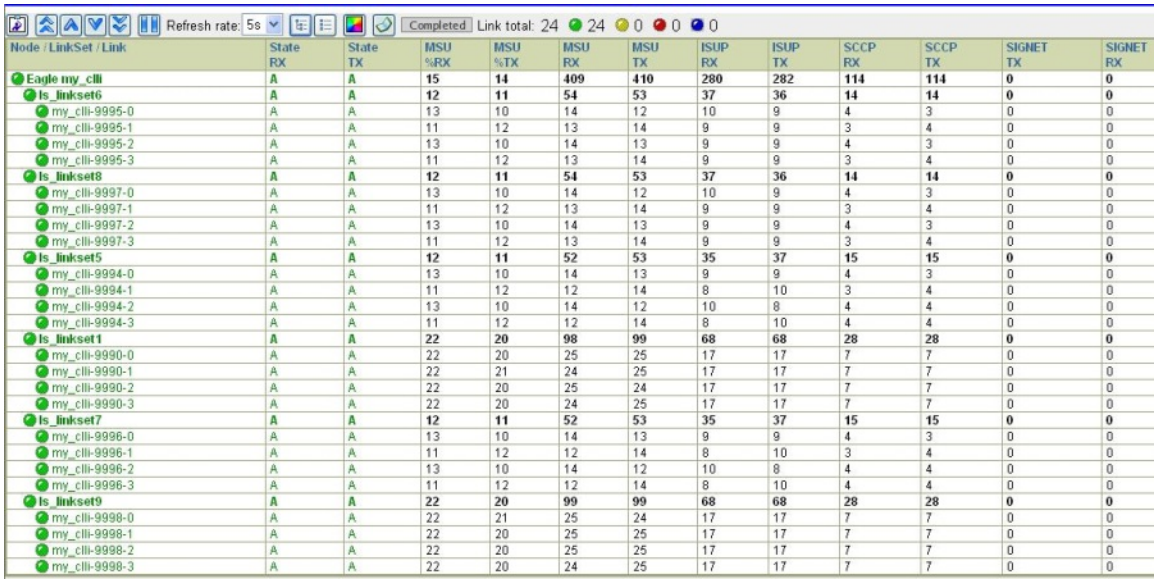
Performance Intelligence Center SS7 Surveillance has a nice GUI:

- The object tree provides a graphic representation of the nodes, linksets and links in the system
- Configurable and customize colors
- Configurable auto refresh rate 1, 3 or 5 seconds (default 5 secs)
- Ability to reset counters
- Tabular and graphical display options
- Ability to export data to PNG file
- Enables to export all the data in the table that is shown in the monitoring page
- Check the status and state for linksets from Performance Intelligence Center Network and Service Alarm viewer

The user can select all nodes in the network or a particular subset of interest (e.g., specific region). Once selected, Performance Intelligence Center SS7 Surveillance will indicate the status of the nodes by different user assigned colors and informational elements.

When you select a monitoring option and open an element, a separate page opens that shows all the pertinent information of that element (node/linkset/link).

From the Node View the user can click on any node or subset of nodes and Performance Intelligence Center SS7 Surveillance will expand the view to indicate the status of the linksets associated with the node(s). From this view the user can further expand the view to the individual links themselves. This is illustrated below.



Node / LinkSet / Link	State RX	State TX	MSU %RX	MSU %TX	MSU RX	MSU TX	ISUP RX	ISUP TX	SCCP RX	SCCP TX	SIGNET TX	SIGNET RX
Eagle my_clli	A	A	15	14	409	410	280	282	114	114	0	0
ls_linkset6	A	A	12	11	54	53	37	36	14	14	0	0
my_clli-9995-0	A	A	13	10	14	12	10	9	4	3	0	0
my_clli-9995-1	A	A	11	12	13	14	9	9	3	4	0	0
my_clli-9995-2	A	A	13	10	14	13	9	9	4	3	0	0
my_clli-9995-3	A	A	11	12	13	14	9	9	3	4	0	0
ls_linkset8	A	A	12	11	54	53	37	36	14	14	0	0
my_clli-9997-0	A	A	13	10	14	12	10	9	4	3	0	0
my_clli-9997-1	A	A	11	12	13	14	9	9	3	4	0	0
my_clli-9997-2	A	A	13	10	14	13	9	9	4	3	0	0
my_clli-9997-3	A	A	11	12	13	14	9	9	3	4	0	0
ls_linkset5	A	A	12	11	52	53	35	37	15	15	0	0
my_clli-9994-0	A	A	13	10	14	13	9	9	4	3	0	0
my_clli-9994-1	A	A	11	12	12	14	8	10	3	4	0	0
my_clli-9994-2	A	A	13	10	14	12	10	8	4	4	0	0
my_clli-9994-3	A	A	11	12	12	14	8	10	4	4	0	0
ls_linkset1	A	A	22	20	98	99	68	68	28	28	0	0
my_clli-9990-0	A	A	22	20	25	25	17	17	7	7	0	0
my_clli-9990-1	A	A	22	21	24	25	17	17	7	7	0	0
my_clli-9990-2	A	A	22	20	25	24	17	17	7	7	0	0
my_clli-9990-3	A	A	22	20	24	25	17	17	7	7	0	0
ls_linkset7	A	A	12	11	52	53	35	37	15	15	0	0
my_clli-9996-0	A	A	13	10	14	13	9	9	4	3	0	0
my_clli-9996-1	A	A	11	12	12	14	8	10	3	4	0	0
my_clli-9996-2	A	A	13	10	14	12	10	8	4	4	0	0
my_clli-9996-3	A	A	11	12	12	14	8	10	4	4	0	0
ls_linkset9	A	A	22	20	99	99	68	68	28	28	0	0
my_clli-9998-0	A	A	22	21	25	24	17	17	7	7	0	0
my_clli-9998-1	A	A	22	20	25	25	17	17	7	7	0	0
my_clli-9998-2	A	A	22	20	25	25	17	17	7	7	0	0
my_clli-9998-3	A	A	22	20	24	25	17	17	7	7	0	0

Figure 41 - Linkset view

The Performance Intelligence Center SS7 Surveillance application presents a user with a choice of following monitoring counts and statistics for the element (node/linkset/link):

- Link status - monitors the status of a link(s): state of the link and message counter per SIO
- Link state - monitors the state of a link(s): counters about state messages, retransmission and errors
- NetMgmt transfer signals - monitors the transfer information
- NetMgmt signal route - monitors the route information
- NetMgmt others - monitors other information about inhibition and restart

3.2.8 Performance Intelligence Center SIGTRAN Surveillance– SIGTRAN network diagnostic (Integrated Acquisition)

Performance Intelligence Center SIGTRAN Surveillance manage SIGTAN based SS7 networks gathered from the Performance Intelligence Center Integrated Acquisition.

Performance Intelligence Center SIGTRAN Surveillance provides immediate visual notification, and details, of SIGTRAN events that could impede or prevent the transport of SIGTRAN traffic in an CSP's network.

Performance Intelligence Center SIGTRAN Surveillance monitors and displays diagnostics data (status and counters) for SIGTRAN layers e.g. SCTP, M2PA, M3UA and SUA.

Functioning as a near real-time application, Performance Intelligence Center SIGTRAN Surveillance indicates state and status of application servers, application server processes, links, linksets, associations, cards that make up a network. Performance Intelligence Center SIGTRAN Surveillance application is integrated into Performance Intelligence Center Management and functions on a network view context. Performance Intelligence Center SIGTRAN Surveillance provides the capability to view overall status of elements as well as to drill down to individual links and associations

Sigtran Surveillance performs the following functions:

- Display status and statistics on the various SIGTRAN application server, application server processes, linksets, links, cards and associations that make up the network.
- Monitor status and state of an element(s)
- Tabular and graphical display options
- Ability to customize display
- Monitor element(s) in either table or graph format
- Monitor TOP N Associations by TPS or Occupancy
- Reset capability for state counts to zero
- Choose a specific color scheme using the themes option

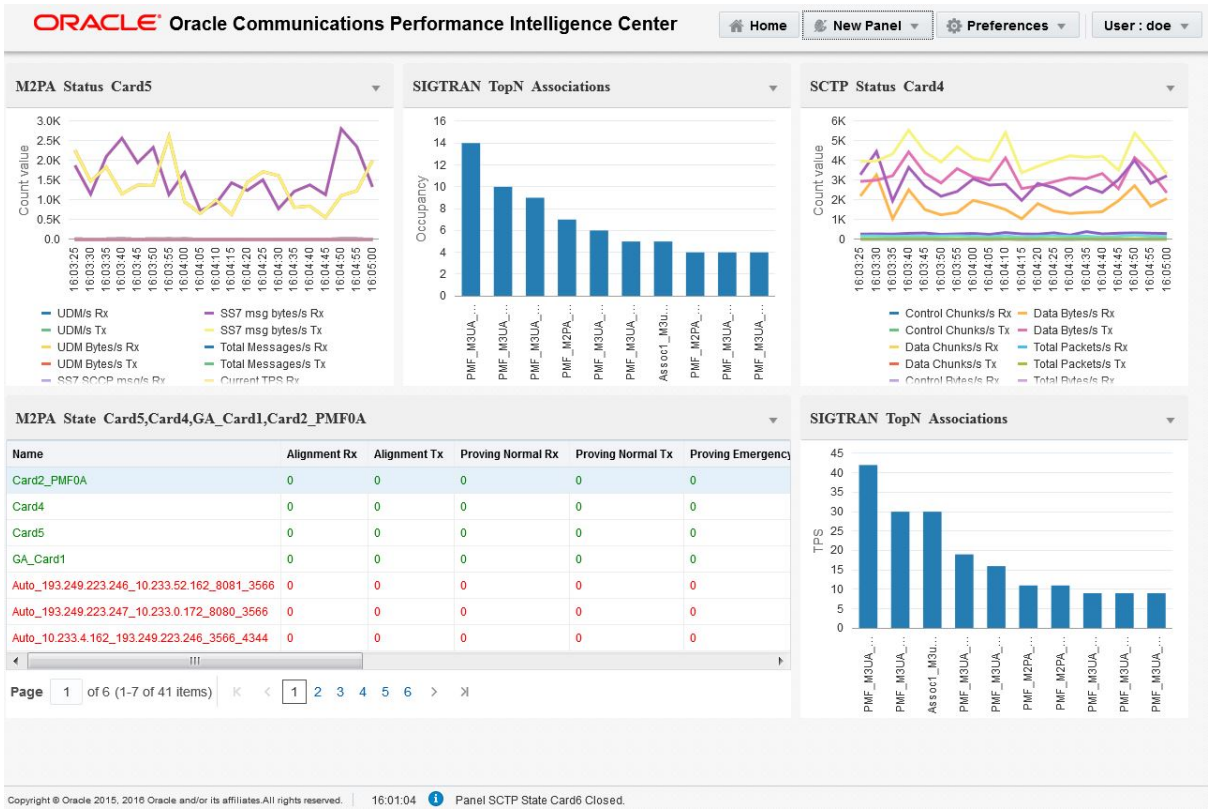


Figure 42 – SIGTRAN Surveillance main screen

3.2.8.1 STATE COUNTERS

SCTP:

- Heartbeat requests Rx/Tx
- Heartbeat ACKS Rx/Tx
- Operation Errors Rx/Tx
- Shutdown Rx/Tx
- Abort Rx/Tx

M2PA:

- Alignment Rx/Tx
- Proving normal Rx/Tx
- Emergency Rx/Tx
- Out of service Rx/Tx
- Processor outage Rx/Tx

- Busy Rx/Tx

M3UA:

- Management messages Rx/Tx
- SSNM messages Rx/Tx
- ASPSM messages Rx/Tx
- ASPTM messages Rx/Tx
- RKM messages Rx/Tx
- Destination unavailable Rx/Tx
- Signaling congestion Rx/Tx

3.2.8.2 STATUS COUNTERS

SCTP:

- # Control chunks Rx/Tx
- # Data chunks Rx/Tx
- # Control Bytes Rx/Tx
- # Data bytes Rx/Tx
- Total packets Rx/Tx
- Total bytes Rx/Tx

M2PA:

- # UDMs rx/Tx
- # UDM bytes Rx/Tx
- SS7 SCCP messages Rx/Tx
- SS7 ISUP messages Rx/Tx
- SS7 management messages Rx/Tx
- SS7 message bytes Rx/Tx
- Total messages Rx/Tx
- Current TPS Rx/Tx
- Occupancy % (TPS) Rx/Tx
- Reserved occupancy % Rx/Tx

M3UA:

- Non-data messages Rx/Tx
- Non-data message bytes Rx/Tx
- Data messages Rx/Tx
- Data message bytes Rx/Tx
- Current TPS Rx/Tx
- SCCP message Rx/Tx
- ISUP message Rx/Tx
- Total messages Rx/Tx
- % Total Occupancy (TPS) Rx/Tx
- Reserved occupancy % (TPS) Rx/Tx (Available only for links)

SUA :

- Management messages Rx/Tx
- Management message bytes Rx/Tx
- Data messages (CLDT + CLDR) Rx/Tx
- Data messages (CLDT + CLDR) bytes Rx/Tx
- Total messages Rx/Tx
- Total messages bytes Rx/Tx
- Current TPS Rx/Tx
- Total occupancy % Rx/Tx

3.2.9 Q.752 Application (EAGLE Integrated Acquisition)

In order to manage effectively the resources provided by a signaling system n° 7 network, it is necessary to monitor and measure the present, and estimate the future performance, utilization and availability of these resources.

The values measured are compared to a predetermined threshold for "regular traffic." When a value exceeds the predetermined threshold, an alarm normally is generated, and a notification might be sent to maintenance personnel. In this way, SS7 network monitoring helps the CSP detect security breaches.

Q.752 defines a standard set of measurements (statistical counts) and alarms for monitoring the health of SS7 networks.

Q.752 application supports a large number of counts and statistics. A snapshot of the Q752 counters that are supported by the Performance Intelligence Center system is as follows:

		Table	Description	Period	Name
☐	1	1	MTP - Signalling link fault and performance	30'	Q752_1
☐	2	2	MTP - Signalling link availability	30'	Q752_2
☐	3	3	MTP - Signalling link utilization	5'	Q752_3
☐	4	4	MTP - Signalling link set and route set availability	30'	Q752_4
☐	5	6	MTP - Signalling link traffic distribution	30'	Q752_6
☐	6	7	SCCP - Error performance	30'	Q752_7
☐	7	9	SCCP - Utilization	5'	Q752_9
☐	8	9 bis	SCCP - Quality of service	5'	Q752_9bis
☐	9	11	ISUP - Utilization	5'	Q752_11
☐	10	-	ISUP - Call failure measurement	30'	Q752_ISUPFailCau
☐	11	-	MTP - Signalling link occupancy rate	5'	Q752_SLOR

Figure 43 - Q.752 counters supported

The Q.752 counters need to be activated at the Performance Intelligence Center Integrated Acquisition and thresholds for the generation of alarms must be set. By default the configuration sets the status of the counters to true and has default threshold values set. The user can modify the low and high threshold of any of the counts and the effect will take place after 10 seconds.

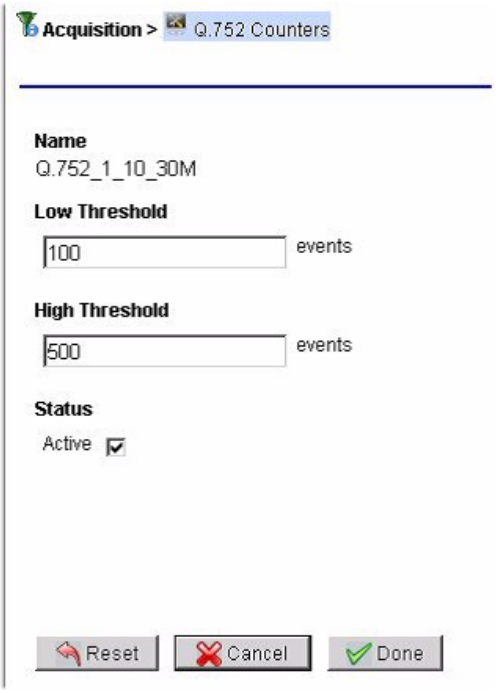


Figure 44 - Q.752 alarm threshold

The *XDR browser* application is used to view these Q.752 counters. All the counts are stored in the sessions. Q752 sessions can be identified by the session name. The session name will typically have Mediation Subsystem name_<Q752 Counter name> For example: Table 1 session for *Performance Intelligence Center Mediation (IXP)* Subsystem that has name: Mediation' Subsystem1 will look as "Mediation' Subsystem1_Q752_1 ".

3.2.10 SIGTRAN statistics and alarms

Performance Intelligence Center provides SIGTRAN statistics on the following layers:

- SCTP
- M2PA
- M3UA
- SUA

3.2.10.1 SCTP STATISTIC AND ALARMS

Statistics provided:

- SCTP association availability
- SCTP association performance (e.g. message counts, message rate, checksum error counts, etc)
- SCTP retransmissions

Alarms:

- Alarms related to the above statistics can be generated thanks to Performance Intelligence Center Management KPI application: Statistical alarm if % SCTP retransmissions is higher than a user-defined threshold. Performance Intelligence Center Management KPI application alarms generated on Statistics session
- SCTP associations loss and recovery alarms (endpoint failure detection)
- SCTP path failure loss and recovery alarms (multi-homed path loss)

3.2.10.2 M2PA STATISTICS AND ALARMS

Statistics :

- Number of Signaling link Congestion
- % of time a link is congested in a statistics period
- Number of Changeovers
- Number of Link Alignment procedures

Alarms

- Alarms related to the above statistics can be generated thanks to Performance Intelligence Center Management KPI application.
- Alarm on detection of transmit congestion
- Alarm on changeovers: alarm if number of changeovers is higher as a user-defined threshold on the statistics period
- Alarm on link alignment procedures: alarm if number of alignment is higher as a user-defined threshold on the statistics period

3.2.10.3 M3UA STATISTICS AND ALARMS

Statistics are provided per link ID (Association), per point code and per user part:

- Number of events & total duration: (per association & point code)
- Signaling congestion (SCON)
- Destination unavailable (DUNA)
- Destination user part unavailable (DUPU): also per user part
- Number of ASP (Application service part) down and total duration per statistical period
- Number of changeovers: per link ID and point code

Alarms:

- Alarms related to the above statistics can be generated thanks to Performance Intelligence Center Management KPI application.
- Statistical alarms on the number of occurrences of the events: SCON, DUNA, DUPU
- Statistical alarm on the number of changeovers: per link ID & point code
- Statistical alarm on total ASP down per period

3.2.10.4 SUA STATISTICS

Statistics per association and point codes:

- Number of events & total duration
- Signaling congestion (SCON)
- Destination unavailable (DUNA)
- Destination restricted (DRST)
- Destination user part unavailable (DUPU): also per user part
- Number of ASP (Application service part) down and total duration
- Number of connection oriented SUA messages sent & received per period (Connection refused: COREF)

Related alarms can be generated thanks to Performance Intelligence Center Management KPI application:

- Statistical alarms on the number of occurrences of the events: SCON, DUNA, DRST, DUPU
- Statistical alarm on total ASP down per period
- Statistical alarms on connection oriented SUA messages sent & received per period (Connection Refused: COREF)

3.3 PERFORMANCE INTELLIGENCE CENTER MEDIATION

3.3.1 Performance Intelligence Center Mediation

Performance Intelligence Center Mediation subsystem performs core functions of real-time correlation of PDUs into XDRs. It generates Key Performance Indicators (KPI), counts and corresponding QoS alarms in real time. It receives the Performance Intelligence Center Mediation data stream and stores XDRs and KPIs in an Oracle Database and PDUs into a flat file database for subsequent data requests.

This data can be analyzed in real-time for such functions as call trace as well as analyze KPIs to trigger alarms or reports on network and service status and state. Historical data analysis can be performed for trend or QoS/QoE analysis on traffic, resource utilization or network services as examples.

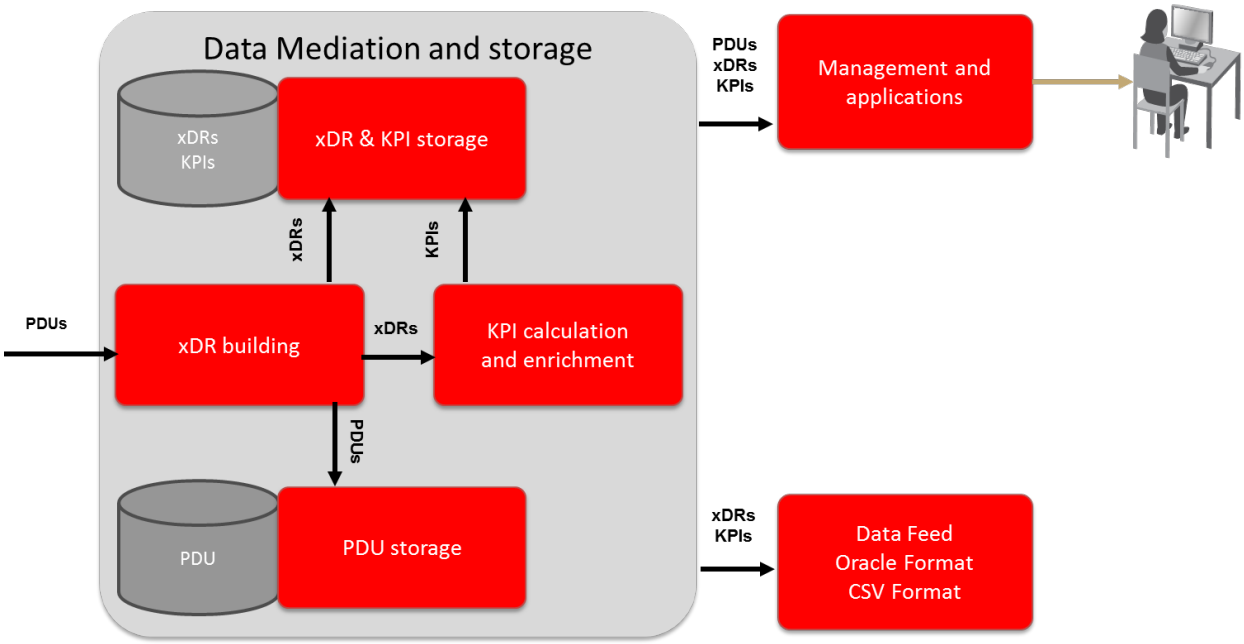


Figure 45 - Performance Intelligence Center Mediation

Performance Intelligence Center Mediation XDR correlation for multiple network types based on an array of protocols is accomplished with a library of XDR builders. The desired builder can be selected for the appropriate network and traffic type such as ISUP, TCAP, SIP, Diameter, etc. The XDR library is comprehensive with over 120+ protocols supported on a global basis for most any wire line, wireless, wireless data, VOIP or IMS network.

Mediation is distributed throughout the geographical areas corresponding to traffic capture. Each site may consist of one or several Performance Intelligence Center Mediation subsystems.

A Performance Intelligence Center Mediation subsystem is a collection of servers organized in 3 functional areas as depicted in the following diagram:

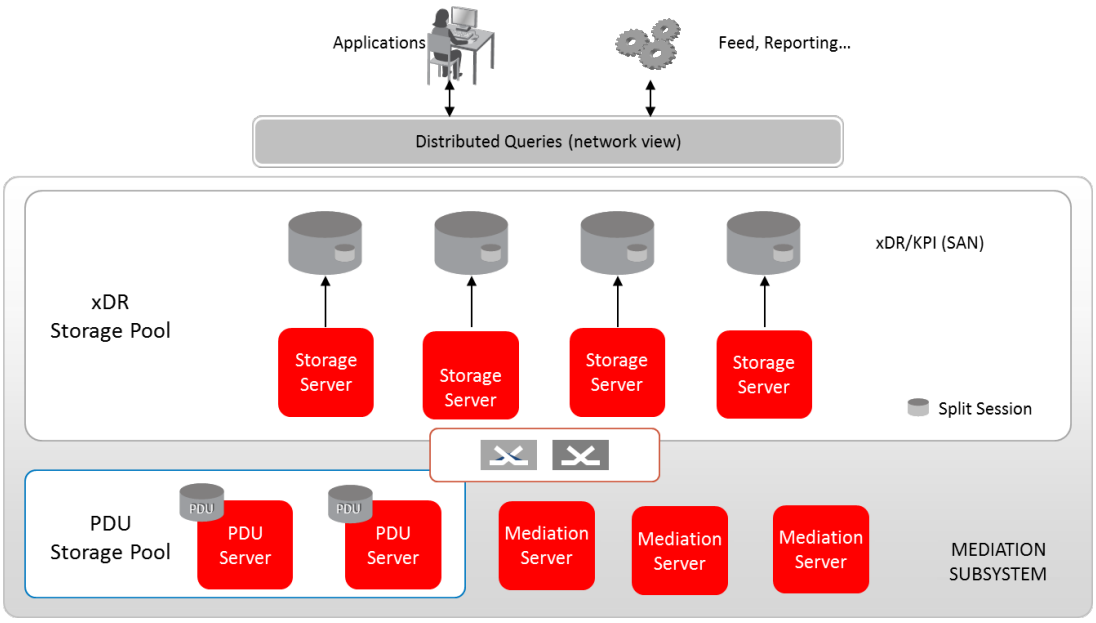


Figure 46 - Performance Intelligence Center Mediation subsystem overview

3.3.1.1 PERFORMANCE INTELLIGENCE CENTER MEDIATION SERVERS

Mediation servers receive real time PDU flows from Performance Intelligence Center Integrated or stand-alone Acquisition, correlate them and build XDRs accordingly. Process includes dynamic enrichment consisting of enriching XDR with fields that are not present in the related PDUs (e.g. IMSI) but come from the global context (e.g. mobile context) kept by the XDR builder.

Static enrichment may optionally add fields to XDR according to an external user table (e.g. add a network element label from its IP address).

Generated XDRs feed data into Performance Intelligence Center Management KPI application for generating KPIs and related alarms in real time.

Mediation servers work in load sharing mode so that the system can be easily sized according to the total throughput to be processed.

Virtualized Mediation server:

Performance Intelligence Center Mediation server can also be virtualized, using VMware or KVM hypervisor (see section 3.6).

3.3.1.2 PERFORMANCE INTELLIGENCE CENTER XDR STORAGE POOL

XDR storage pool is the Performance Intelligence Center XDR and KPI real time data base. A pool is a virtual server consisting of an extensible number of servers allocated to storage and independently from their physical location in enclosures. Each server of the pool runs an autonomous Oracle Database and has its own disk space. Storage is dynamically load-balanced throughout servers of the pool so that a given XDR or KPI session (e.g. MAP XDR session) is evenly distributed over the servers.

If a server goes down, then the xDR traffic is automatically taken over by the other servers of the pool without any loss of data (optional, option N+1 redundancy).

A query to the data base from an application is executed in parallel over all the servers of the pool (distributed queries) so that response time is reduced and the system can scale up to increase the number of simultaneous users.

3.3.1.3 PERFORMANCE INTELLIGENCE CENTER PDU STORAGE POOL

PDU storage server stores the PDUs originated from Mediation servers into its integrated PDU database. PDU servers, as XDR servers, are grouped into a pool. Each server of the pool runs an autonomous flat PDU database and has its own disk space. PDU storage is dynamically load-balanced throughout servers of the pool so that PDUs are evenly distributed over the servers.

If a server goes down, then the PDU traffic is automatically taken over by the other servers of the pool without any loss of data (optional, option N+1 redundancy).

Architecture advantages summary:

- Provide flexible linear scaling up:
    - add a storage server (hot plug insertion) to increase storage capacity or number of users independently from Mediation servers
    - or add PDU servers independently from Mediation and XDR storage servers
- Provide optional redundancy mechanism with automatic server failover. This will assure no loss of insertion data in case of server failure

3.3.2 Data Records, Packet Data Units and KPIs Storage on Customer IT infrastructure

As a full alternative to Performance Intelligence Center internal storage described in sections 3.3.1.2 and 3.3.1.3, it is possible for the customer to use his existing Customer IT Storage Infrastructure instead of Performance Intelligence Center internal storage servers. This can be done on a mediation site by site basis: both internal storage and storage on Customer IT Storage Infrastructure can be mixed on a an Performance Intelligence Center system but not on a given mediation site.

Main advantages for the customer are as follows:

- saving CAPEX and OPEX costs by using Customer existing infrastructure (cloud)
- enabling Customer to size storage duration as needed independently from the limitation of the Performance Intelligence Center internal storage
- enabling Customer to open access to the databases to non Performance Intelligence Center Users and Applications

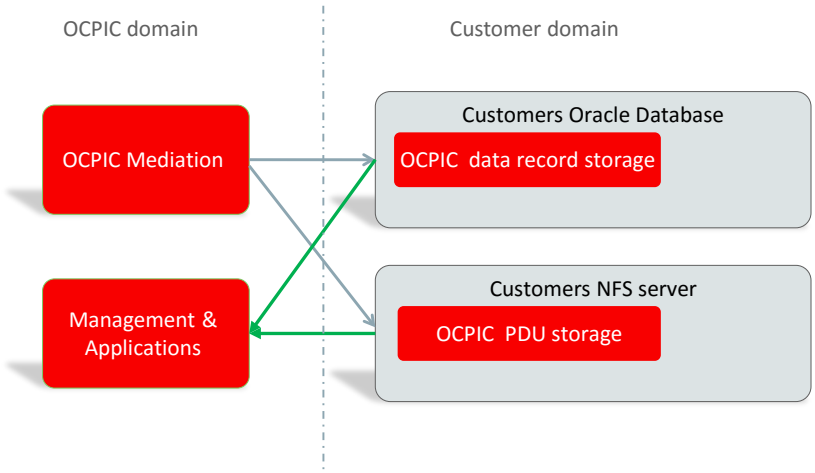


Figure 47 – Data Records, Packet Data Units and KPIs Storage on Customer IT Storage Infrastructure

3.3.3 XDR builders and protocols

3.3.3.1 XDR BUILDERS

Performance Intelligence Center generates protocol specific XDRs in real-time in the Performance Intelligence Center Mediation layer. XDR builders are correlating protocol exchanges in real time. XDR represent the high value from network information. Automatic enrichment of XDR is performed by correlation of multiple protocols allowing integration of IMSI, MSISDN, cell ID, EMEI, APN etc in XDR.

The XDR can be from multiple types:

- TDR for transaction based protocols (MAP, INAP, IS 41…)
- CDR for call based protocols (ISUP…)
- SDR for session based services (PDP session)

The XDR can be browsed with the XDR browser and be processed by Performance Intelligence Center Management KPI application to generate high value service oriented KPIs.

3.3.3.2 STATIC XDR ENRICHMENT

Performance Intelligence Center enables XDR enrichment with high value customer or network information. The static XDR enrichment reads a text file built with external data and external application to add useful information in real time in all the XDRs which match the filtering conditions.

Typical uses cases are:

- Country and operator recognition in SCCP calling or called global title
- Tagging VIPs based on their IMSI or MSIDN to later build related KPIs for SLA management
- LERG management in the context North American numbering plan
- Identifying carrier based on the node addresses

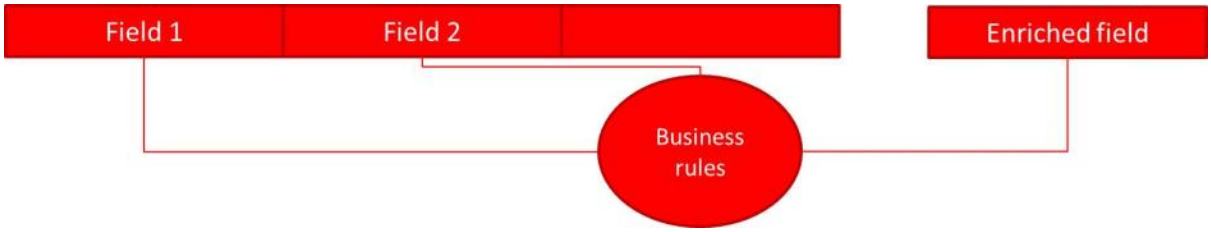


Figure 48 - Static XDR enrichment principle

On the other side, the automatic static enrichment update enables to automatically and periodically populate the static enrichment information from customer database without any manual process as shown in the diagram below.

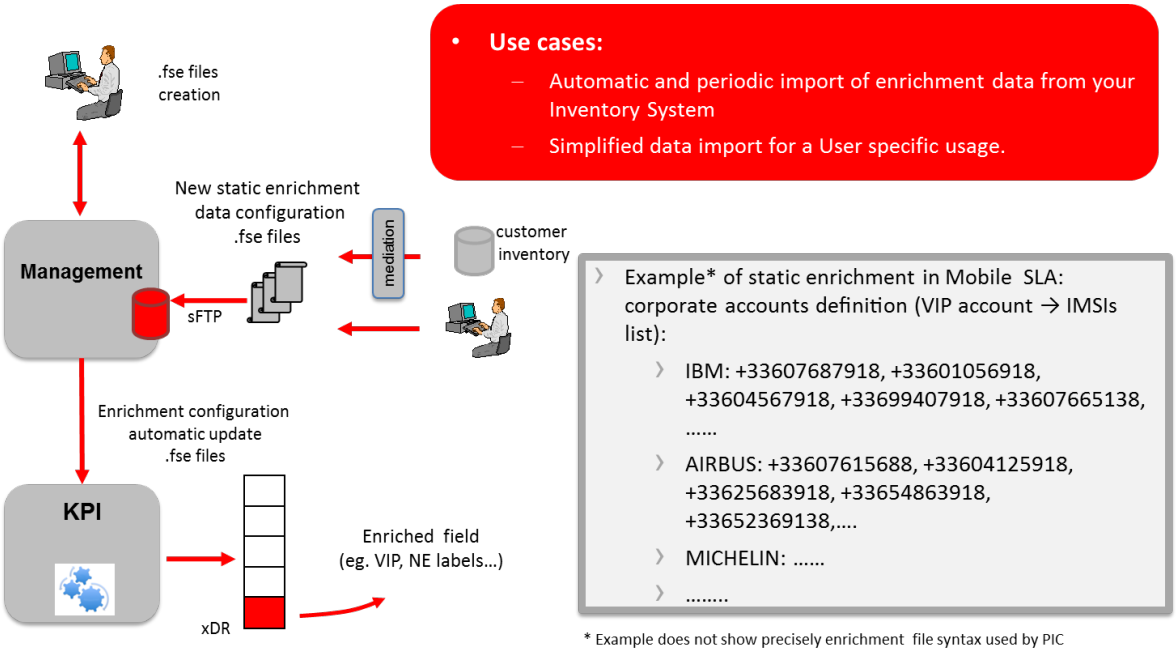


Figure 49 – Automatic static enrichment update

3.3.3.3 PROTOCOLS

Performance Intelligence Center supports a very broad array of protocols. For the complete list of supported protocols refer to Appendix B.

Performance Intelligence Center system is compliant with IPv6/IPv4 addressing formats. All IPv4 addresses remain displayed in IPv4 format while IPv6 addresses are displayed in IPv6 format.

All XDRs contain IPv6/IPv4 compatible addresses, with the exception of SIGTRAN CDRs which support only IPv4 addresses.

3.4 PERFORMANCE INTELLIGENCE CENTER MEDIATION DATA FEED

Performance Intelligence Center Mediation Data Feed is a capability to export/transmit signaling data – XDRs and KPIs (Key Performance Indicator) – captured and/or created by the Performance Intelligence Center platform, to external 3rd party applications and databases. Following is the architecture overview for the Data Feeds:

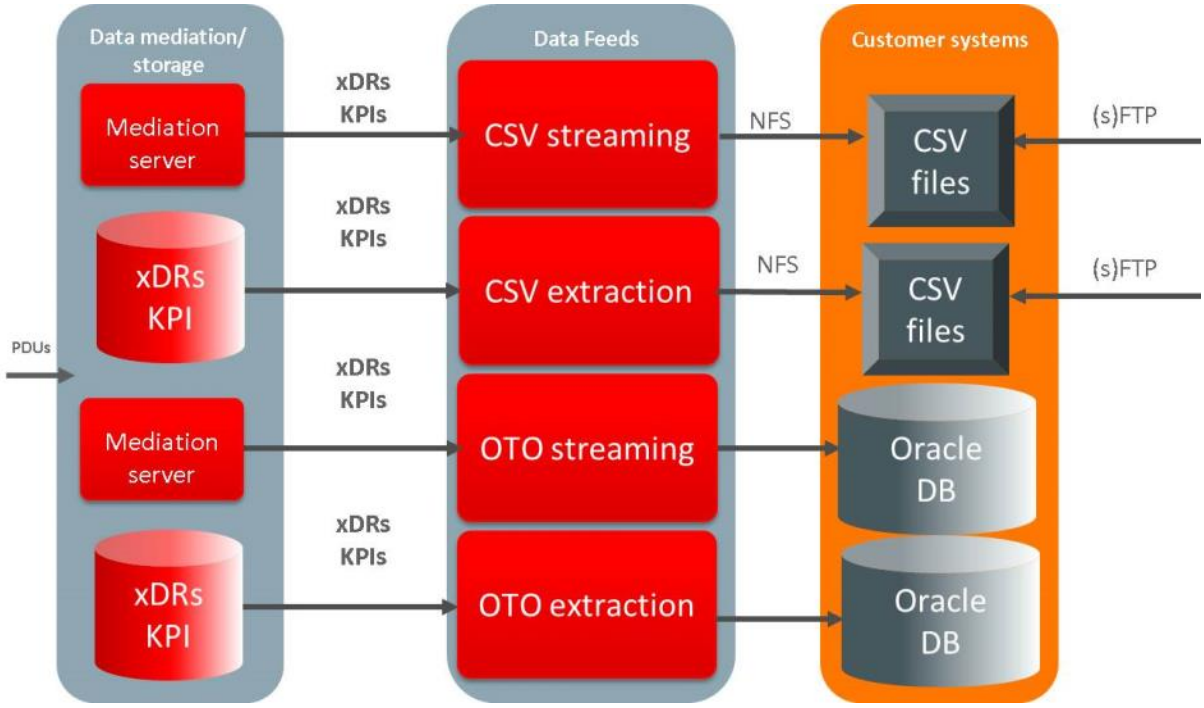


Figure 50 - Performance Intelligence Center Mediation Data Feed

All the data feeds carry out their function from the Performance Intelligence Center Mediation subsystem which is the correlation and storage subsystem.

The XDR/KPI records can be exported from the Performance Intelligence Center system using the following modes:

- CSV streaming
- CSV extraction
- OTO streaming
- OTO extraction

There is also a MSU data feed that maybe be activated directly from the Performance Intelligence Center Integrated or stand-alone Acquisition. It is called Acquisition Data Feed and will be described into more details later in this document.

3.4.1 Performance Intelligence Center Mediation Data Feed general features

The following general features apply to all the Performance Intelligence Center Mediation Data Feed:

- Centralized configuration of the data feeds under Performance Intelligence Center Management
- Export of data based on schedule (automatic mode)
- Various format of export file (txt, csv, Oracle,…)

- Filtering of exported data based on specific parameters, related to specific subscriber (IMSI/MSISDN) or network element (APN name, SGSN/GGSN IP address)
- Data can be exported from multiple Performance Intelligence Center Mediation sub-systems
- Monitor the status and progress of the Performance Intelligence Center Mediation Data Feed
- System surveillance and recovery

3.4.2 Performance Intelligence Center Acquisition Data Feed - MSU data feed from the Performance Intelligence Center Integrated or Probed Acquisition

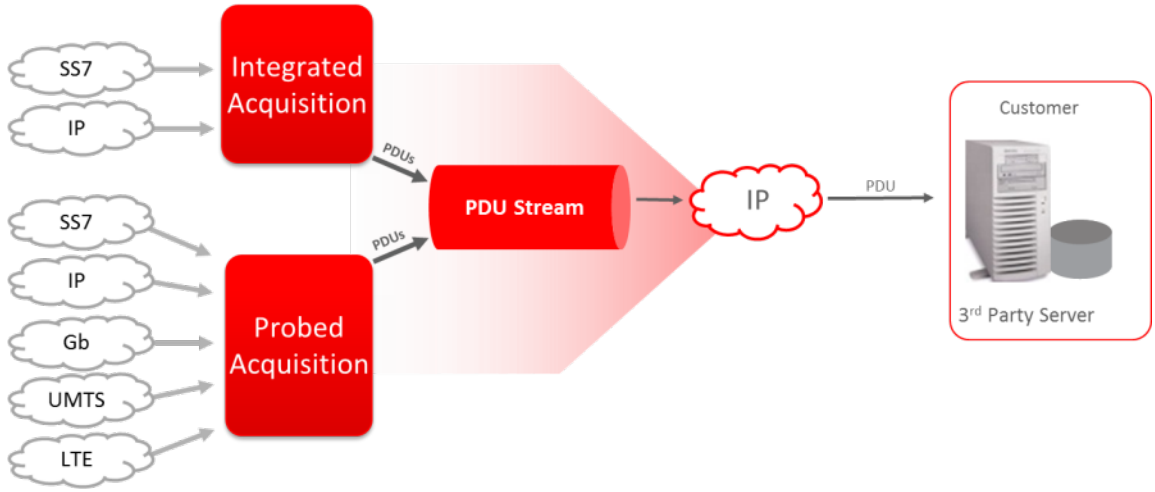


Figure 51 – Performance Intelligence Center Acquisition Data Feed Architecture

Oracle has developed Performance Intelligence Center Acquisition Data Feed to allow direct MSU data feed from the Performance Intelligence Center Integrated or Probed Acquisition to the customer 3rd party server. Performance Intelligence Center Acquisition Data Feed is a Oracle provided software compatible with Linux OS. It establishes a Linux process that allows for the establishment of a LAN/WAN connection from all XMFs at a site to the customer 3rd party server. The customer server can be located at the site with the Performance Intelligence Center Acquisition or may be located remotely. If connection is lost an alarm is triggered.

The MSU/IP packets are stored in single file/single directory, or multiple files/single directory or multiple files/multiple directories according to the configuration. Each record contains the full MSU/IP packet + a header. The file is rotated at configurable interval (from 15 sec to 1 hour) and it is renamed when it is closed.

Performance Intelligence Center Acquisition Data Feed is compatible with the filterable MSU capability of Performance Intelligence Center. It is available from all of the following Performance Intelligence Center EAGLE Integrated , Performance Intelligence Center Diameter Signaling Router Integrated or stand-alone Acquisition interfaces, for any of the protocol carried on the following interfaces:

- LSL/HSL (through converter)
- SIGTRAN
- IP
- EAGLE

3.5 PERFORMANCE INTELLIGENCE CENTER DATA ACQUISITION

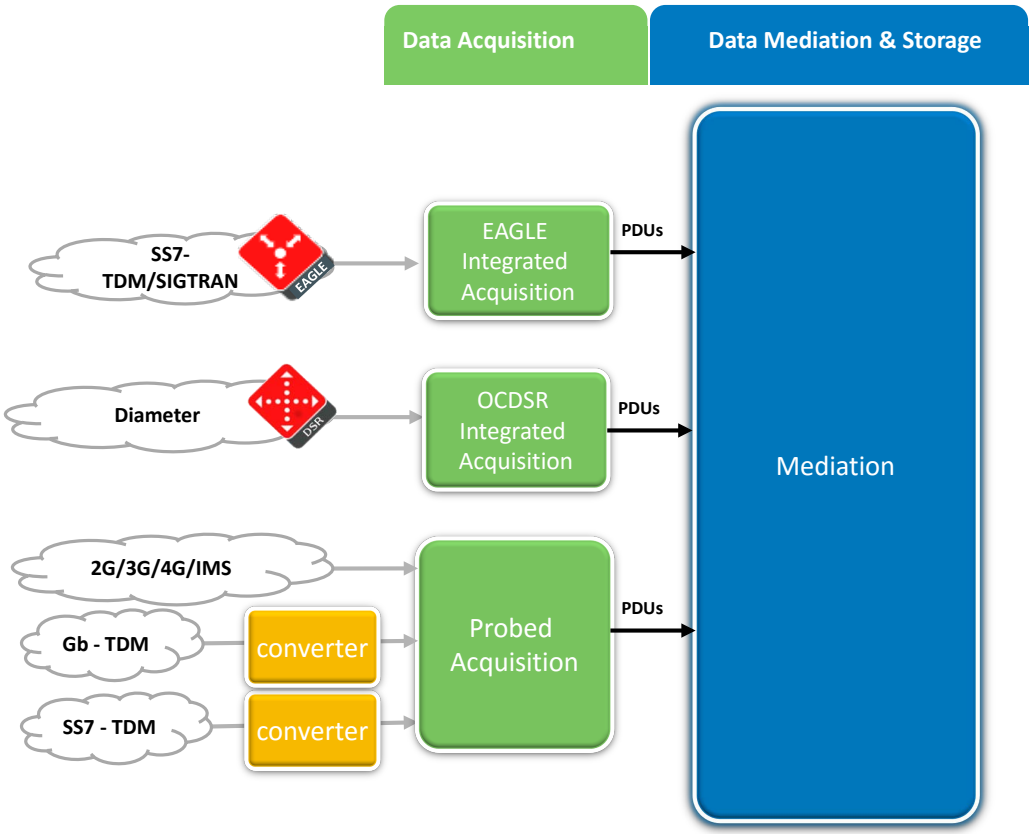


Figure 52 – Performance Intelligence Center Acquisition Architecture

3.5.1 Performance Intelligence Center EAGLE Integrated Acquisition

3.5.1.1 PERFORMANCE INTELLIGENCE CENTER EAGLE INTEGRATED ACQUISITION ARCHITECTURE

Performance Intelligence Center EAGLE Integrated Acquisition is a data acquisition component that provides integrated signaling acquisition in conjunction with the EAGLE.

Inputs to the Performance Intelligence Center EAGLE Integrated Acquisition are signaling frames acquired from EAGLE. Outputs from the Performance Intelligence Center EAGLE Integrated Acquisition are filtered frames with timestamps. The primary functions of the Performance Intelligence Center EAGLE Integrated Acquisition are:

- Data Acquisition: to support a highly, reliable architecture for signaling message capture.
- 6 h buffering, this option allows frames to be buffered to avoid data loss in the event of network problems.

- Filtering to ensure non-relevant frames are identified and discarded. The filters, which consist of any combination of fields, are fully configurable. Arithmetic expressions can also be included.
- Routing to provide secure transport to the proper mediation processing resource according to configurable criteria.

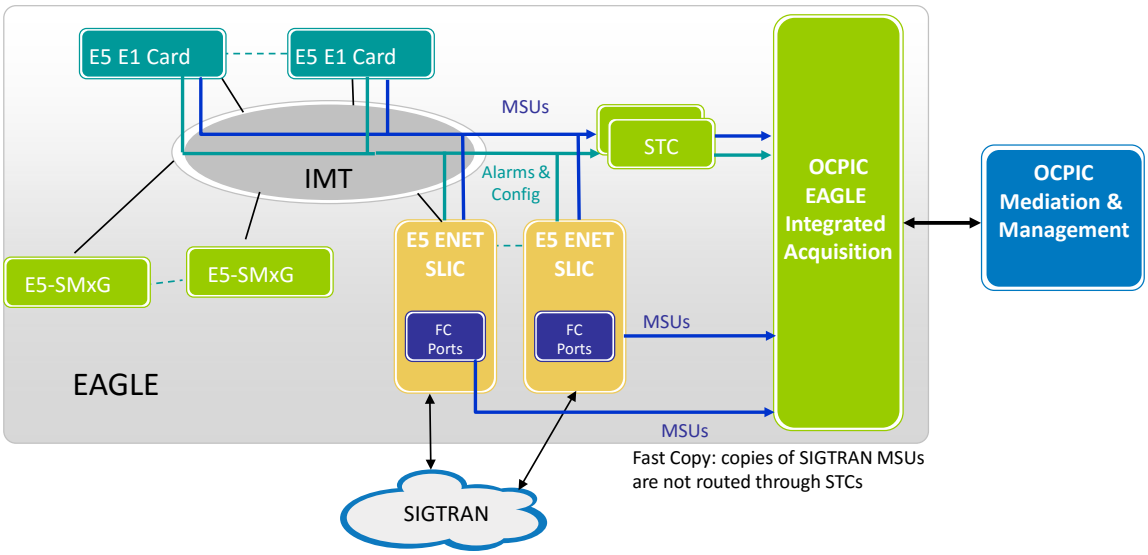


Figure 53 - Performance Intelligence Center EAGLE Integrated Acquisition

Performance Intelligence Center EAGLE Integrated Acquisition provides the capability to monitor the signaling link interfaces supported on the EAGLE LIM cards, including LSL, ATM HSL, SE HSL, and SIGTRAN (M2PA, M3UA & SUA).

Time stamping of signaling messages captured is made at the message copy source as the messages are copied. Time stamping is synchronized using the Network Timing Protocol (NTP) using a centralized NTP server assigned on a system basis.

Communication between the Performance Intelligence Center EAGLE Integrated Acquisition and the EAGLE to forward the MSU is available through 2 modes:

STC copy

In this mode, MSUs for the monitored linksets are copied from the EAGLE cards through the IMT bus to the STC cards. The STC cards are then forwarding the MSU to the Performance Intelligence Center EAGLE Integrated Acquisition.

Fast copy

To avoid monitoring traffic presence on the IMT bus and to reduce the copy overhead on the EAGLE cards for SIGTRAN traffic, IPSG and IPGW E5Enet and SLIC cards implement a fast copy mechanism. Full capacity of EAGLE card and IMT bus is available for customer operational traffic.

Fast copy is available on Enet ISPG and SLIC cards. Monitoring of other cards is available on STC copy. Fast Copy and STC copy are supported concurrently on the Performance Intelligence Center EAGLE Integrated Acquisition.

3.5.1.2 PERFORMANCE INTELLIGENCE CENTER EAGLE INTEGRATED ACQUISITION RELIABILITY

The Performance Intelligence Center EAGLE Integrated Acquisition provides reliability with the following attributes:

- Optional automatic failover to the N+1 server if a failure occurs on any Performance Intelligence Center EAGLE Integrated Acquisition in the subsystem
- Redundant LAN architecture for interface reliability to the EAGLE
- Redundant WAN access architecture for interface reliability to the Performance Intelligence Center Mediation
- Mirrored drives for reliability and to enable live upgrade of Performance Intelligence Center EAGLE Integrated Acquisition servers

3.5.1.3 PERFORMANCE INTELLIGENCE CENTER EAGLE INTEGRATED ACQUISITION 6H BUFFERING

Performance Intelligence Center EAGLE Integrated Acquisition provides buffering and storage of processed signaling information associated with the interface protocol used for secure transfer of the message signaling PDUs to downstream correlation servers thus mitigating WAN outages

When configured on the Performance Intelligence Center EAGLE Integrated Acquisition, buffering of signaling data from monitored links for up to 6 hours is performed on the Performance Intelligence Center EAGLE Integrated Acquisition in case of network outage. When the outage event is cleared, the buffered data are sent to the Performance Intelligence Center Mediation for correlation and XDR builder functions. By default the 6h buffering is activated for the MSU and not for IP raw (see IP raw feature section).

If 6h buffering is not required in customer implementation, it is possible to deactivate completely the functionality in the Performance Intelligence Center EAGLE Integrated Acquisition. A reduced buffering function (few seconds) is maintained in memory and Performance Intelligence Center EAGLE Integrated Acquisition performances are increased.

3.5.1.4 PERFORMANCE INTELLIGENCE CENTER EAGLE INTEGRATED ACQUISITION FILTERING

Performance Intelligence Center EAGLE Integrated Acquisition provides filtering capabilities for filtering and discrimination of protocol signaling messages for creation of protocol data flows and data source connections to mediation layer.

All non-relevant frames can be identified and discarded for data flow creation.

Performance Intelligence Center EAGLE Integrated Acquisition supports an extended filter capability mode to create very complex filter algorithms.

3.5.1.5 PERFORMANCE INTELLIGENCE CENTER EAGLE INTEGRATED ACQUISITION AUTOMATIC FAILOVER

In order to allow faster recovery and to avoid reconfiguration issue, in case of failure and after all recovery attempts, the system de-allocates the traffic assigned to the failed Performance Intelligence Center EAGLE Integrated Acquisition server and reassigns the traffic from the failed

Performance Intelligence Center EAGLE Integrated Acquisition server. Nominal traffic analysis is restored automatically.

3.5.1.6 Performance Intelligence Center EAGLE Integrated Acquisition management

Through the Performance Intelligence Center EAGLE Integrated Acquisition integration with the EAGLE, the configuration of the signaling network is discovered and available in the Performance Intelligence Center central configuration management. This simplifies and provides an error free mechanism to configure the monitoring.

3.5.1.7 Performance Intelligence Center EAGLE Integrated Acquisition IP raw and MSU forwarding option

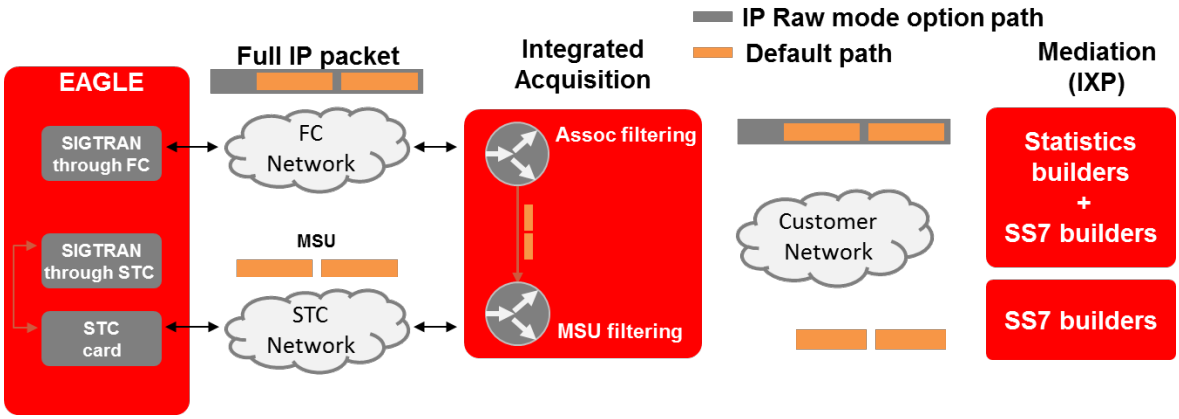


Figure 54 - IP Raw & MSU

By default, the Performance Intelligence Center EAGLE Integrated Acquisition is working in MSU forwarding option. Only chunks containing valuable MSU are monitored. This is the best approach to optimize the bandwidth on the customer network and to allow rich set of filtering in the Performance Intelligence Center EAGLE Integrated Acquisition. High level SS7 stacks are not impacted and visibility down to the chunk level (M2PA , M3UA or SUA) is provided.

If SIGTRAN low layers visibility is requested, with Fast copy, the IP raw option can be activated. In that case, the full IP packet is forwarded to the Performance Intelligence Center EAGLE Integrated Acquisition, including all SCTP low layers and management messages. This traffic is used to feed the SIGTRAN low layers builders. It enables in depth troubleshooting for the selected associations and SIGTRAN statistics.

Both modes can be activated simultaneously on the Performance Intelligence Center EAGLE Integrated Acquisition server (the IP raw option can be activated per associations).

3.5.1.8 Performance Intelligence Center EAGLE Integrated Acquisition options

2 options are available for EAGLE Integrated acquisition:

- For all configurations (including large configurations)
  EAGLE Integrated acquisition is loaded on standard servers installed inside a frame close to the EAGLE. By adding new servers or switches, this frame dedicated to EAGLE Integrated monitoring, allows scalability up to the monitoring of a fully loaded EAGLE.

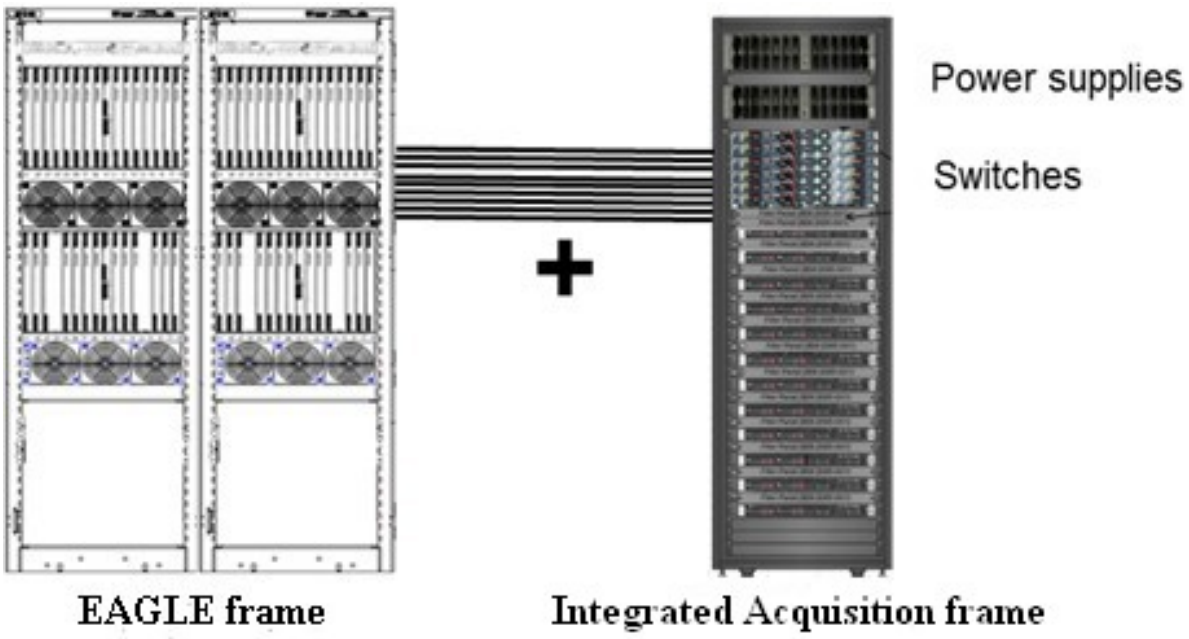


Figure 55 - EAGLE Frame to EAGLE Integrated Acquisition connection

- For small to medium configuration

  For small to medium configuration, the use of a dedicated frame may not be optimized. When configuration allows it, EAGLE Integrated acquisition can be loaded on EAGLE APP-B cards installed inside the EAGLE frame. This option provides several advantages like footprint saving, simplified cabling, no external power supplies (power provided by the EAGLE) and extended life cycle compared to standard servers.

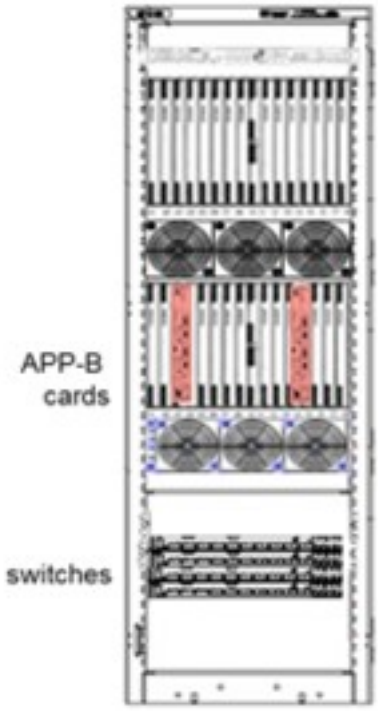


Figure 56 - APP-B in the EAGLE frame

For both options, all EAGLE Integrated monitoring functionalities are the same.

3.5.2 Performance Intelligence Center Probed Acquisition

Performance Intelligence Center stand-alone Acquisition acts as an application level router. It extracts frames from the network using network monitored access (for passive monitoring), timestamps them, and sends this information to the Performance Intelligence Center Mediation. Some filters can be defined to select only a given set of data.

Acquisition supports specific interfaces for different protocols as reflected in the table below.

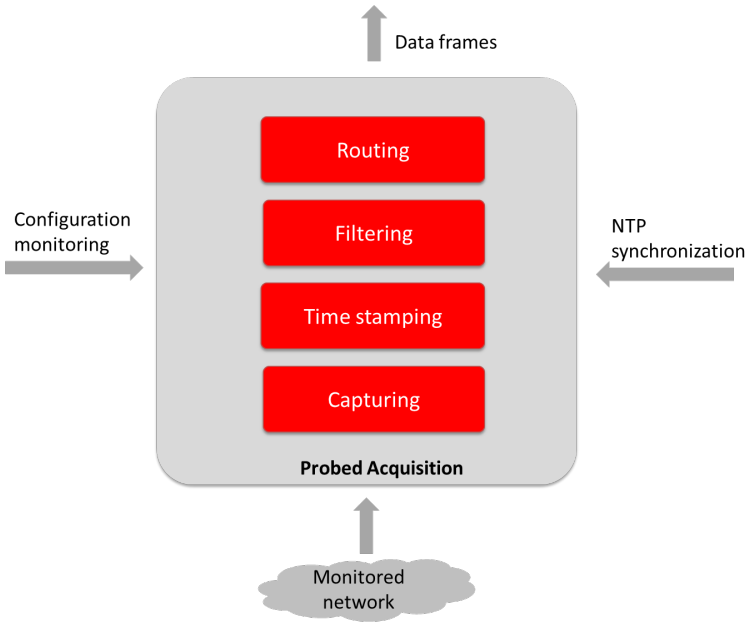


Figure 57 - Overview of Performance Intelligence Center Probed Acquisition

Table 4 - Performance Intelligence Center Probed Acquisition feature supported matrix

Network	Physical layer	Network Monitoring Access	Signaling transport
SS7	G703 - G704	Through SS7 to SIGTRAN converter	MTP2 Q703
GSM	G703 - G704	Through SS7 to SIGTRAN converter	MTP2 Q703
GPRS Gb	G703 - G704	Through Gb over E1 to Gb over IP converter	Frame relay
GPRS /UMTS/LTE IP	Ethernet	TAP or port mirroring	IP
SS7- SE-HSL	G703 G704	Through SS7 to SIGTRAN converter	MTP2 Q703
SS7- ATM-HSL	G703 – G704 – ATM	Through SS7 to SIGTRAN converter	SAAL

Virtualized Probed Acquisition server:

Performance Intelligence Center Probed Acquisition server can also be virtualized, using VMware or KVM hypervisor (see section 3.6).

3.5.2.1 *FRAME ACQUISITION*

Inputs to the Performance Intelligence Center Acquisition are signaling frames acquired from the network. Output beingframes with timestamps, minus irrelevant data. The primary functions of the Acquisition are:

- Time stamping: To ensure timestamp accuracy and particularly the necessary synchronization of the different message feeders distributed all over the network, each must be synchronized by one or several NTP servers
- 6 hours buffering option for SS7 traffic
- Filtering: All non-relevant frames must be identified and discarded. The filters, which consist of any combination of fields, are fully configurable. Arithmetic expressions can also be included. An extension of filters is now available for SIGTRAN (PC, SSN, SIO and GT).
- Routing: Frames are routed to the proper mediation processing resource according to configurable routing criteria

3.5.2.2 *HSL/LSL TO SIGTRAN CONVERTER*

Based on market evolution towards SIGTRAN, Oracle is now proposing to use the HSL/LSL to SIGTRAN converter with Performance Intelligence Center Probed Acquisition IP to replace HSL/LSL legacy old cards. This solution provides smooth migration path for customer still having legacy links and migrating towards SIGTRAN. All investment made on SIGTRAN are preserved and the high capacity of the converter in a very small foot print provides a very efficient solution for legacy links.

The converter is an external high density box positioned in front of a standard Performance Intelligence Center Probed Acquisition. It extracts the MSU above the MTP2 layer and codes them inside a M2UA SIGTRAN association. All the layers above MTP2 are preserved. Therefore, the conversion doesn't impact the upper layers builder visibility.

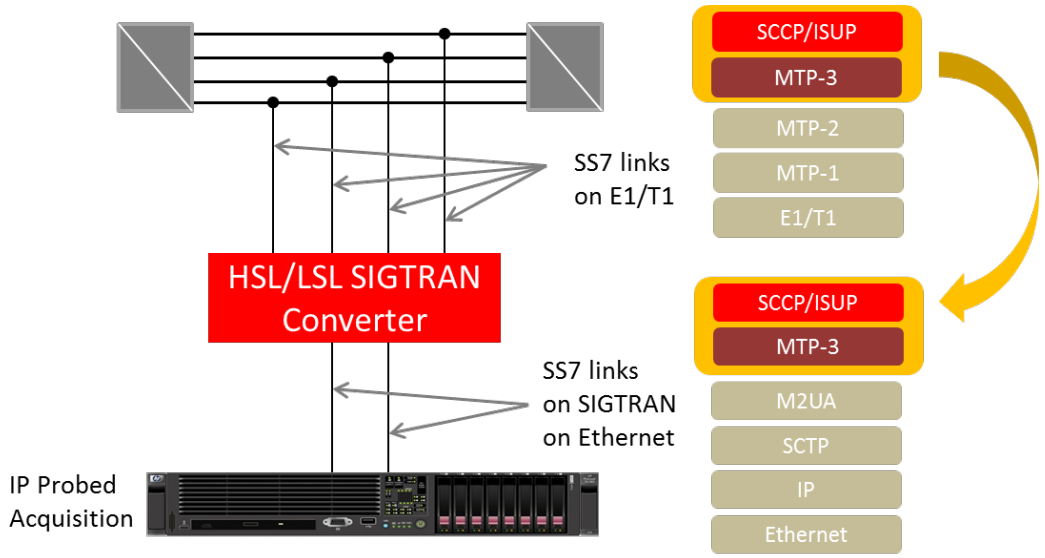


Figure 58 – LSL/HSL to SIGTRAN Converters

The converter is available for E1 or T1, from 64 to 128 links. High concentration connectivity is achieved through external patch panels (balanced 120 Ω and unbalanced 75 Ω circuits are supported). The converter supports up to 200 LSL (for 64 links option) or 400 LSL (for 128 links option)

Figure 59 – LSL/HSL to SIGTRAN Converters – connectivity

Note that the conversion doesn't allow low layer builder to compute information like SLOR, Q752…
Note: The converter implements troubleshooting tools and counters reports accessible through its own interface. This includes:

- Link status: LOS (Loss of Signal), AIS (Alarm Indication Signal), LOF (Loss of Frame), RAI (Remote Alarm Indication) and BPV (Bipolar Violation).
  Alarms can be generated for link status change.
- Counters:
  - # Synchronizations down, #Frame errors, #CRC4 errors, #LOS, #AIS, #LOF and #RAI
  - ATM counters: #Total Cells, #HEC Errors, #Discarded Cells, #failed Reassemblies, #Forwarded and Discarded Packets.
  - HDLC: #Total Packets, #Frame Check Sequence Errors, # Frame Aborted, #Alignment Errors and #Length Errors.

Note that 56Kb/s in E1 LSL is not supported.

3.5.2.3 GB OVER E1 TO GBOIP CONVERTER

As for SS7, Oracle is following network evolution to all IP. Oracle is proposing a front head converter before the Performance Intelligence Center Probed Acquisition to convert Gb over E1 to Gb over IP. This solution provides smooth migration path for customer still having legacy Gb links and migrating towards IP. All investment made on IP are preserved.

The converter is an external high density box positioned in front of a standard Performance Intelligence Center Probed Acquisition. It extracts the layers encapsulated in the frame relay PVC and codes them inside Gb over IP path. All the layers above frame relay (including NS/BSSGP) are preserved. Therefore, the conversion doesn't impact the Gb builder visibility

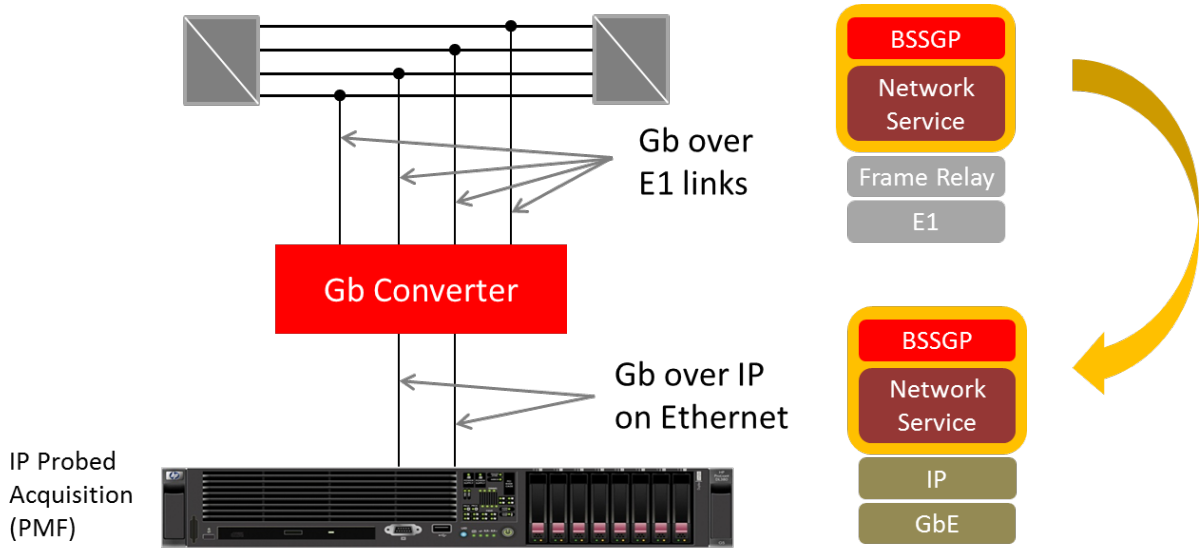


Figure 60 – Gb over E1 to Gb over IP Converter

The converter is available for 64 or 128 Gb over E1 links. High concentration connectivity is achieved through external patch panels (balanced 120 Ω and unbalanced 75 Ω circuits are supported). The converter supports up to 200 frame relay PVC (for 64 links option) or 400 PVC (for 128 links option)

3.5.2.4 PCAP CAPTURE

With Performance Intelligence Center, detailed PDU are available for each XDR. But for troubleshooting purpose, it is important sometime to have a capture of the packets captured directly on the wire. The *Performance Intelligence Center Probed Acquisition* IP allows Ethereal like capture and storing directly on the probe.

Filters can be defined to extract only the relevant data for the capture. All *Performance Intelligence Center Probed Acquisition* filtering rules are applicable including SIGTRAN content filtering. Specifically for SIGTRAN, customer has the capability to capture the IP packets before or after chunk extraction.

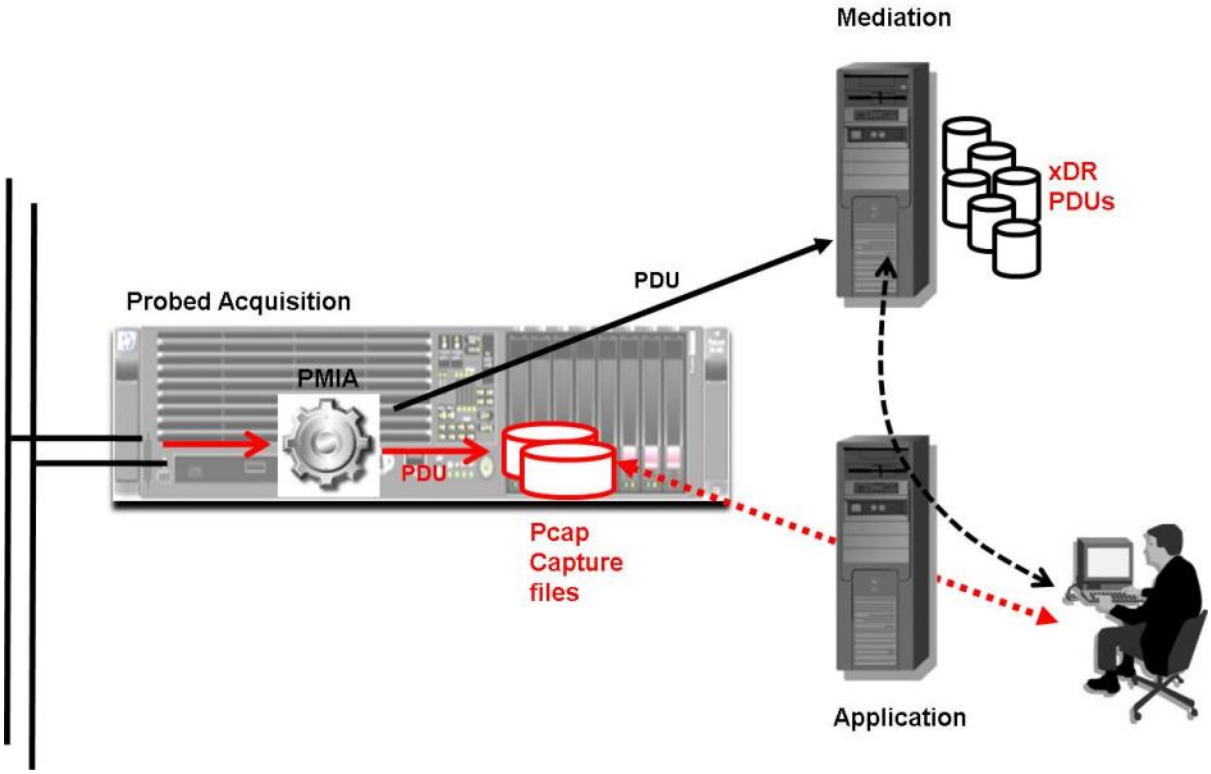


Figure 61 – Pcap capture for Performance Intelligence Center Probed Acquisition

All configuration including start and stop of the capture is controlled through the configuration.

The capture file is created based on standard pcap format (compatible with Ethereal, Wireshark…).

3.5.3 Diameter Signaling Router Integrated Acquisition

In the Diameter Signaling Router monitoring case, Performance Intelligence Center can take benefit of a management link to Diameter Signaling Router enabling to acquire the configuration tables from Diameter Signaling Router. This allows Performance Intelligence Center LTE Diameter xDRs (generic) to be populated with the explicit names of the Diameter Signaling Router peers equipement which is very convenient for trace and troubleshooting .

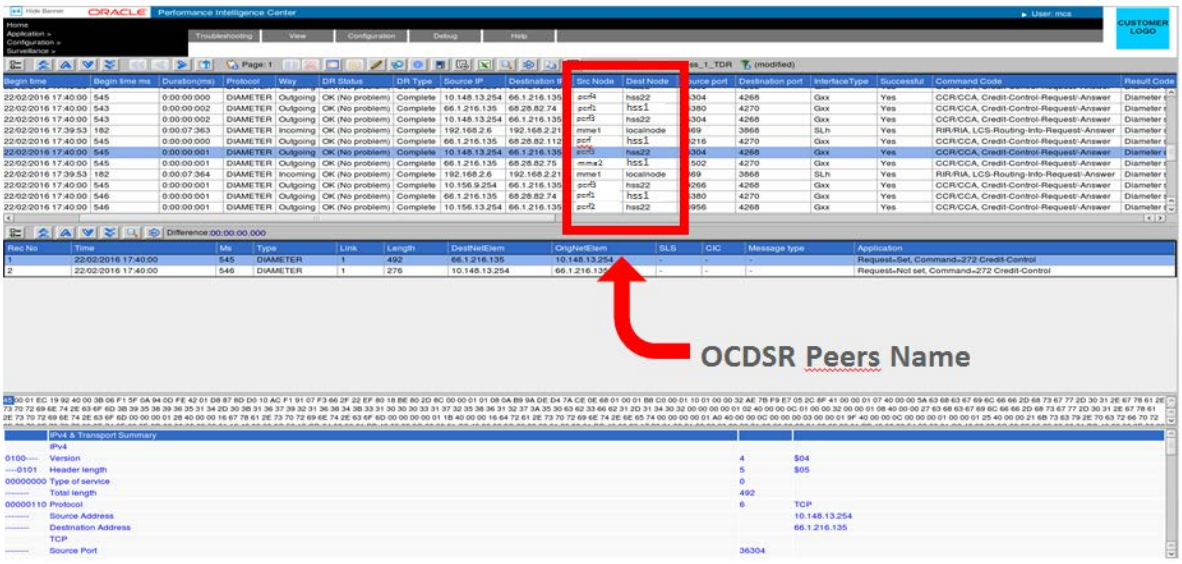


Figure 62 – LTE Diameter xDR enrichment with Diameter Signaling Router peers names

This configuration is fully dedicated to Diameter Signaling Router monitoring and only Diameter Signaling Router Diameter traffic can be monitored here.

HW configuration is based on Probed Acquisition HW (see §3.5.2).

PCAP capture (§3.5.2.4) and Acquisition Data Feed (§3.4.2) functions are still valid for Diameter Signaling Router Integrated Acquisition (Diameter Signaling Router Diameter traffic only).

Performance Intelligence Center Diameter Signaling Router Integrated Acquisition server can also be virtualized, using VMware or KVM hypervisor (see section 3.6).

3.6 Performance Intelligence Center Virtualized Configurations Summary

Figure 63 summarizes the possible Performance Intelligence Center Virtualized Configurations for Acquisition, Mediation and Management.

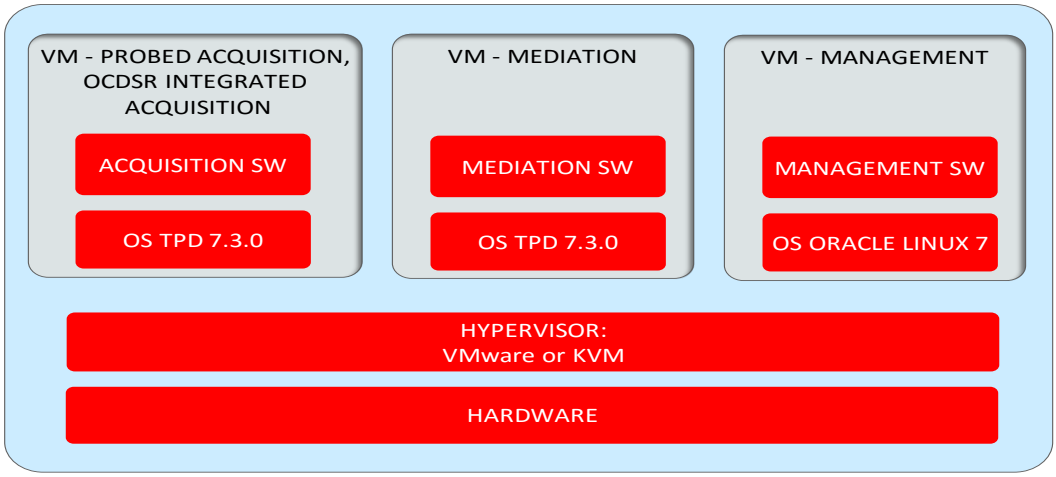


Figure 63 – Performance Intelligence Center Virtualized Configurations Summary

Note: EAGLE Integrated Acquisition Server is not virtualizable.

4 APPENDIX A: ACRONYMS

This section defines the specific terms, acronyms, and abbreviations used in this document.

Table 5 – List of acronyms

Acronym	Definition
A Interface	the GSM interface between a BSS and an MSC
AIN	advanced intelligent network
AMA	automatic message accounting
ANSI	American National Standards Institute
API	application programming interface
ARPU	Average Revenue Per User
ASCII	American standard code for information interchange
ASR	answer seizure ratio
ATM	asynchronous transfer mode
BCD	binary coded decimal
B-G Interfaces	all GSM interfaces that use the MAP protocol
BHC	base hardware configuration
BIB	backward indicator bit
BNS	billing number services
BSC	base station controller
BSN	backward sequence number
BSS	GSM base station subsystem
BSSMAP	GSM base station subsystem mobile application part
CDMA	code division multiple access
CDR	call detail record
CIC	ISUP circuit identification code
CIMD2	Computer Interface to Message Distribution 2, Nokia
CLLI	common language location identifier
CMISE	common management information service element
CORBA	common object request broker architecture
CPN	called party number
CR	an SCCP connection request message
CRC	cyclic redundancy check
CSFB	Circuit Switched Fallback
DCM	data communication module cards
DIR	direction, transmit or receive
DTAP	GSM direct transfer application part
ECM	enhanced communications module
EECM	Ethernet enhanced communications module
EMI/UCP	External Machine Interface/Universal Computer Protocol,

Acronym	Definition
EMM	Evolved Mobility Management
EMR	event message report
ERAB	Evolved Radio Access Bearer
ESM	Evolved Session Management
ESP	extended services platform
FIB	forward indicator bit
FIFO	First-in/First-Out
Filter	A set criteria for matching against all buffered messages which to display in a protocol analysis form
FISU	fill in signal unit
FSN	forward sequence number
FTP	file transfer protocol
GDMO	guidelines for the definition of managed objects
GMM	GPRS mobility management
GMSC	gateway mobile switching center
GPL	generic program load
GPRS	General Purpose Radio System
GSM	global system for mobile communications
GSM A	global system for mobile communications, A-interface
GSM MAP	global system for mobile communications, mobile application
GTP-C	GPRS tunneling protocol-control
GTT	global title translation
GUI	graphical user interface
HLR	GSM home location register
ICP	Integrated Correlation Platform
ICTM	inter-carrier TCAP monitoring
IMF	Integrated Message Feeder
IMSI	international mobile subscriber identity
IN	intelligent network
INAP	intelligent network application part
IP	Internet protocol
IPDR	IP Detail Record
IS41	interim standard 41, a signaling protocol used in the North American standard cellular system
IS634	interim standard 634, the interface between cellular base stations and mobile traffic switching offices
ISDN	integrated services digital network
ISP	Internet service provider
ISUP	ISDN user part
ITU	International Telecommunications Union
KPI	Key Performance Indicator
KQI	Key Quality Indicator

Acronym	Definition
LAN	local area network
LATA	local access transport area
LAP-B	link access procedure-balanced
LEC	local exchange carrier
LIC	link interface card – The LIC is a processor card of the i2000 hardware shelf. Every appliqué in the i2000 resides on an LIC. The term LIC may refer to any of the following PCBAs: the 8Mhz LIC, the 16Mhz LIC, or the 32Mhz 486 LIC or “ALICE”.
LIDB	Line information database
LIM	link interface modules
LNP	local number portability
LTE	Long Term Evolution
LUP	location update
M2PA	MTP2 user peer-to-peer adaptation layer
M3PA	MTP3 user peer-to-peer adaptation layer
M2UA	MTP2 User Adaptation Layer
M3UA	MTP3 User Adaptation Layer
MAP	GSM mobile application part
MBS	message buffer server
ME	Mediation Engine
MGCP	media gateway control protocol
MIB	managed information base
MIT	managed information tree
MMC	mobile-to-mobile call
MO	managed object
MOC	mobile-originated call
MS	mobile station
MSC	mobile switching center
MSISDN	mobile-station ISDN number
MSU	message signal unit
MT	message type
MTC	mobile-terminated call
MTP	message transfer part – message transaction part that provides functions for basic routing of signaling messages between signaling points
NAS	Non Access Stratum
NEBS	network equipment building standards
NFS	network file system
NMS	network management system
NNM	HP OpenView Network Node Manager
NOC	network operations center
NOCC	network operation control center
NPLT	network performance load test
NTP	network time protocol

Acronym	Definition
NUP	network user part
OAM&P	operations administration maintenance and provisioning
OCS	Online Charging System
OCDSR	Oracle Communications Diameter Signalling Router
ODS	operational data store
OFCS	Offline Charging system
OPC	origination point code
OSI	open system interconnection
PA	Protocol Analysis
PCC	Policy & Charging Rule
PCI	peripheral component interconnect
PCM	Pulse Coded Modulation
PCS	personal communications service
PDF	Protocol Definition File
PDN	Packet Data Network
PDU	protocol data unit
PDR	Peg Count Data Record
PGW	PDN GateWay
PLMN	Public Land Mobile Network
PMF	Probed Message Feeder
PSTN	public switched telephone network
QoS	Quality of Service
RAM	random access memory
RMS	RackMount Server
ROI	return on investment
SAS	signaling application system
SBC	Session Border Controller
SCCP	signaling connection control part
SCP	service control point
SCP/AP	service control point/application part
SCSI	small computer system interface
SCTP	simple control transmission protocol
SDP	session description protocol
SDR	Session Detail Record
SGW	Service GateWay
SI	MTP service indicator
SIP	session initiation protocol
SLA	Service Level Agreement
SLR	SCCP source local reference
SLTM/SLTA	signaling link test message/signaling link test acknowledge
SMPP	Short Message Peer to Peer

Acronym	Definition
SMS	Short Message Service
SMS-C	Short Message Service Center
SNAP	signaling node application platform
SNMP	simple network management protocol
SP	signaling point
SQL	structured query language
SS7	Signaling system number 7 provides two key abilities: fast-call setup via high-speed circuit-switched connections and transactions capabilities that deal with remote data base interactions
SSN	SCCP subsystem number
SSP	service switching point
STC	Sentinel transport card (Oracle)
STP	signal transfer point
SU	signaling unit
SUA	SCCP user adaptation layer
TAC	technical assistance center
TA	Tracking Area
TCAP	transaction capabilities application part
TCP	transmission control protocol
TCP/IP	transmission control protocol/Internet protocol
TDR	Transaction Detail Record
TID	TCAP transaction ID
TMN	telecommunications management network
TMSI	temporary mobile subscriber identity
TGN	trunk group number
TUP	telephone user part
UE	User Equipment
UDM	user defined message
USM	Unified Session Manager
VoIP	Voice over IP
VoLTE	Voice Over LTE
VLR	Visitor Location Register
VPN	Virtual Private Network
WAN	wide area network
WWW	World Wide Web
XDR	x Detail Record (Call, Transaction...)

5 APPENDIX B: LIST OF SUPPORTED PROTOCOLS

Table below presents the list of protocols handled by Performance Intelligence Center system and pertaining standards.

All XDRs, with the exception of SIGTRAN CDRs which remain in IPv4 only, contains IPv6/IPv4 compatible addresses.

Table 6 - List of supported protocols and builders

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
SS7	**ISUP V1**	ITU-T			see ISUP V3
SS7	**ISUP V2**	ITU-T			see ISUP V3
SS7	**ISUP V3**	ITU-T	Signaling system N°7 - ISDN user part formats and codes	Q.763 / Sept_97 (Q.761 to Q.764, Q.766 and Q.767)	SS7IsupEtsiCdr SS7IsupEtsiSudrAccounting Ss7IsupEtsiSuperCdr SS7UMSudr
SS7	**BT NUP (UK)**	National UK BT	BT Network Requirement	BTNR 167 *Jul-87*	SS7BtnupCdr
SS7	**ISUP ANSI** **Party Information Parameter (PIP)**	ANSI	Signaling System N°7 (SS7) - Integrated Services Digital Network (ISDN) User Part Calling Party Name Convention Facility Specification	T1.113-1995 *Jun-05* TICO076E *Feb-98*	SS7IsupAnsiCdr Ss7IsupAnsiSentinelCdr SS7UMSudr
SS7	**ISUP Chinese**		ETSI ISUP support with 24 bits OPC/DPC		see ISUP V3
SS7	**ISUP Russian Variant (Sovintel)**	National	CIS ISUP - Functional Description	CIS ISUP - Functional Description	see ISUP V3
SS7	**ISUP Portuguese Variant (NOVIS)**	National Portugal PT	ESPECIFICAÇÃO DE INTERFACE COM A REDE PÚBLICA INTERFACE DE COMUTADOR (2 Mbit/s) Sinalização Canal Comum SS#7 - Procedimento de taxação em ISUP	Spécifications PT - Procedimento de taxação em ISUP *Apr-99*	see ISUP V3
SS7	**ISUP Brasilian Variant**	TELEBRAS	#7 Common Channel Signaling System ISDN User part - ISUP, Issue 3	TB 220-250-732 *Apr-98*	see ISUP V3
SS7	**ISUP Colombian Variant**	Ministerio des Comunicaciones	Norma Nacional de Señalizacion por Canal Comun N.°7 - SCC7	Norma Nacional *Apr-98*	see ISUP V3
SS7	**ISUP Mexican Variant**	Telmex	E-801.04 Sepcification - Integrated Services Degital Network user Part (ISUP), Edition "C-3"	E-801.04 *Dec-97*	see ISUP V3
SS7	**ISUP Argentina variant**	Telefonica Argentina	RDSI User Part Specification Signaling System N°7	General Specification AR.EG.s1.002 Ed 1 corrected	see ISUP V3
SS7	**Cisco E-ISUP**	Cisco	EISUP Specification - Cisco Systems	Cisco ENG-46168 Release 44	SS7_EISUP_CDR
		IETF	Reliable UDP Protocol	draft-ietf-sigtran-reliable-udp-00.txt *Feb-1999*	
SS7	**LSSU**	ITU-T	Signaling link	Q.703 *Jul-96*	

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
SS7	**MTP ITU-T Level 2 & 3**	ITU-T	Functional description of the Message Transfer Part (MTP) of Signaling System No. 7 Signaling link	Q.701 *Mar-93* Q.703 / Q.704 *Jul-96*	SS7L2L3EtsiSudr SS7Q752EtsiStats
SS7	**MTP ANSI Level 2 & 3**	ANSI	Signaling System N°7 - Message Transfer Part (MTP)	T1.111-1996 *Mar-96*	SS7L2L3AnsiSudr
SS7	**SCCP ITU-T**	ITU-T	Signaling connection control part formats and codes	Q.713 *Jul-96*	Ss7SccpSuaSudr
SS7	**SCCP ANSI**	ANSI	Signaling System Number 7 - Signaling Connection Control Part (SCCP)	T1.112-1996 *Jan-96*	Ss7SccpSuaSudr
SS7	**TCAP (MAP & INAP support)**	ITU-T	Transaction capabilities formats and encoding	Q.773 *Jun-97*	
SS7	**TCAP (IS-41 support)**	ANSI ANSI	Signaling System Number 7 (SS7) - Transaction Capabilities Application Part (TCAP) Signaling System Number 7 (SS7) - Transaction Capabilities Application Part (TCAP)	T1.114-1996 *Mar-96* T1.114-2000 *Jun-00*	
SS7	**INAP Siemens**	Specific: Siemens	Siemens Core INAP	P30308-A7128-A120-01-7659 *May-98*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**INAP CS1**	ETSI ITU-T ITU-T ITU-T	Intelligent Network (IN); Intelligent Network Capability Set 1 (CS1); Core Intelligent Network Application Protocol (INAP); Introduction to intelligent network capability set 1 Distributed functional plane for intelligent network CS-1 Interface Recommendation for intelligent network CS-1	ETS 300 374-1 *Sep-94* ITU-T Q.1211 *Mar-93* ITU-T Q.1214 *Oct-95* ITU-T Q.1218 *Oct-95*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**INAP CS2**	ITU-T	Intelligent Network (IN); Intelligent Network Application Protocol (INAP); Capability Set 2 (CS2)	ETS 301 140-1 *Jun-96*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**INAP Ericsson CS1**	Ericsson	ERICSSON SUPPORT OF ETSI CORE INAP CS1 Ericsson Support of ETSI Core INAP CS1	87/155-CRT 249 12 Uen *May-98*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**INAP Ericsson CS1+**	Ericsson	Ericsson INAP CS1+, Services assumed from TCAP, revision A Ericsson INAP CS1+, Abstract Synthax, revision B	4/155 17-CRT 249 09 Uen *Aug-96* 171/155 17-CRT 249 12 Uen *Jun-03*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
SS7	**INAP Ericsson V2 / V3 / V4**	Ericsson	Ericsson's Protocol for Intelligent Networks, version 4, Formats and Codes	2/155 17-CRT 249 01 Uen D (V2) *Jan-96* 7/155 17-CRT 249 01 Uen B (V3) *Jan-97* 12/155 17-CRT 249 01 Uen A (V4) *Jan-98*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**INAP Alcatel V3**	Alcatel	INAP for E10 Version 3	ALCATEL E10 Version 3 *Sep-96*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**INAP Alcatel V4**	Alcatel	INAP for E10 Version 5	ALCATEL E10 Version 5 *Jan-99*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**INAP Alcatel CS1**	Alcatel	INAP Alcatel CS1	ALCATEL INAP CS1	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**CAMEL Phase 2**	ETSI	Digital cellular telecommunications system (Phase 2+); Customised Applications for Mobile network Enhanced Logic (CAMEL); CAMEL Application Part (CAP) specification - **GSM 09.78**	TS 101 046 V7.0.0 (Release 98) *Aug-99*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**CAMEL Phase 3**	ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Customised Applications for Mobile network Enhanced Logic (CAMEL); CAMEL Application Part (CAP) specification - **GSM 29.78**	TS 129 078 V5.9.0 (Release 5) *Sep-04*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**CAMEL Phase 4**	ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Customised Applications for Mobile network Enhanced Logic (CAMEL); CAMEL Application Part (CAP) specification - **GSM 29.78**	TS 129 078 V6.5.0 (Release 6) *Jun-06*	SS7InapSudrAccounting SS7InapTdr SS7_INAP_Compact_TDR
SS7	**BSSAP (Phase 2+) BSSMAP**	ETSI	Digital cellular telecommunications system (Phase 2+); Mobile-services Switching Centre – Base Station Systel (MSC – BSS) interface; Layer 3 specification - **3GPP TS 08.08**	TS 48.008 V12.0.0 (Release 12) Sept-14	RanCC2Cdr RanMMTdr RanSMSTdr RanUSSD SS7BssapTdr
	DTAP		Digital cellular telecommunications system (Phase 2+); Mobile Radio Interface;Layer 3 specification - **3GPP TS 04.08**	TS 24.008 V12.7.0 (Release 12) Sept-14	
	SMS		Digital cellular telecommunications system (Phase 2+); Point-to-Point (PP) Short message Service support on mobile radio interface - **3GPP TS 04.11**	TS 24.011 V12.0.0 (Release 12) Sept-14	

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
	SMS SM-TP		Digital cellular telecommunications system (Phase 2+); Technical realization of the short Message Service (SMS) - **3GPP TS 03.40**	TS 23.040 V12.2.0 (Release 12) Dec-14	
	Supplementary Services		Digital cellular telecommunications system (Phase 2+); Mobile Radio interface layer 3 supplementary service specification; Formats and Coding - **3GPP TS 04.80**	TS 24.080 V12.0.0 (Release 12) Sept-14	
SS7	**BSSAP+ (Gs Interface)**	ETSI	Digital Cellular Telecommunications System (Phase 2+); Universal Mobile Telecommunications System (UMTS); general Packet radio Service (GPRS); Serving GPRS Support Node (SGSN) - Visitor Location register (VLR); Gs Interface layer 3 Specification - **3GPP TS 29.018**	TS 29.018 V6.5.0 (Release 6) *Dec-06*	Ss7GsInterfaceTdr
SS7	**GSM MAP**	ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile Application Part (MAP) specification - **3GPP TS 29.002**	TS 29.002 V12.6.0 (Release 12) Sept-14	Ss7HLRVTdr SS7MapTdr SS7MapSudrAccounting SS7MapSmTdr SS7MapMultiLegTdr SS7MapDB SS7Smdr SS7_MAP_Compact_TDR
SS7	**IS-41 Révisions B, C, D & E (MAP)**	ANSI	Cellular Radiotelecommunications Intersystem Operations	ANSI/TIA/EIA-41-D-1997 *Nov-97*	SS7IS41DB SS7IS41DE SS7IS41Tdr
	MEID	3GPP2	3G Mobile Equipment identifier (MEID) - Stage 1	3GPP2 S.R0048-A Ver 4.0 *Jun-05*	
		Telecommunications Industry Association	MEID Standards Update, version 1.8.4	TIA-MEID *Apr-06*	
	IS-41-P	Lucent	ANSI -41 Protocol Extensions for Interfaces C and D (HLR - VLR/MSC) - Issue 2.0	IS-41-P *Nov-04*	
	IS-41-EE	Ericsson	IS-41 Intersystem Call delivery Signalling	IS-41-EE *Jan-99*	
SS7	**ISDN over IUA**	ITU-T	ISDN user-network interface layer 3 specification for basic call control	Q.931 *May-98*	VoIP_Q_931_Cdr
SS7	**AIN**				SS7AinTdr
	MTP ANSI Level 2 & 3	ANSI	Signalling System N°7 - Message Transfer Part (MTP)	T1.111-1996 *Mar-96*	
	SCCP ANSI	ANSI	Signalling System Number 7 - Signalling Connection Control Part (SCCP)	T1.112-1996 *Jan-96*	
	TCAP (IS-41 support)	ANSI	Signalling System Number 7 (SS7) - Transaction Capabilities Application Part (TCAP)	T1.114-2000 *Jun-00*	
	Services **- CNAM** **- ATF** **- NS 800** **- LNP** **- Flexible Number Rounting**	Telcordia	Telcordia Technologies Generic Requirements, GR-1188-CORE: Calling Name Delivery Generic Requirements, Issue 2	GR-1188-CORE *Dec-00*	
		Telcordia	Telcordia Technologies Generic Requirements, GR-533-CORE: Datababase Services Service Switching Points - Toll-Free Service Generic Requirements, Issue 2	GR-533-CORE *Jun-01*	

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
		Telcordia	Telcordia Technologies Generic Requirements, GR-1299-CORE: Switch - Service Control Point (SCP) / Adjunct Interface Generic requirements, Issue 6	GR-1299-CORE *Nov-00*	
		Telcordia	Telcordia Technologies Generic Requirements, GR-1519-CORE: CCS Network Interface Specification (CCSNIS) Supporting TR-NWT-001188 Calling Name Delivery Generic Requirements, Issue 1A	GR-1519-CORE *Oct-94*	
		Telcordia	Telcordia Technologies Generic Requirements, GR-2982-CORE: Local Number LNP Capability, Issue 1	GR-2982-CORE *Dec-97*	
		Telcordia	Telcordia Technologies Generic Requirements, GR-246-CORE: Specification of Signaling System Number 7, Issue 5	GR-246-CORE *Dec-00*	
		Telcordia	Telcordia Technologies Generic Requirements, GR-2892-CORE: Switching and Signaling Generic Requirements for Toll-Free Service using AIN, Issue 1	GR-2892-CORE *Apr-95*	
SS7	**LIDB**	Telcordia	Telcordia Technologies Generic Requirements, GR-1158-CORE : OSSGR Section 22.3: Line Information Database, Issue 4	GR-1158-CORE *Dec-00*	SS7LidbTdr
			Telcordia Technologies Generic Requirements, GR-1149-CORE - OSSGR Section 10: System Interfaces, Issue 6	GR-1149-CORE *Sep-06*	
SS7	**CLASS**	Telcordia	Telcordia Technologies Generic Requirements, GR-1188-CORE: Calling Name Delivery Generic Requirements, Issue 2	GR-1188-CORE *Dec-00*	SS7ClassTdr
			Telcordia Technologies Generic Requirements, GR-215-CORE: LSSGR: CLASS Feature: Automatic Callback (FSD 01-02-1250), Issue 2	GR-215-CORE *Apr-02*	
			Telcordia Technologies Generic Requirements, GR-220-CORE: LSSGR: CLASS Feature: Screening List Editing (FSD 30-28-0000), Issue 2	GR-220-CORE *Apr-02*	
			Telcordia Technologies Generic Requirements, GR-227-CORE: LSSGR: CLASS Feature: Automatic Recall (FSD 01-02-1260), Issue 2	GR-227-CORE *Apr-02*	
SS7	**WIN Services**	Telcordia	Wireless Intelligent Network	EIA/TIA IS-771 *Jul-99*	SS7WinServiceTdr
	IS-771	Telcordia	Wireless Intelligent Network - Addendum 1	EIA/TIA IS-771 *Aug-01*	
		Telcordia	Cellular Radiotelecommunications ntersystem Operations, Revision B to E	EIS/TIA IS-41 *Nov-97*	
		3GPP2	Win Phase 1, Version 1.0	3GPP2 N.S0013-0 *Dec-98*	
		3GPP2	Win Phase 2, Version 1.0	3GPP2 N.S0004-0 *Apr-01*	
		3GPP2	ANSI -41-D Miscellaneous Enhancements, Version 1.0.0, Revision 0	3GPP2 N.S0015 *Jan-00*	
	IS-826	Telcordia	Wireless Intelligent Network Capabilities for pre-paid Charging	TIA/EIA/IS-826 (1 to 7) *Aug-00*	
	J-STD-036B	ANSI	Enhanced Wireless SP-3-3890-RV2 9-1-1 Phase II	J-STD-036-B *Jan-08*	

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
	IS-843	Telecommunications Industry Association	Wireless Intelligent network Support for Location Based Services	TIA-843 *Aug-04*	
	IS-801	Telecommunications Industry Association	Position Determination Service for cdma2000 Spread Spectrum Systems	TIA-801-A *Apr-04*	
	IS-881	Telecommunications Industry Association	TIA/EIA-41-D Location Services Enhancements	TIA-881 *Mar-04*	
	IS-725	Nortel	TIA/EIA-41-D Enhancements for Over-The-Air Service Provisioning (OTASP) & Parameter Administration (OTAPA), Version 1	TIA/EIA/IS-725-A *Mar-99*	
	IS-764	Telecommunications Industry Association	TIA/EIA-41-D Enhancements for Wireless Calling Name - Feature Descriptions	TIA-764 *Jan-02*	
	IS-756	Telcordia	TIA/EIA-41-D Enhancements for Wireless Number Portability Phase II	TIA/EIA/IS-756-A *Dec-98*	
SS7	**BICC ETSI**	ITU-T	Bearer Independent Call Control protocol Signaling System N°7 - ISDN User Part	Q.1901 *Apr-02* Q.763 *Sep-97* (Q.761 to Q.764, Q.766 and Q.767)	Ss7BICCEtsiCdr
SS7	**BICC ANSI**	ANSI	Specifications of the Bearer Independent Call Control	ANSI T1.BICC.1-2000 to ANSI T1.BICC.7-2000 *Jan-00*	Ss7BICCAnsiCdr
SS7	**SIGTRAN**	IETF	**Support only for ISUP Family Planned for MAP, INAP and IS-41**		IPSctpStats IPSctpSudr SS7M2paStats SS7M2PaSudr Ss7M2uaStats Ss7M2uaSudr SS7M3uaStats Ss7M3uaSudr Ss7SccpSuaSudr Ss7SuaStats SS7_SIGTRAN_Transport_SUDR
	SCTP		Stream Control Transmission Protocol . Used as support for SIGTRAN	RFC 2960 *Oct-00*	
	M3UA		Signaling System 7 (SS7) Message Transfer Part 3 (MTP3) - User Adaptation Layer (M3UA). SUDR & Statistics	RFC 4666 *Sep-06*	
	M2UA		Signaling System 7 (SS7) Message Transfer Part 2 (MTP2) - User Adaptation Layer	RFC 3331 *Sep-02*	
	SUA		Signaling Connection Control Part User Adaptation Layer (SUA)	RFC 3868 *Oct-04*	
	M2PA		Signaling System 7 (SS7) Message Transfer Part 2 (MTP2) - User Peer-to-Peer Adaptation Layer (M2PA). SUDR & Statistics	RFC 4165 *Sep-05*	

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
GPRS / IP	**GPRS Gn & Gp**	ETSI	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS);GPRS Tunneling Protocol (GTP) accross the Gn and Gp Interface - **3GPP TS 09.60** Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS);GPRS Tunneling Protocol (GTP) accross the Gn and Gp Interface - **3GPP TS 09.60**	TS 101 347 V7.8.0 (Release 98) *Sep-01* TS 29.060 V12.6.0 (Release 12) Sept-14	GprsGnGpCdr GprsGnGpTdr IP_Sessions_summary_TDR
GPRS	**GPRS Gb** **Network Service (NS)**	ETSI	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) Interface; Network Service **- 3GPP TS 48.016**	TS 48.016 V7.4.0 (Release 7) *Mar-08*	GprsGbTdr
	BSS GPRS Protocol (BSSGP)	ETSI	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) Interface; BSS GPRS Protocol (BSSGP) - **3GPP TS 48.018**	TS 48.018 V7.13.0 (Release 7) *Dec-09*	
	Logical Link Control (LLC)	ETSI	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station - Serving GPRS Support Node (MS - SGSN) Logical Link Control Layer (LLC) - **3GPP TS 04.64**	TS 44.064 V7.3.0 (Release 7) *Mar-08*	
	GPRS Mobility Management (GMM) **GPRS Session Managment (GSM)**	ETSI	Digital cellular telecommunications system (Phase 2+)(GSM); Mobile Radio Interface; Layer 3 Specification - **3GPP TS 04.08**	TS 24.008 V7.12.0 (Release 7) *Jun-08*	
	SNDCP	ETSI	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station - Serving GPRS Support Node (MS - SGSN); Subnetwork Dependent Convergence Protocol (SNDCP) - **3GPP TS 04.65**	TS 24.065 V7.0.0 (Release 7) *Dec-06*	
	Short Message Service (SMS)	ETSI	Digital cellular telecommunications system (Phase 2+); Point-to-Point (PP) Short Message service (SMS) Support on Mobile Rdio Interface - **3GPP TS 04.11** Digital cellular telecommunications system (Phase 2+); Technical realization of Short Message Service (SMS) Point-to-Point (PP) - **3GPP TS 03.40**	TS 24.011 V7.1.0 (Release 7) *Jun-09* TS 23.040 V7.2.0 (Release 7) *Mar-09*	
GPRS	**GPRS Gr & Gd**	ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile Application Part (MAP) specification - **3GPP TS 29.002**	TS 29.002 V12.6.0 (Release 12) Sept-14	SS7MapTdr SS7_MAP_Compact_TDR

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
IP	**DNS**	IETF	Domain Names - Concepts and Facilities Domain Names - Implementation and Specification	RFC 1034 *Nov-87* Not relevant or supported: RFC1101, RFC1183, RFC1348, RFC1876, RFC1982, RFC2065, RFC2181, RFC2308, RFC2535, RFC4033, RFC4034, RFC4035, RFC4343, RFC4035, RFC4592, RFC5936 RFC 1035 *Nov-87* Not relevant or supported: RFC1101, RFC1183, RFC1348, RFC1876, RFC1982, RFC1995, RFC1996, RFC2065, RFC2136, RFC2181, RFC2137, RFC2308, RFC2535, RFC2845, RFC3425, RFC3658, RFC4033, RFC4034, RFC4035, RFC4343, RFC5936, RFC5966	IpDnsTdr
IP	**DNS ENUM**	IETF	E.164 Number and DNS	RFC 2916 *Sep-00*	IpDnsEnumTdr
IP	**RADIUS**	IETF	Remote Authentication Dial In User Service (RADIUS)	RFC 2865 *Jun-00* RFC2866 *Jun-00* Not relevant or supported: RFC2868, RFC3575, RFC5080	IpRadius
IP	**DHCP** **BOOTP** **DHCP**	IETF IETF	Bootstrap protocol (BOOTP) Dynamic Host Configuration Protocol	RFC 951 *Sep-85* Not relevant or supported: RFC1395, RFC1497, RFC1532, RFC1542, RFC5494 RFC 2131 *May-97* Not relevant or supported: RFC3396, RFC4361, RFC5494	IpDhcpTdr
IP	**WAP** **WTP** **WSP**	 WAP Forum / OMA WAP Forum / OMA	 Wireless Transaction protocol WAP - Wireless Session Protocol Specification	 WAP-224-WTP-20010710-a *Jul-01* WAP-230-WSP-20010705-p *Jul-01*	IpWapv1Tdr
IP	**MMS**	OMA	Multimedia Messaging Service Encapsulation Protocol Version 1.1	OMA-MMS-ENC-v1_1-20021030-C *Oct-02*	IpMmsWapv1Tdr IpMmsWapv2Tdr

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
IP	**HTTP**	IETF	Hypertext Transfer Protocol - HTTP/1.1	RFC 2616 *Jun-99* Not relevant or supported: RFC2817, RFC5785, RFC6266	IpHttpTdr
IP	**WAP2**	IETF	Hypertext Transfer Protocol - HTTP/1.1	RFC 2616 *Jun-99* Not relevant or supported: RFC2817, RFC5785, RFC6266	IpWapv2Tdr
		WAP Forum / OMA	WAP Architecture	WAP-210-WAPArch-20010712 *Jul-01*	
IP	**POP3**	IETF	Post Office protocol - Version 3	RFC 1460 *Jun-93*	IpPop3Tdr
IP	**SMTP**	IETF	Simple Mail Transfer Protocol	RFC 2821 *Apr-01*	IpSmtpTdr
IP	**IMAP4**	IETF	Internet Message Access Protocol - Version 4rev1	RFC 2060 *Mar-03*	IpImap4Tdr
IP	**FTP**	IETF	File Transfer Protocol	RFC 959 *Oct-85* Not relevant or supported: RFC2228, RFC2640, RFC2773, RFC3659, RFC5797	IpFtpTdr
IP	**TCP**	IETF	Transmission Control Protocol	RFC 793 *Sep-81* Not relevant or supported: RFC1122, RFC3168, RFC6093	IpTcpCdr
IP	**RTSP**	IETF	Real Time Streaming Protocol (RTSP)	RFC 2326 *Apr-98*	IpRtspTdr
		IETF	SDP:Session Description Protocol	RFC 2327 *Apr-98*	
IP	**SMPP**	SMS Forum	Short Message Peer-to-Peer protocol Specification, Version 5.0	SMPP v5.0 *Feb-03*	IpSmppTdr
IP	**UCP**	Logica CMG	Short Message Service center; EMI - UCP Interface 4.6	EMI UCP Interface *May-05*	IpUcpTdr
UMTS	**UMTS** **Iu-CS Control Plane over IP** **Iu-PS Control Plane over IP**		Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface Radio Access Network Application Part (RANAP) signalling - **3GPP TS 25.413**	TS 25.413 V12.3.0 (Release 12) Dec-14	Ran_CC2_Cdr Ran_MM_Tdr Ran_SMS_Tdr Ran_USSD UMTS_Iu_C_TDR UMTS_Iu_P_GMM_TDR UMTS_Iu_P_TDR UMTS_Iu_P_SM_TDR
			Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile radio interface layer 3 specification; Radio Resource Control (RRC) protocol - **3GPP TS 44.018**	TS 44.018 V12.3.0 (Release 12) Sept-14	
			Digital cellular telecommunications system (Phase 2+); Mobile Radio interface layer 3 supplementary service specification; Formats and Coding - **3GPP TS 04.80**	TS 24.080 V12.0.0 (Release 12) Sept-14	

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
	Iu-PS User Plane over IP	ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Technical realization of Short Message Service (SMS) Point-to-Point (PP) - **3GPP TS 24.011**	TS 24.011 V12.0.0 (Release 12) Sept-14	
			Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 - **3GPP TS 24.008**	TS 24.008 V12.7.0 (Release 12) Sept-14	
			Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS);GPRS Tunneling Protocol (GTP) accross the Gn and Gp Interface - **3GPP TS 09.60**	TS 29.060 V12.6.0 (Release 12) Sept-14	
VoIP	**VoIP SIP / SIP-T / SIP-I**	IETF	**SIP** Session Initiation Protocol	RFC 3261 *Jun-02* Not relevant or supported: RFC3853, RFC4320, RFC4916, RFC5393, RFC5621, RFC5626, RFC5630, RFC5922, RFC5954, RFC6026, RFC6141	VoipSipCdr VoipSiptAnsiCdr VoipSiptItuCdr
		IETF	Reliability of Provisional Responses in the Session Initiation Protocol (SIP)	RFC 3262 *Jun-02*	
		IETF	Session Initiation Protocol (SIP) - Specific Event Notification	RFC 3265 *Jun-02* Not relevant or supported: RFC5367, RFC5727, RFC6446	
		IETF	The Session Initiation Protocol (SIP) UPDATE Method	RFC 3311 *Sep-02*	
		IETF	The Session Initiation Protocol (SIP) Refer Method	RFC 3515 *Apr-03*	
		IETF	The SIP INFO Method	RFC 2976 *Oct-00*	
		IETF	Session Initiation Protocol for Telephones (**SIP-T**): Context and Architectures	RFC 3372 *Sep-02*	
		IETF	SDP:Session Description Protocol	RFC 2327 *Apr-98*	
		IETF	Session Description Protocol (SDP) Simple Capability Declaration	RFC 3407	
		ITU-T	Interworking between Session Initiation Protocol (SIP) and Bearer Independant Call Control Protocol or ISDN User Part.	Q.1912-5 *Mar-04*	
		Nortel	CS2000 SIP/SIP-T Interoperability Specification (Issue 0.82) System Requirement Document	Nortel CS2000 *01/10/2003*	
			Multiple Dialog Usages in the Session Initiation Protocol	*RFC5057*	
VoIP	**VoIP H.225/Q.931**	ITU-T	Serie H: Audiovisual and Multimedia Systems - Call Signalling protocols and media stream packetisation for packet-based multimedia communication systems	H.225.0 *Jul-03*	VoipQ931Cdr

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
		ITU-T	ISDN user-network interface layer 3 specification for basic call control	Q.931 *Dec-99*	
VoIP	**VoIP H.225/RAS**	ITU-T	Call Signalling protocols and media stream packetisation for packet-based multimedia communication systems	H.225.1 *Jul-03*	VoipRasTdr
VoIP	**VoIP H.245**	ITU-T	Control Protocol for multimrdia communication	H.245 *Jul-03*	VoipH245Tdr
VoIP	**MGCP**	IETF	Media Gateway Control Protocol (MGCP) version 1.0	RFC 3435 *Jan-03* Not relevant or supported: RFC3661	VoipMgcpCdr VoipMgcpTdr
		IETF	Media Gateway Control Protocol (MGCP) Return Code Usage	RFC 3661 *Dec-03*	
		IETF	Media Gateway Control Protocol (MGCP) Packages	RFC 3660 *Dec-03*	
VoIP	**MEGACO**	IETF	Gateway Control Protocol Version 1.0	RFC 3525 *Jun-03*	VoipMEGACOTdr
VoIP	**H.248**	ITU-T	Gateway Control Protocol: Version 2	H.248.1 *May-02* Supported packages H.248.2 until H.248.31	VoipH248Tdr
IMS	**Diameter**	IETF	Diameter Base Protocol	RFC 3588 *Sep-03*	ImsDiameterCcTdr ImsDiameterCxTdr ImsDiameterGqTdr ImsDiameterShTdr ImsDiameterTdr LTE_Diameter-TDR
		IETF	Diameter Credit-Control Application	RFC 4006 *Aug-05*	
	Diameter Credit-Control (Cc, Ro, Rf, Gy, Ga)	ETSI / 3GPP	3rd Generation Partnership Project; Technical Specification Group Service and System Aspects; Telecommunication management; Charging management; Diameter charging applications	TS 32.299 V12.6.0 (Release 12) Sept-14	
	Diameter Gq	ETSI	Universal Mobile Telecommunications System (UMTS); Policy control over Gq interface (3GPP TS 29.209 version 6.5.0 Release 6) . Replaced by Rx in LTE	TS 29.209 V6.5.0 (Release 6) *Jun-06*	
	Diameter Cx/Dx	ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Signalling flows and message contents **3GPP TS 29.228**	TS 29.228 V12.3.0 (Release 12) Sept-14	
		ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Cx and Dx interfaces based on the Diameter protocol **3GPP TS 29.229**	TS 29.229 V12.3.0 (Release 12) Sept-14	

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
		ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Diameter applications; 3GPP specific codes and identifiers **3GPP TS 29.230**	TS 29.230 V12.6.0 (Release 12) Sept-14	
	Diameter Sh	ETSI	Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Sh interface based on the Diameter protocol; **3GPP TS 29.329**	TS 29.329 V12.4.0 (Release 12) Sept-14	
LTE	**Diameter S6**	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol (Release 9)	TS 29.272 V12.6.0 (Release 12) Sept-14	LTE_Diameter_S6_TDR LTE_Diameter_SUDR_Accounting LTE_Diameter-TDR
	Diameter Gx/S7	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Policy and Charging Control over Gx reference point (Release 9)	TS 29.212 V12.6.0 (Release 12) Sept-14	LTE_Diameter_Gx_TDR LTE_Diameter-TDR
	Diameter Rx	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Policy and Charging Control over Rx reference point (Release 9)	TS 29.214 V12.5.0 (Release 12) Sept-14	LTE_Diameter_Rx_TDR LTE_Diameter-TDR
	Diameter Gy	3GPP	3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; Charging management; Diameter charging applications	TS 32.299 V12.6.0 (Release 12) Sept-14	LTE_DIAMETER_Gy_TDR LTE_Diameter-TDR
	Diameter S9	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Policy and Charging Control (PCC) over S9 reference point; Stage 3	TS 29.215 V12.5.0 (Release 12) Sept-14	LTE_DIAMETER_S9_TDR LTE_Diameter-TDR
	Diameter AAA	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Evolved Packet System (EPS); 3GPP EPS AAA interfaces	TS 29.273 V12.5.0 (Release 12) Sept-14	LTE_Diameter_AAA_TDR

Family	Protocol	Organization	Complete Reference	PIC 10.2.1 standards	Final builder
	Diameter LCS	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Location Services (LCS); Evolved Packet Core (EPC) LCS Protocol (ELP) between the Gateway Mobile Location Centre (GMLC) and the Mobile Management Entity (MME); SLg interface	TS 29.172 V12.4.0 (Release 12) Mar-14	LTE_Diameter_LCS_TDR
			3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Location Services (LCS); Diameter-based SLh interface for Control Plane LCS	TS 29.173 V12.2.0 (Release 12) Sept-14	
	GTPv2	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3 (Release 9)	TS 29.274 V12.6.0 (Release 12) Sept-14	LTE_GTP_v2_Tunnel_Management_TDR LTE_GTP_v2_Mobility_Management_TDR LTE_GTP_v2_Sv_TDR
	S1-AP	3GPP	3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) (Release 9)	TS 36.413 V12.3.0 (Release 12) Sept-14	LTE_S1AP_TDR RAN_ESM_TDR RAN_EMM_TDR
		3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 (Release 9)	TS 24.301 V12.6.0 (Release 12) (Release 12)Sept-14	
	SGs	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Mobility Management Entity (MME) – Visitor Location Register (VLR) SGs interface specification (Release 9)	TS 29.118 V12.6.0 (Release 12) Sept-14	LTE_SGsAP_TDR
	LTE User Plane (S5-U, S8-U, S1-U, S12-U)	3GPP	3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U) (Release 9)	TS 29.281 V11.6.0 (Release 11) Mar-13	LTE_GTP_User_Plane_Capture

6 APPENDIX B: MY ORACLE SUPPORT

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.

7 APPENDIX C: LOCATE PRODUCT DOCUMENTATION

Oracle Communications customer documentation is available on the web at the Oracle Help Center (OHC) 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. Access the **Oracle Help Center** site at http://docs.oracle.com.
2. Click **Industries** icon.
3. Under the **Oracle Communications** heading, click **Oracle Communications documentation**.
4. The Communications Documentation page appears. Go to the **Analytics** section.
5. Click on **Performance Intelligence Center** and then the release number.

A list of the entire documentation set for the selected release appears.

To download a file to your location, right-click the **PDF** link and select Save Target As (or similar command based on your browser), and save to a local folder.

Note: As long as the documentation site has not been significantly refactored, you may use this link as a shortcut to step 5:

http://docs.oracle.com/en/industries/communications/performance-intelligence-center/index.html