NTQR

Network Traffic & Quality Reports

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What is NTQR?

NTQR is a web application for monitoring the capacity and the traffic of Voice, VoIP and IMS networks. It provides network capacity planner and network operation & management with traffic analysis data and network performance information.
NTQR generates reports based on the switch traffic measurement, device logs, CDR (Call Detail Record) and port allocation data. Several reports are available for the network capacity management and network quality monitoring.

The development the NTQR application was started in 2001. It has been growing since then with new features accompanying the evolution of the networks.
The focus of the development has been the web-based applications that work as well as they look, which is essential for the users to enhance the way doing the daily business. The approach is to find creative ways to design web portal that look nice and work for everyone.

NTQR is developed to provide a single environment to support regional network planning and traffic engineering across different countries and networking technologies (Nortel, Siemens, Cisco, Sonus).

NTQR Modules

NTQR comprises of several modules. Following are the most used modules and are explained in the next slides:

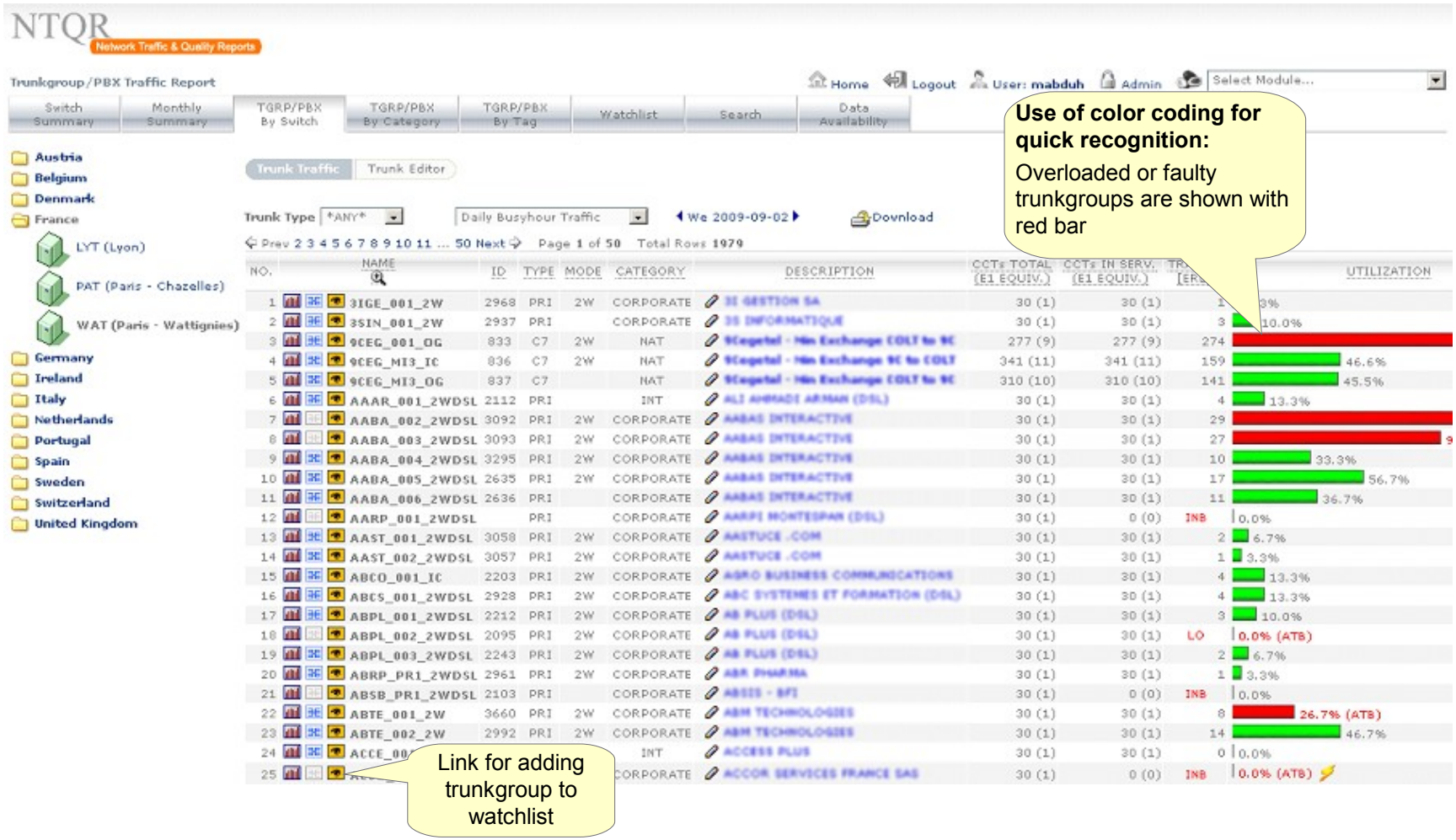
- Trunkgroup Traffic Reports
- Network Quality Reports
- Germany Transit Traffic Analysis
- Cisco Monitoring
- Sonus Monitoring

Module “Trunkgroup Traffic Reports”

- Incorporate trunkgroup description, categories and tags
- Search trunkgroups
- Manage trunkgroups in the watchlist
- Alert notification on trunkgroup faults
- Generate monthly capacity reports

How can I manage more than 25,000 trunkgroups of a large pan-European network without tools? It was the question raised by a desperate network planning engineer. NTQR was developed to help users monitor huge number of trunkgroups. User can manage trunkgroups in her/his watchlists. NTQR provides reports that show historical data of traffic volume, call statistics, trunk usage, trunk status etc. of trunkgroups. It can help us detect traffic flow problems such as out-of-service trunks, all trunk busy conditions, or call blocking which ensures uninterrupted voice services to the customers. Customers sometimes ask for reports for their PBX trunks. Such PBX traffic report can be generated by NTQR in a very easy way.

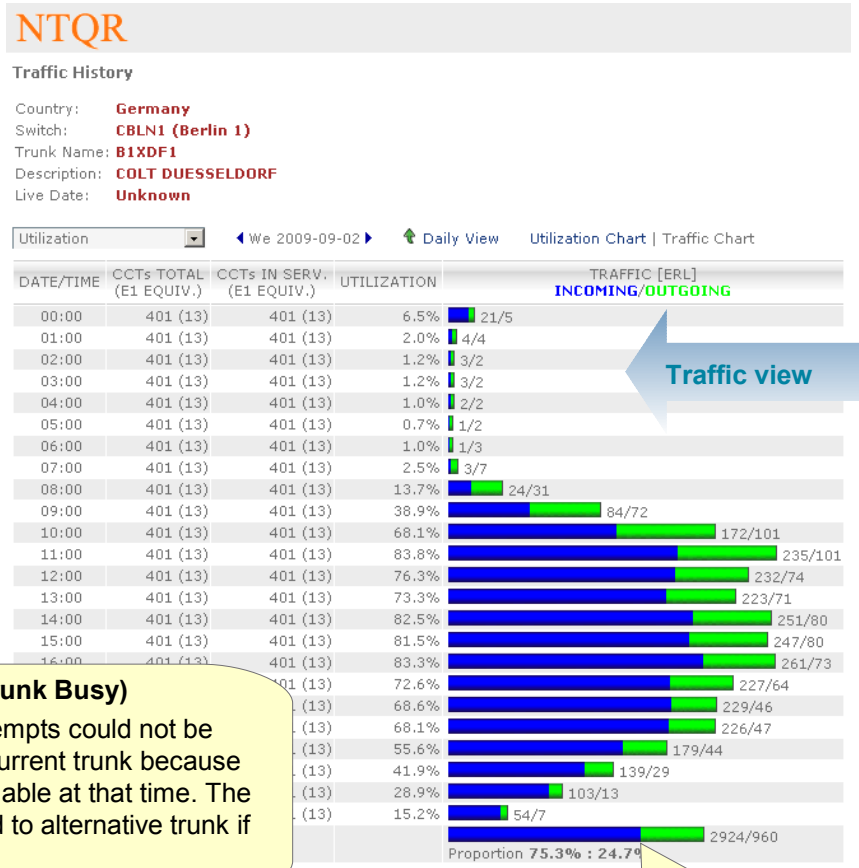
Module “Trunkgroup Traffic Reports”



Display trunkgroups by switch

Module “Trunkgroup Traffic Reports”

Utilization view



Traffic view

ATB (All Trunk Busy)

A number of call attempts could not be routed through the current trunk because no idle circuit is available at that time. The calls might be routed to alternative trunk if there is any.

Display of traffic in Erlang split in incoming and outgoing

History of trunkgroup traffic & utilization

Module “Trunkgroup Traffic Reports”

NO.	REGION	COUNTRY	SWITCH	TYPE	MONTH	CATEGORY	UTILIZATION
1	CR	Austria	CLT01	EWSD	September 2009	COLT	34.0% N/A
2	CR	Austria	CLT01	EWSD	September 2009	IMT	0.0% N/A
3	CR	Austria	CLT01	EWSD	September 2009	INT	26.3% N/A
4	CR	Austria	CLT01	EWSD	September 2009	NAT	49.0% 60%-65%
5	NR	Belgium	BRU	DMS	September 2009	COLT	46.3% N/A
6	NR	Belgium	BRU	DMS	September 2009	INT	34.7% N/A
7	NR	Belgium	BRU	DMS	September 2009	NAT	56.3% 60%-65%
8	NR	Denmark	DAN01	EWSD	September 2009	COLT	28.9% N/A
9	NR	Denmark	DAN01	EWSD	September 2009	IMT	0.0% N/A
10	NR	Denmark	DAN01	EWSD	September 2009	INT	50.3% N/A
11	NR	Denmark	DAN01	EWSD	September 2009	NAT	42.6% 65%-70%
12	SR	France	PAT	DMS	September 2009	COLT	65.9% N/A
123	NR	United Kingdom	PBL	DMS	September 2009	IMT	66.7% 75%-
124	NR	United Kingdom	BGL	DMS	September 2009	IMT	66.1% 75%-
125	NR	United Kingdom	KJL	DMS	September 2009	IMT	75.4% 75%-
126	NR	United Kingdom	MBT	DMS	September 2009	IMT	67.2% 75%-
127	NR	United Kingdom	CRT	DMS	September 2009	IMT	67.7% 75%-
128	NR	United Kingdom	KC1	DMS	September 2009	IMT	78.8% 75%-
129	NR	United Kingdom	CRT	DMS	September 2009	INT	10.3% N/A
130	NR	United Kingdom	KC1	DMS	September 2009	INT	39.2% N/A
131	NR	United Kingdom	MBT	DMS	September 2009	ISP/CVX	0.0% 45%-55%
132	NR	United Kingdom	PBL	DMS	September 2009	NAT	65.9% 65%-70%
133	NR	United Kingdom	BGL	DMS	September 2009	NAT	54.3% 65%-70%
134	NR	United Kingdom	KJL	DMS	September 2009	NAT	86.

Utilization Legends:

- Utilization > max. target
- Utilization is within target
- Utilization < min. target
- Target

Network usage is the KPI for the network capacity management. It can be monitored easily in NTQR.

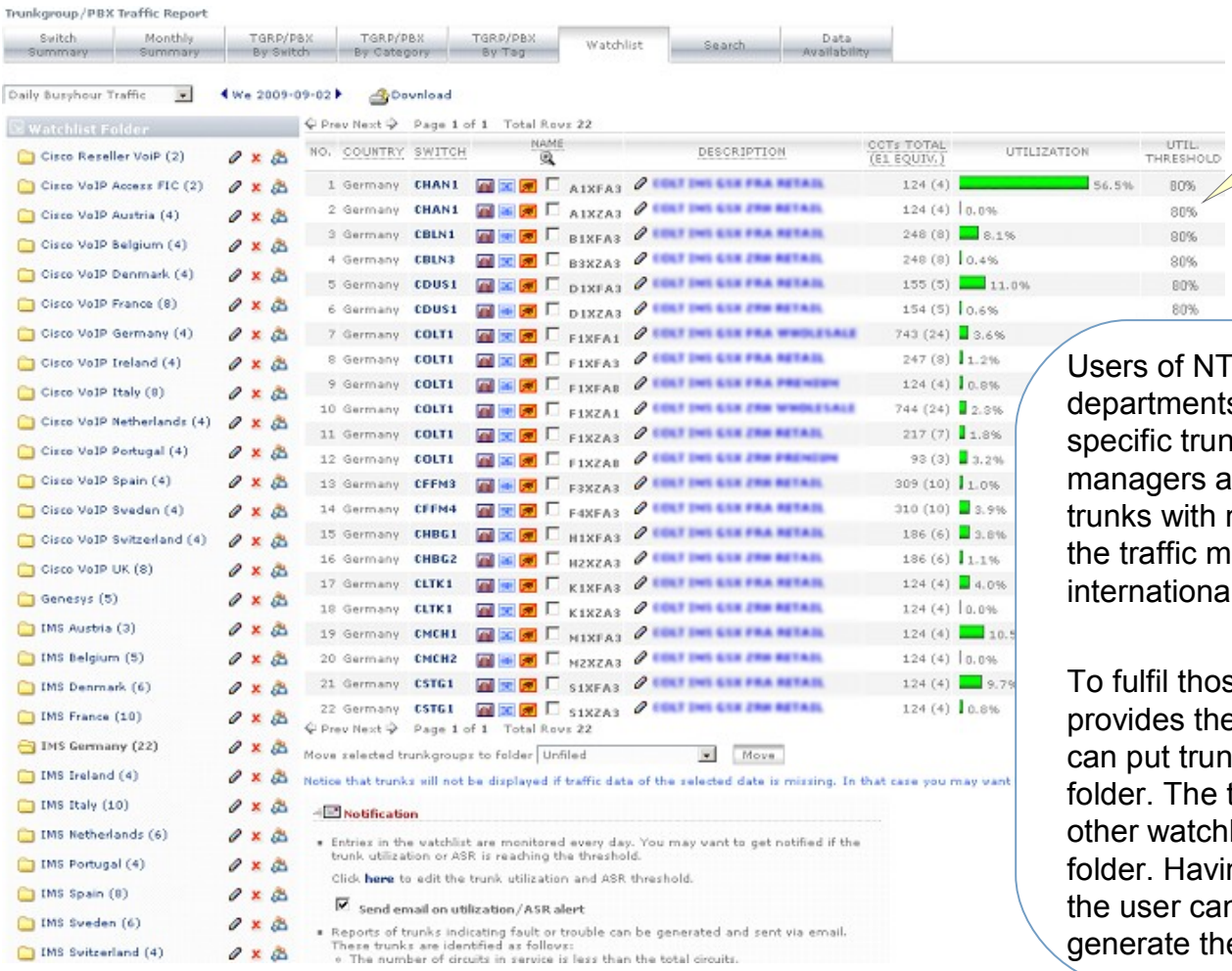
To minimize the network cost e.g. leased line cost the network must be dimensioned properly. Underutilized trunks causes unnecessary cost.

Example:

The Interconnect-trunks should have the average usage of 80%. The monthly capacity reports show the actual average trunk utilization compared to the target utilization. If the actual utilization exceeds the target then there is a need to expand the capacity. If the current utilization is below the target some circuits may need to be ceased.

Monthly reports

Module “Trunkgroup Traffic Reports”



Utilization threshold can be specified for each trunkgroup. The user receives alert emails if the current utilization exceeds the threshold.

Users of NTQR are from different departments. Each user is interested in specific trunks. The national interconnect managers are interested in Interconnect-trunks with national carriers whereas for the traffic management team the international trunk are more relevant.

To fulfil those requirements NTQR provides the Watchlist feature. The user can put trunkgroups to her/his watchlist folder. The trunkgroups can be moved to other watchlist folder or removed from the folder. Having trunkgroups in the watchlist the user can find the trunkgroups and generate the traffic reports quickly.

Manage trunkgroups in the Watchlist

Module “Network Quality Reports”

- Monitor ASR, NER, ACD by destination, routing plan, supplier
- Identify bad suppliers
- Real-time alert notification on ASR
- Call routing adjustment

Keep revenue for voice services high and increase customer trust with SLA assurance! NTQR performs real-time monitoring of network quality parameters ASR (Answer Seizure Ratio), NER (Network Effectiveness Ratio) and PDD (Post Dial Delay) per destination and per routing plan e.g. Wholesale, Retail. A real-time alert notification is available for network operation engineer. He is responsible for optimizing call routing in term of voice quality and economy, but also for routing adjustment of calls with low ASR to guarantee SLA's and to reduce revenue loss.

Module “Network Quality Reports”

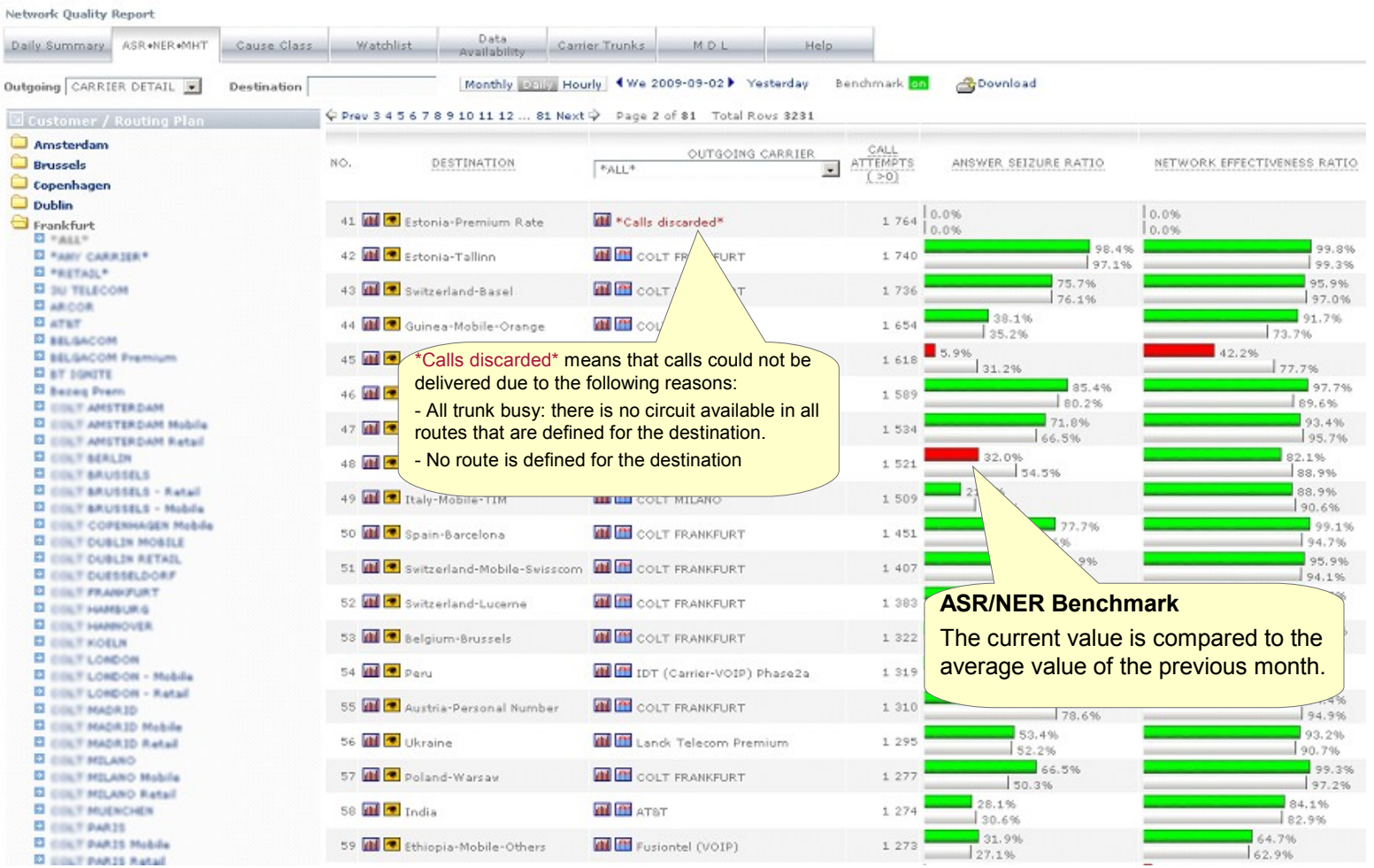
NO.	DESTINATION	CARRIER NAME ***	CALL ATTEMPTS (>1000)	ASR
1	Spain-Freephone	COLT Madrid BW	3 490	0.1%
2	Egypt	COLT Frankfurt Retail	1 425	3.4%
3	Canada	COLT FRANKFURT	1 072	4.2%
4	Bangladesh-Mobile-Others	COLT BMS GSX PAR PREMIUM	1 493	4.7%
5	Bangladesh-Mobile-Grameen	COLT BMS GSX PAR PREMIUM	2 366	5.1%
6	Bangladesh-Mobile-Others	COLT BMS GSX LON PREMIUM	1 553	5.2%
7	Bangladesh-Mobile-Grameen	COLT BMS GSX LON PREMIUM	2 408	5.2%
8	Sri Lanka	COLT Frankfurt Mobile	1 246	7.4%
9	Ethiopia-Mobile-Addis Ababa	Sansfil	2 520	10.5%
10	Iran-Mobile	NOBEL (Carrier VoIP) Ph2	1 203	12.2%
11	Thailand	COLT FRANKFURT	3 978	13.2%
12	Guinea-Mobile-Sotelguy	COLT STOCKHOLM - Wholesale	1 038	14.2%
13	Zimbabwe-Mobile-Econet	Arbinet	16 027	15.5%
14	Armenia-Erevan	COLT AMSTERDAM	22 603	15.6%
15	Monaco-Mobile-KFOR	COLT MILAN	1 613	15.7%
16	Jamaica-Mobile-Digicel	VINCULUM (Carrier VoIP) Ph2	13 016	16.4%
17	Australia	COLT BMS GSX PAR WHOLESALE	7 284	20.1%
18	Australia	COLT BMS GSX LON WHOLESALE	7 170	20.8%
19	Tunisia-Mobile-Others	COLT MILAN	2 792	21.6%
20	Bangladesh-Mobile-Others	Telos214 (Carrier VoIP) Ph2	3 124	22.5%
	Total		1 503 700	56.4%

Lower ASR means revenue loss.

Traffic management team is the main user of Network Quality Reports. The team is responsible for the routing management of international calls.

Destinations with poor ASR

Module “Network Quality Reports”



ASR, NER by destination

Module “Network Quality Reports”

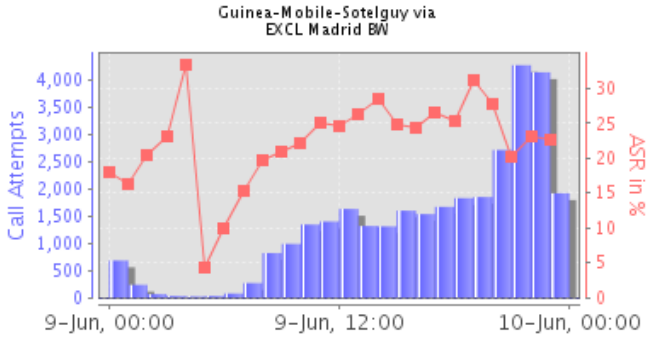
Network Quality Statistics

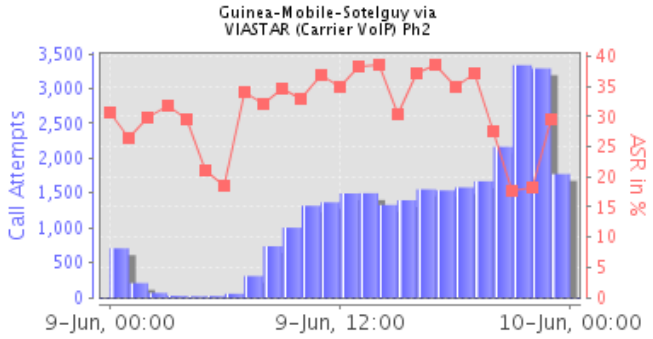
Gateway: London
Routing Plan: *ALL*
Destination: Guinea-Mobile-Sotelguy
Prefix Codes: 22460

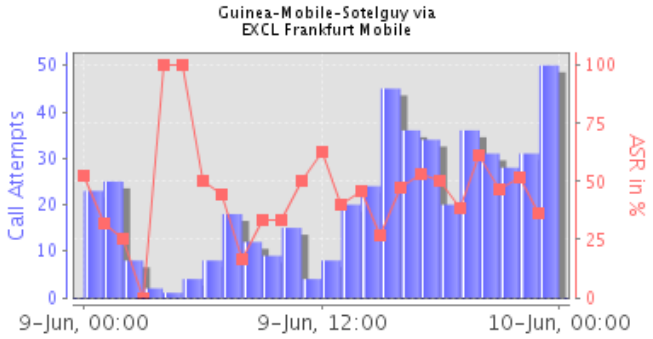
Monthly | Daily | Hourly ◀ Tu 2009-06-09 ▶

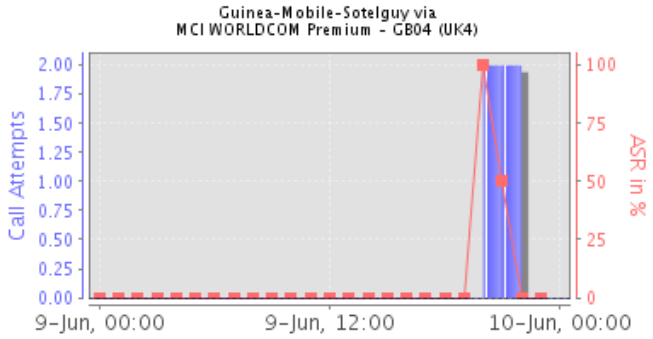
Back to standard display.

Historical trends of the traffic quality are provided for each supplier over time periods allowing any preventative action.









Comparison of ASR of different suppliers

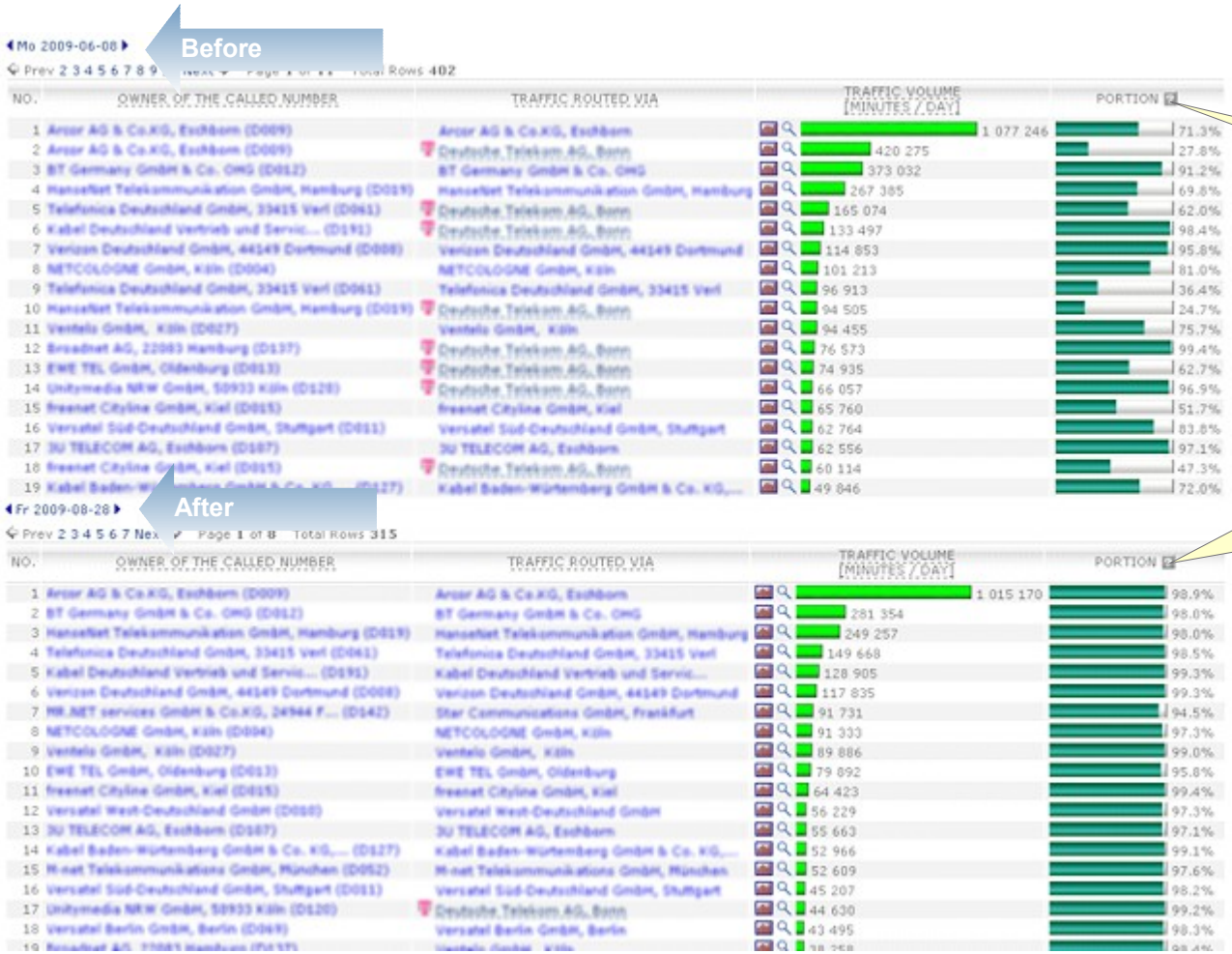
Module “Germany Transit Traffic Analysis”

- Charge for transit service is high
- The goal is to reduce the transit traffic
- Direct routing or routing via interconnect partners e.g. BT, Arcor
- Provide transit service to other carriers

By default the calls to subscribers or to service numbers of other network operator are routed via Deutsche Telekom (DTAG). DTAG then forwards the calls to the actual network operator. This call routing service of DTAG is called transit service which causes high costs for the carrier. For this reason the carriers establish interconnect with some network operators to which they can route the calls directly and thus reduce the high charge for transit service via DTAG.

The transit traffic analysis in NTQR is based on CDR. The information regarding the subscriber numbers is available through the number database RDB. The database contains both native and ported numbers of German network operators.

Module “Germany Transit Traffic Analysis”

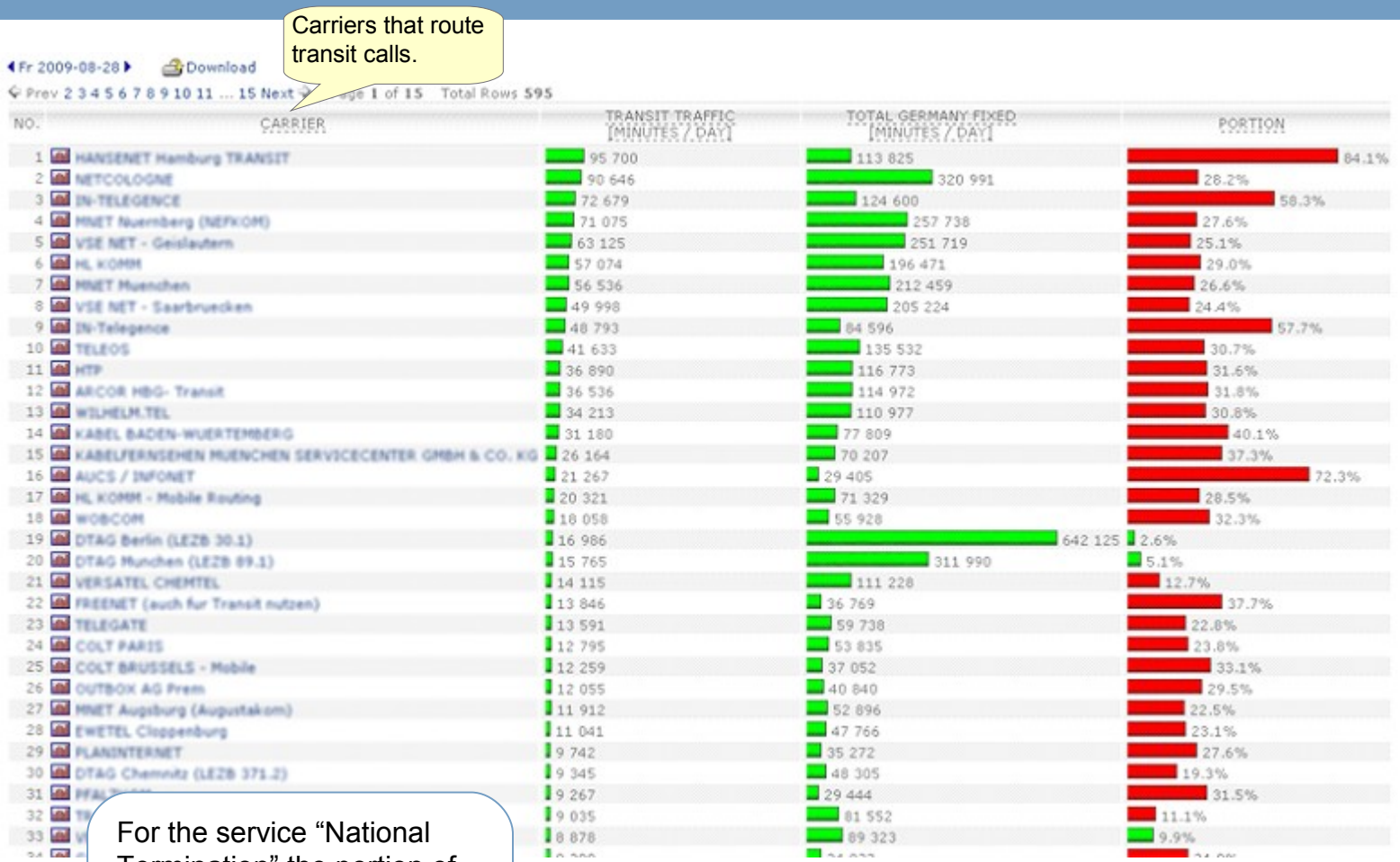


Before the migration of LNP/MNP into IN Teligen system the total portion of transit traffic was ~10%

After the migration of LNP/MNP into IN Teligen system the total portion of transit traffic is now < 1.5%

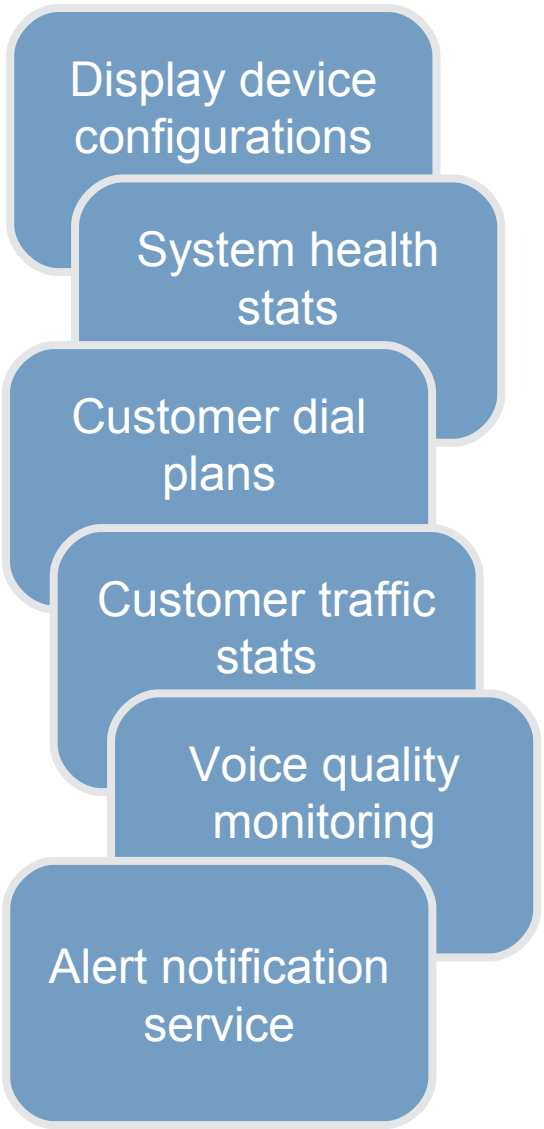
After the introduction of IN Teligen system as routing engine for LNP/MNP the transit traffic has been reduced drastically.

Module “Germany Transit Traffic Analysis”



For the service “National Termination” the portion of transit traffic may not exceed 5%. Otherwise the carrier will be charged with higher prices.

Module “Cisco Monitoring”



COLT provides VoIP services based on Cisco platform. The services include:

- **COLT Total**

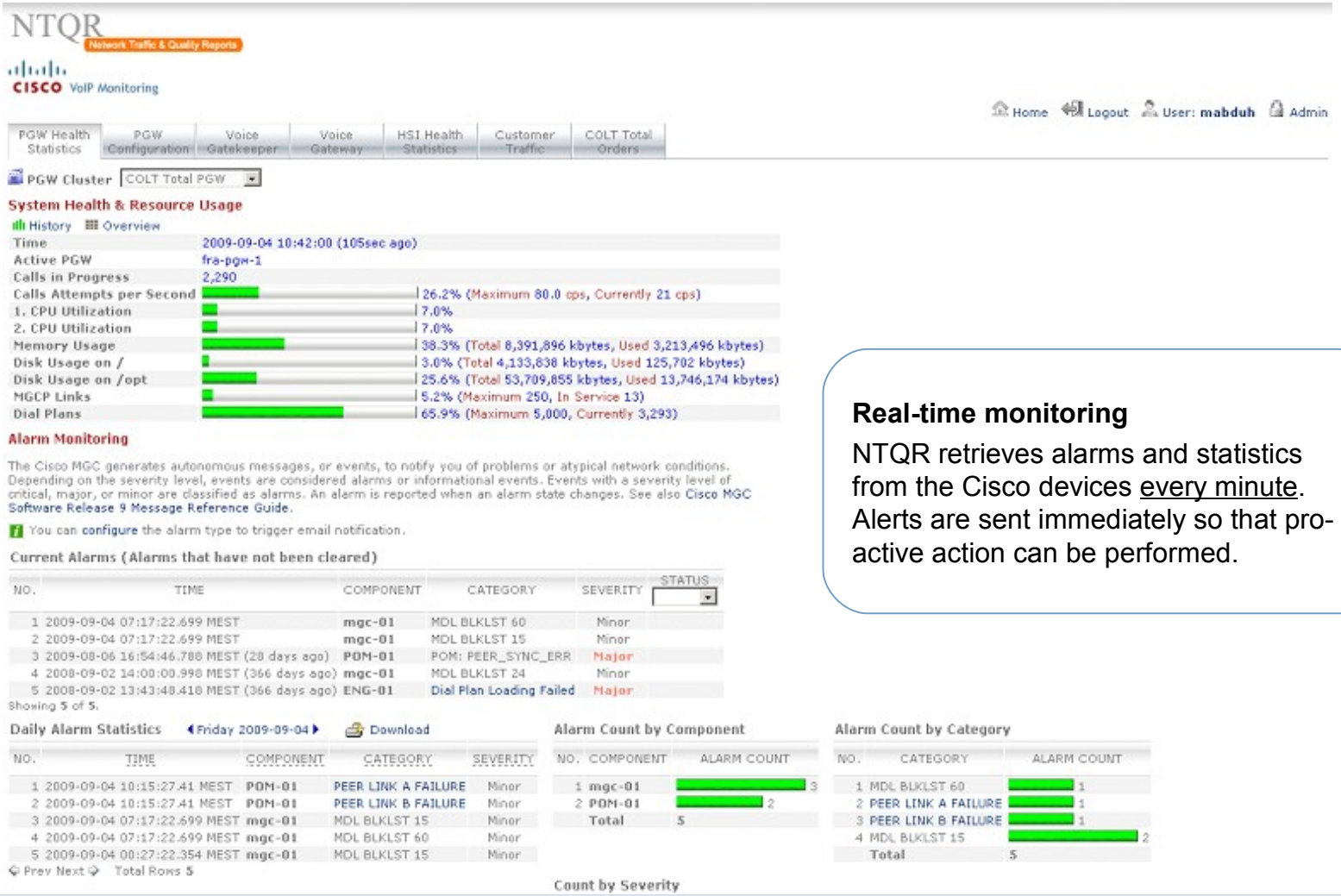
An integrated package of high speed internet and voice services, providing business-grade IP services to midsize companies.

- **COLT VoIP Access**

It connects customer IP PBX to PSTN via an end-to-end IP network.

NTQR is used to monitor the Cisco VoIP devices e.g. PGW, HSI, Gatekeepers, AS5400. The main functions include system health and alarm monitoring, customer traffic reports, voice quality monitoring.

Module “Cisco Monitoring”

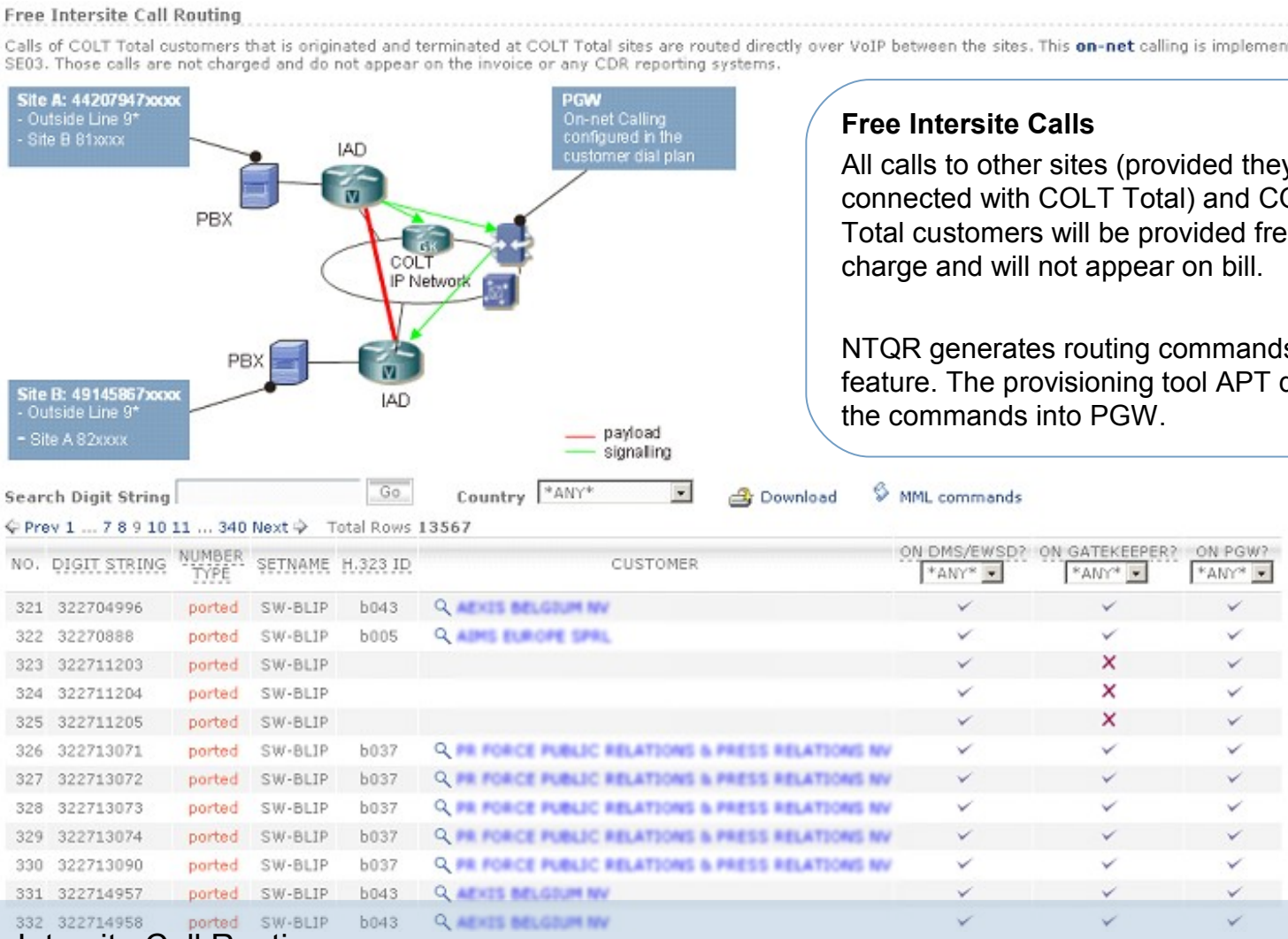


Real-time monitoring

NTQR retrieves alarms and statistics from the Cisco devices every minute. Alerts are sent immediately so that pro-active action can be performed.

PGW Health Statistics

Module “Cisco Monitoring”



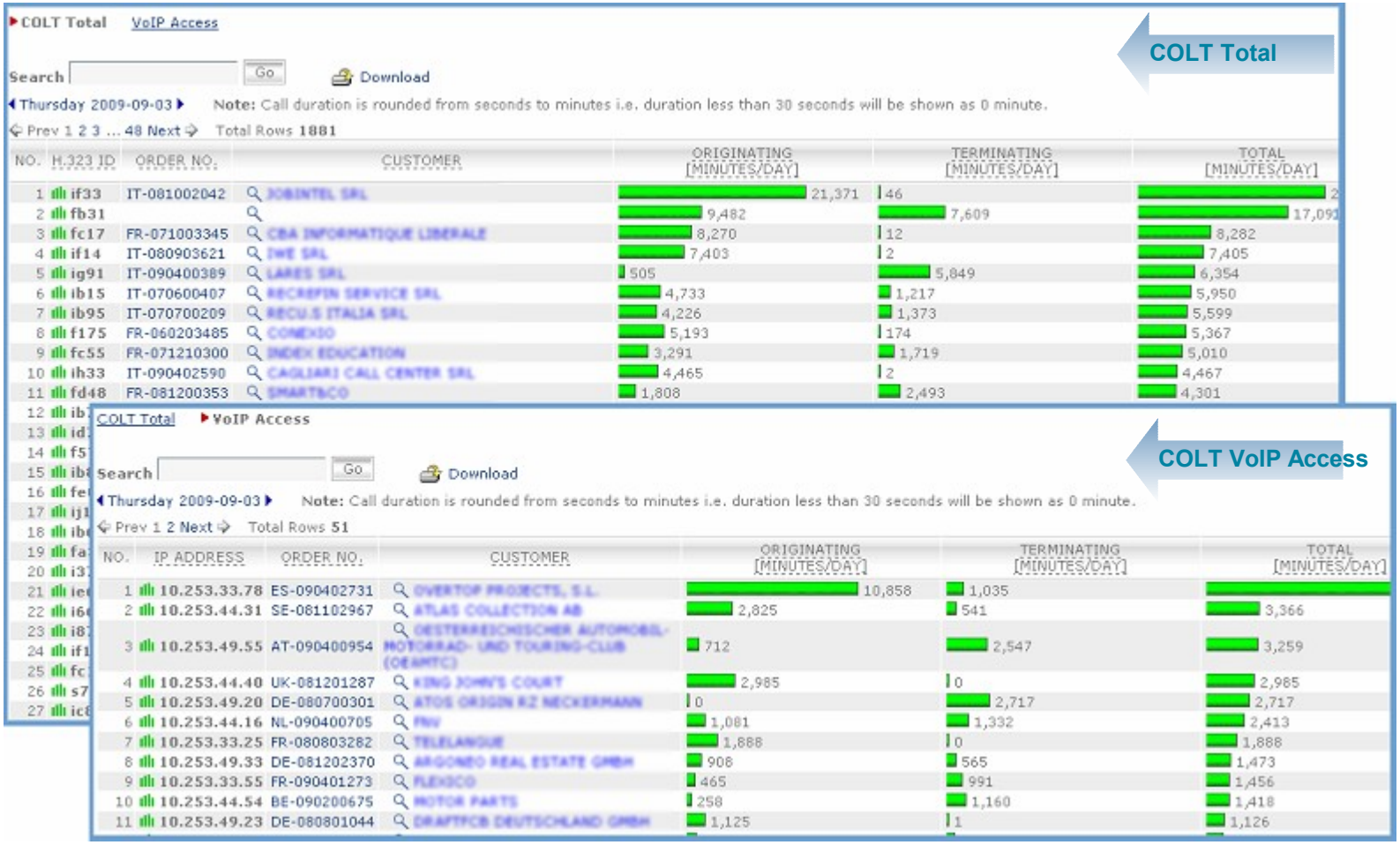
Free Intersite Calls

All calls to other sites (provided they are connected with COLT Total) and COLT Total customers will be provided free of charge and will not appear on bill.

NTQR generates routing commands for the feature. The provisioning tool APT deploys the commands into PGW.

Free Intersite Call Routing

Module “Cisco Monitoring”

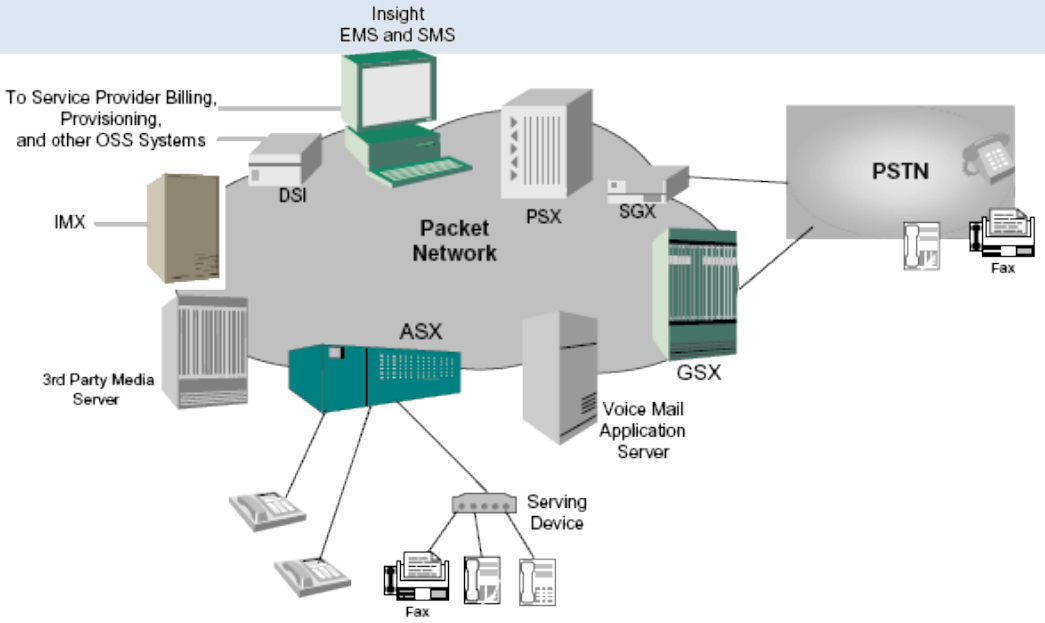


Customer Traffic Statistics

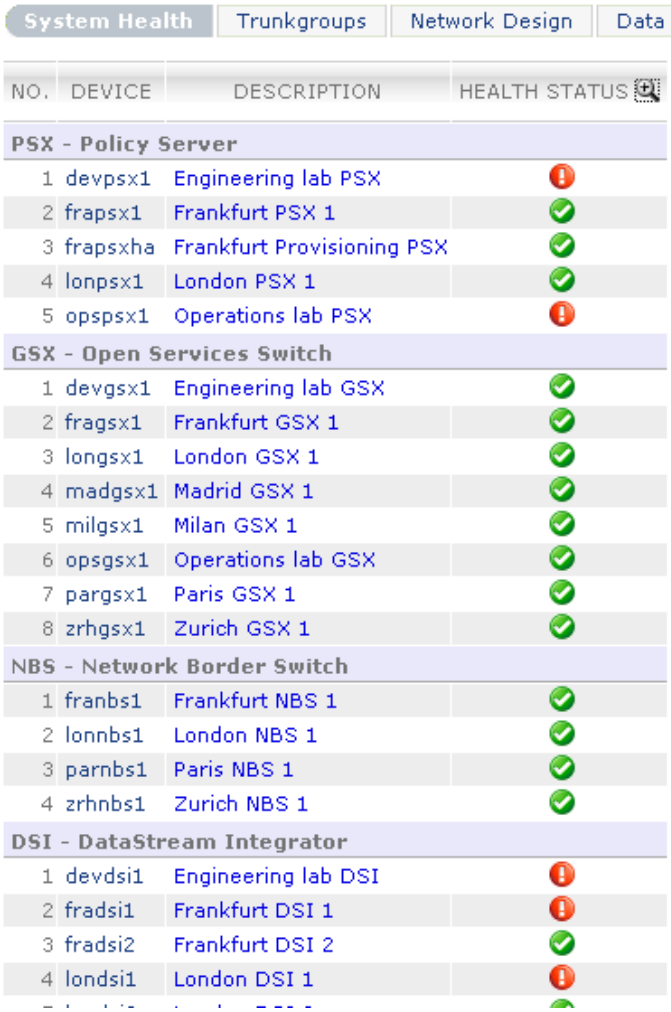
Module “Sonus Monitoring”

- Display device configurations
- Performance analysis and reports
- System health stats
- Trunkgroup traffic stats

The performance reports are generated based upon data collected from the Sonus Insight managed devices e.g. GSX, PSX Policy Server, ASX Access Server etc. The reports supply a variety of performance information useful in ascertaining the overall health of the network. The data collection within Sonus Insight is configured to export the data to NTQR server 15 minutes.



Module “Sonus Monitoring”



The system health status is determined based on Sonus Network Element Engineering Guidelines. According to guidelines the network elements should be eingineered to the following thresholds:

PSX
- CPU: 80%

GSX
- CPU: 80% (for all server cards)
- Memory: 80% (for all server cards)

NBS
- CPU: 80% (for all server cards)
- Memory: 80% (for all server cards)

DSI
- CPU: 80%

EMS
- CPU: 80%

Other indicators to monitor depend on the configuration, traffic characteristics and desired quality level:
- Call attempts per seconds
- Circuit utilization
- Signaling link utilization
- SIP registrations
- Subscriber feature complexity
- Server congestion
- Disk space usage

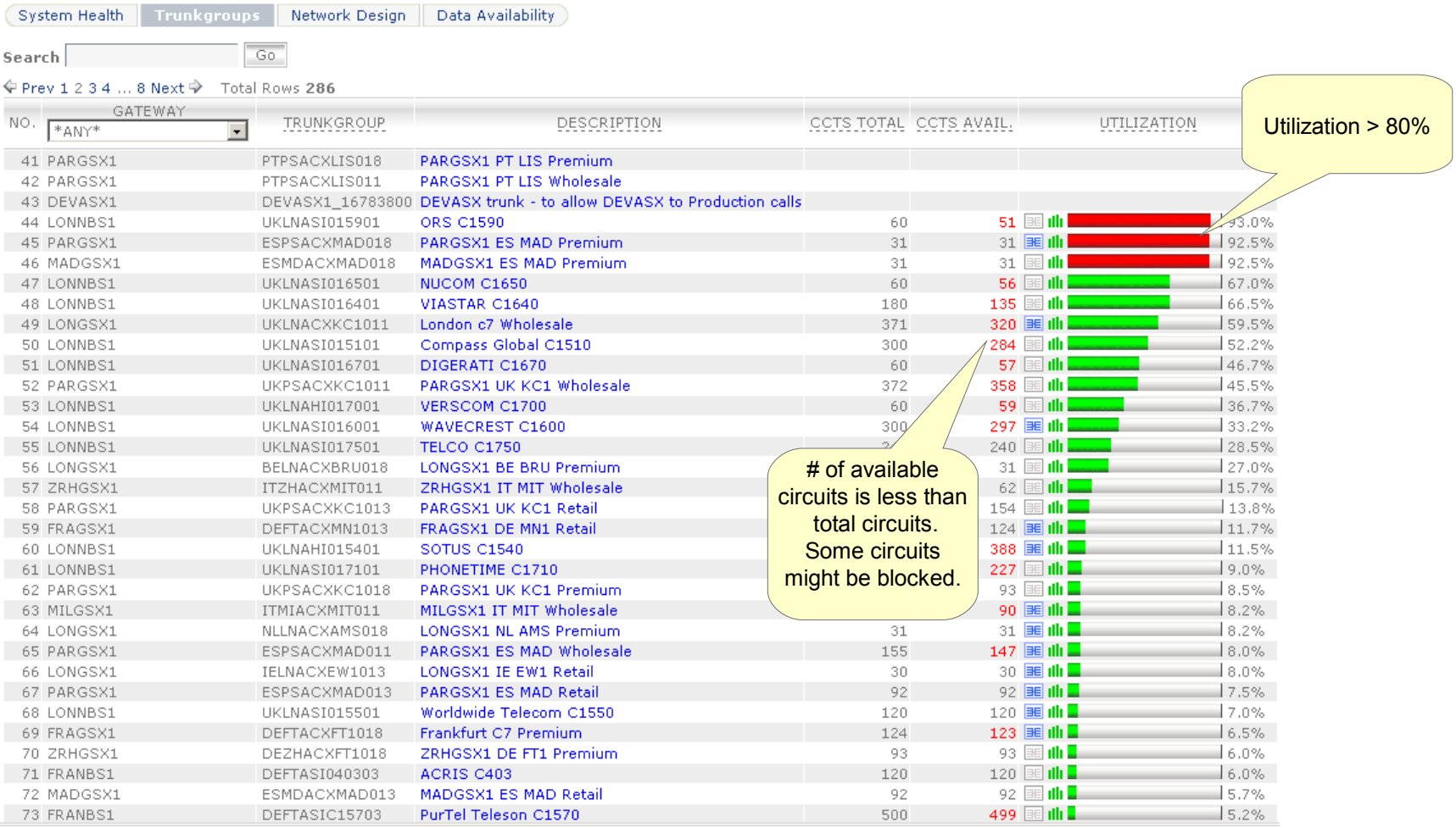
Currently the performance analysis includes the following number of devices

5 PSX - Policy Server
8 GSX - Open Services Switch
4 NBS - Network Border Switch
3 ASX - Access Server
14 DSI - DataStream Integrator
2 EMS - Element Management System

Total devices **36**

System Health Statistics

Module “Sonus Monitoring”



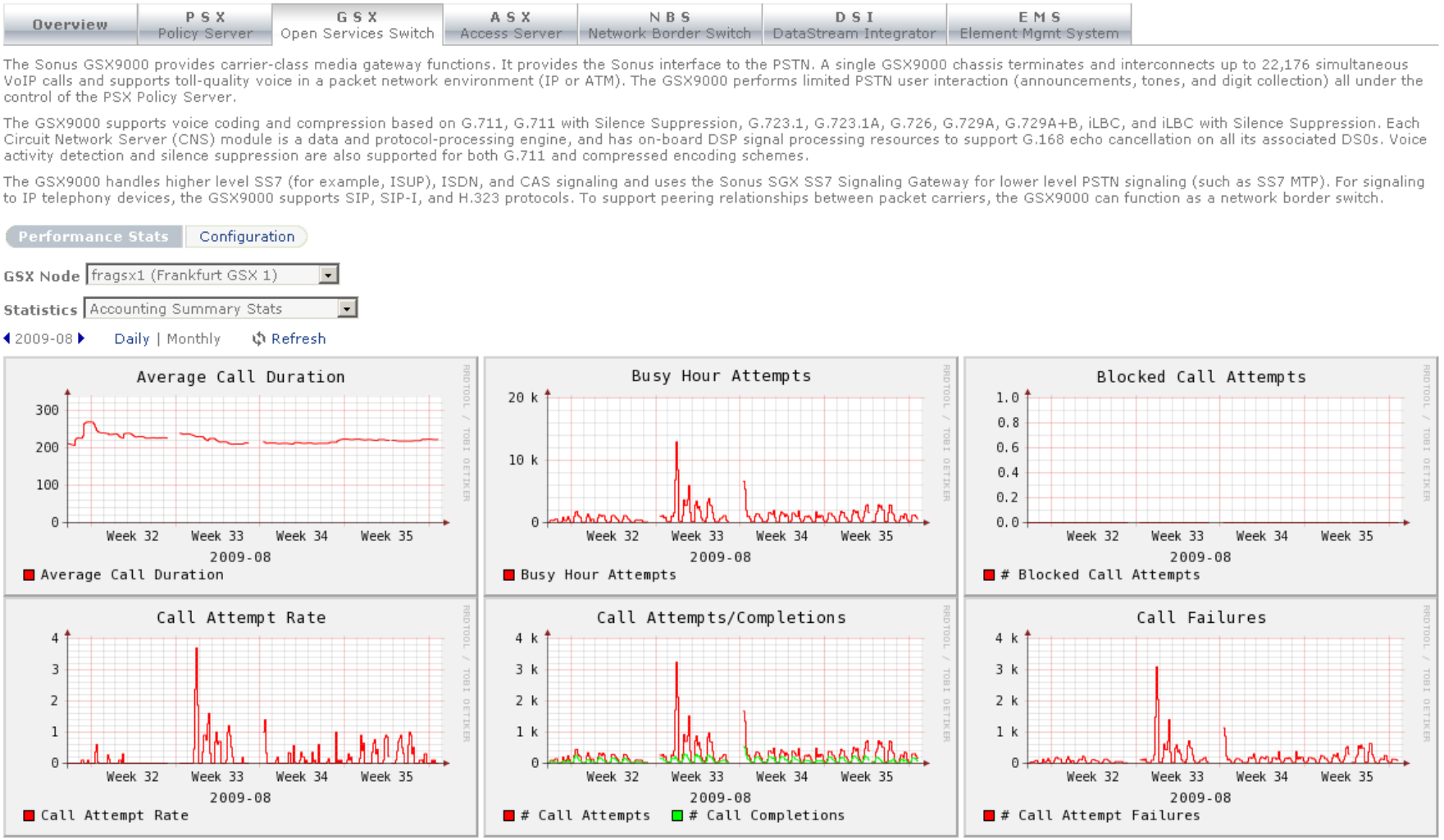
NO.	GATEWAY	TRUNKGROUP	DESCRIPTION	CCTS TOTAL	CCTS AVAIL.	UTILIZATION
	ANY					
41	PARGSX1	PTPSACXLIS018	PARGSX1 PT LIS Premium			
42	PARGSX1	PTPSACXLIS011	PARGSX1 PT LIS Wholesale			
43	DEVASX1	DEVASX1_16783800	DEVASX trunk - to allow DEVASX to Production calls			
44	LONNBS1	UKLNASI015901	ORS C1590	60	51	93.0%
45	PARGSX1	ESPSACXMAD018	PARGSX1 ES MAD Premium	31	31	92.5%
46	MADGSX1	ESMDACXMAD018	MADGSX1 ES MAD Premium	31	31	92.5%
47	LONNBS1	UKLNASI016501	NUCOM C1650	60	56	67.0%
48	LONNBS1	UKLNASI016401	VIASTAR C1640	180	135	66.5%
49	LONGSX1	UKLNACXKC1011	London c7 Wholesale	371	320	59.5%
50	LONNBS1	UKLNASI015101	Compass Global C1510	300	284	52.2%
51	LONNBS1	UKLNASI016701	DIGERATI C1670	60	57	46.7%
52	PARGSX1	UKPSACXKC1011	PARGSX1 UK KC1 Wholesale	372	358	45.5%
53	LONNBS1	UKLNAHI017001	VERSCOM C1700	60	59	36.7%
54	LONNBS1	UKLNASI016001	WAVECREST C1600	300	297	33.2%
55	LONNBS1	UKLNASI017501	TELCO C1750		240	28.5%
56	LONGSX1	BELNACXBRU018	LONGSX1 BE BRU Premium		31	27.0%
57	ZRHGSX1	ITZHACXMIT011	ZRHGSX1 IT MIT Wholesale		62	15.7%
58	PARGSX1	UKPSACXKC1013	PARGSX1 UK KC1 Retail		154	13.8%
59	FRAGSX1	DEFTACXMN1013	FRAGSX1 DE MN1 Retail		124	11.7%
60	LONNBS1	UKLNAHI015401	SOTUS C1540		388	11.5%
61	LONNBS1	UKLNASI017101	PHONETIME C1710		227	9.0%
62	PARGSX1	UKPSACXKC1018	PARGSX1 UK KC1 Premium		93	8.5%
63	MILGSX1	ITMIACXMIT011	MILGSX1 IT MIT Wholesale		90	8.2%
64	LONGSX1	NLLNACXAMS018	LONGSX1 NL AMS Premium	31	31	8.2%
65	PARGSX1	ESPSACXMAD011	PARGSX1 ES MAD Wholesale	155	147	8.0%
66	LONGSX1	IELNACXEW1013	LONGSX1 IE EW1 Retail	30	30	8.0%
67	PARGSX1	ESPSACXMAD013	PARGSX1 ES MAD Retail	92	92	7.5%
68	LONNBS1	UKLNASI015501	Worldwide Telecom C1550	120	120	7.0%
69	FRAGSX1	DEFTACXFT1018	Frankfurt C7 Premium	124	123	6.5%
70	ZRHGSX1	DEZHACXFT1018	ZRHGSX1 DE FT1 Premium	93	93	6.0%
71	FRANBS1	DEFTASI040303	ACRIS C403	120	120	6.0%
72	MADGSX1	ESMDACXMAD013	MADGSX1 ES MAD Retail	92	92	5.7%
73	FRANBS1	DEFTASIC15703	PurTel Teleson C1570	500	499	5.2%

Trunkgroup Traffic Statistics

Module “Sonus Monitoring”

PSX LNP Request Statistics

Module “Sonus Monitoring”



GSX Accounting Summary Statistics

Module “Sonus Monitoring”

Trunkgroup configurations

Performance Stats | Configuration

GSX Node fragsx1 Download

Prev 1 2 3 4 ... 9 Next Total Rows 843

```
Local Policy Trunk Profile

Local Trunk Name: GSX-GW-GW

State                                          ENABLED
Inbound Reserve (percent)                      0
Mode                                           INSERVICE
Action                                         DRYUP
Timeout (min)                                  5
Circuit Reservation State                      DISABLED
Reserved Priority Calls (circuits)             1
Reserved Incoming Calls (circuits)             1
Reserved Outgoing Calls (percent)              10
Alternate Trunk Group Name
Trunk Group Rename Timer (sec)                 0
SILC State                                     DISABLED
SILC Congestion Level 1 Calls Allowed (percent) 075
SILC Congestion Level 2 Calls Allowed (percent) 025
Trunk Group Type                               IPSELECTED
IP Trunk Group Direction                       BOTHWAYS
Parent IP Trunk Group
IP Network Selection Table                     GSX-GW-GW
IP Call Limit                                  UNLMT
IP Bandwidth Limit                             UNLMT
Packet Outage Detection Minimum Duration       6000
Packet Outage Detection Minimum Calls          1000
Packet Outage Detection Bandwidth Limit Reduct 50
Packet Outage Detection State                  DISABLED
Packet Outage Detection Interval (minutes)     15
Master Trunk Group Name
Calls Requested Per MTRG Request               100
Bandwidth Requested Per MTRG Request (1K bps)  12400
Maximum Ingress Sustained Call Rate            0
Maximum Ingress Call Burst Size                0
Maximum Ingress Sustained SIP nonInvite Rate 0
Maximum Ingress SIP nonInvite Burst Size     0
Maximum Egress Sustained Call Rate             0
Maximum Egress Call Burst Size                 0
Maximum Egress Sustained SIP nonInvite Rate  0
Maximum Egress SIP nonInvite Burst Size      0
HPC Profile Name                               defaultintipqueuing
HPC Early ACM or SIP-18X                       USEDEFAULT
HPC IP Oversubscription Override               DISABLED
HPC IP Oversubscription Factor                 10
Local Policy Trunk Profile
```

SIP service configurations

```
SHOW SIP SERVICE ALL ADMIN
Node: FRAGSX1                                  Date: 2009/09/03 22:29:58  GMT
                                               Zone: GMTPLUS01-BERLIN

SIP Service                    : defaultSipIpSrvcGrp

Admin State                    : ENABLED
Mode                           : INSERVICE
Action                         : UNDEFINED
Dryup Timeout (min)            : 0
Trunk Group                    : defaultiptg
Disc Treatment                 : sipDefault
Tone Package                   : default
Source Address Filtering       : ENABLED
Ans Supervision Timeout        : 300
Ans Supervision Timeout Action : RELEASE
Registration Expires (Default) : 3600
Signaling Zone                 : INTERNAL
Media Zone                     : INTERNAL
Media NIF Group                : PNS-1-3-1-INSIDE
NAPT for Signaling             : DISABLED
NAPT for Media                 : DISABLED
NAPT QualificationTable name   :
Parse Embedded BGID            : DISABLED
Congestion Reject Method       : RELEASE
Congestion Retry Timer Min (sec) : 10
Congestion Retry Timer Max (sec) : 30
Congestion Release Timeout (sec) : 0
SIP Timer T1 (msec)            : 500
SIP Timer T2 (msec)            : 4000
SIP Session Keepalive Timer (sec) : 1800
SIP Session Term Delta Time (sec) : 0
SIP Minimum Session Timer (sec) : 90
Retry Count for SIP Messages   : 7
Retry Count for INVITE Message : 6
Retry Count for RE-INVITE Message : 0
Retry Count for BYE Message    : 3
Retry Count for CANCEL Message : 3
Session keepalive retry  on 422 : 5
Session keepalive retry  on 491 : 5
Use Route Set                  : DISABLED
OPTIONS                        : ALLOW
REFER                          : ALLOW
SUBSCRIBE                      : ALLOW
NOTIFY                         : ALLOW
INFO                           : ALLOW
```

GSX Configurations

Module “Sonus Monitoring”

Overview | PSX Policy Server | GSX Open Services Switch | ASX Access Server | NBS Network Border Switch | DSI DataStream Integrator | EMS Element Mgmt System

The Sonus ASX Access Server provides line-side support for subscriber devices, call agent functions, and line-side access features. The ASX supports open standards-based interfaces. The ASX interfaces with the packet network using 100 Base-T Ethernet and supports MGCP, H.248, SIP, and the cable standard NCS to control a wide variety of access devices. The ASX can also leverage third-party application servers, providing additional line-side services such as intelligent call centers, IP voicemail, and unified communications.

The ASX runs on a Sun Netra platform and performs call agent functions including call setup and feature signaling for IP-based endpoints. It provides support for MGCP serving devices (SDs, such as IADs and MTAs), H.248 serving device (Media Gateway), and SIP endpoints. For PSTN interconnection, the ASX seamlessly interoperates with the GSX9000 and GSX4000 Open Services Switches and the SGX SS7 Gateway softswitch module to extend robust SS7/C7 signaling support to the network edge. This includes TCAP support and international ISUP variants for access to worldwide circuit-based networks and services. Also, the ASX communicates with the PSX, which provides both policy and routing services.

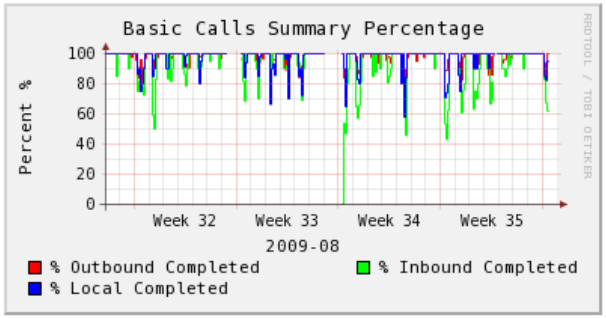
ASX Node fraasx1 (Frankfurt ASX 1)

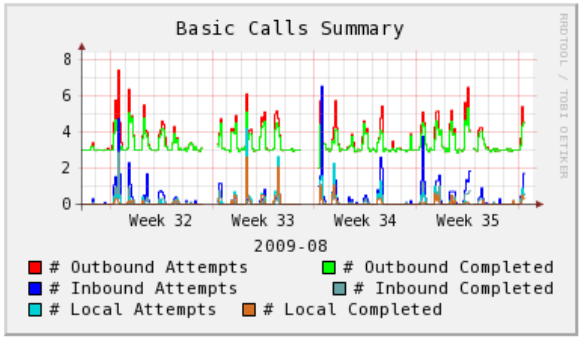
Statistics Basic Calls Summary

There are more than 40 performance statistics for ASX

Provides statistics on the basic call summary.

◀ 2009-08 ▶ Daily | Monthly Refresh





Descriptions

 # Inbound Attempts
The number of inbound calls attempted in current interval.

 # Inbound Completed
The number of inbound calls completed in current interval.

 # Local Attempts
The number of local calls attempted in the current interval.

 # Local Completed
The number of local calls completed in the current interval.

 # Outbound Attempts
The number of outbound calls attempted in current interval.

 # Outbound Completed
The number of outbound calls completed in current interval.

ASX Call Summary Statistics

Module “Sonus Monitoring”

Overview | PSX Policy Server | GSX Open Services Switch | ASX Access Server | NBS Network Border Switch | DSI DataStream Integrator | EMS Element Mgmt System

The DataStream Integrator (DSI) captures call data records from Sonus network elements, transforms them into the appropriate billing system input format, and distributes them to billing applications. Working with other components in Sonus Open Services Architecture (OSA), DSI ensures that network usage data is formatted properly and distributed to back-office applications such as billing, fraud, settlement, performance traffic management, and signaling analysis and reporting systems.

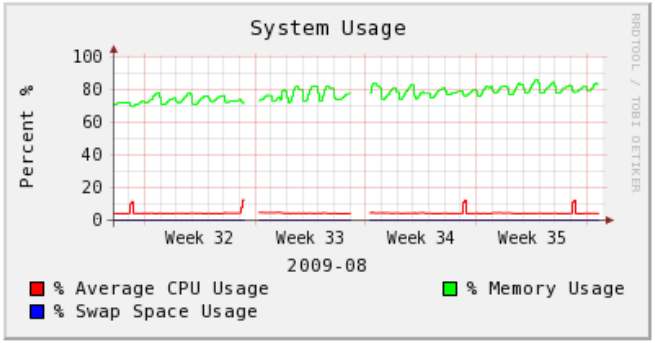
The DSI is typically deployed in a cluster configuration with a minimum of two servers to provide High Availability which ensures data integrity, transaction integrity, and continuity of operations through any single server failure. Secure communications between the DSI and backoffice applications keeps network usage data safe. The figure 1 illustrates how DSI is positioned in the network.

DSI Node fradsi1 (Frankfurt DSI 1)

Statistics System Usage

Provides information concerning host system resource usage.

2009-08 Daily | Monthly Refresh



Descriptions

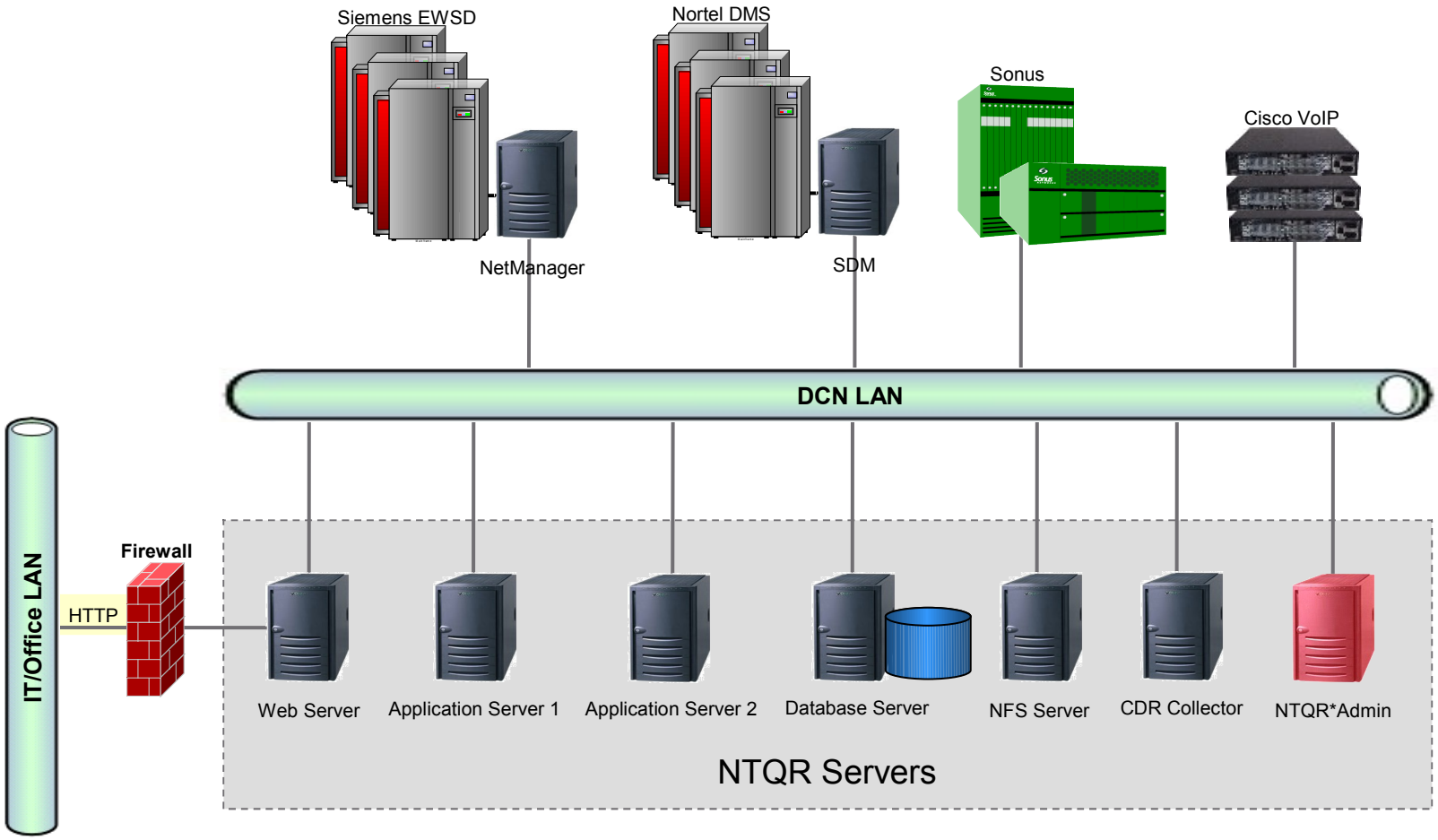
% Average CPU Usage
The total CPU time is the sum of 4 values: user time, kernel time, IO-wait time, and idle time. Each time value is calculated by taking the difference between present and the previous samples. The sampling period is 5 seconds. Usage is calculated using this formula: (user time+kernel time)/(user time+kernel time+IO-wait time+idle time)*100. The value is rounded up to an integer. The calculation is performed for each CPU, and the usage value is the average.

% Memory Usage
The usage value is calculated by dividing total in-use memory by total physical memory in the system. The Usage value is represented as a percentage and rounded up to an integer. The sampling period is 5 seconds.

% Swap Space Usage
The usage value is calculated by dividing total in-use swap space by total available swap space. The Usage value is represented as a percentage and rounded up to an integer. The sampling period is 5 seconds.

DSI System Usage Statistics

System Architecture



Some Technical Facts

Applications	NTQR applications are written in Java and JRuby. The applications run on the application servers Glassfish and Tomcat.
Host servers	SUN X2100 and X4200 series with Solaris 10.
Database servers	Oracle 10g