

Global Assurance for CDMA2000 Networks

As a common worldwide standard for mobile services, CDMA2000 networks are at the heart of how people around the globe communicate. Having a long history for digital voice services, CDMA has been extended via CDMA2000 1xEV-DO (1x Evolution-Data Optimized) to allow the same providers to offer non-voice services, such as text messaging, internet browsing, and multimedia images and video. Operators offering these combined voice and high speed data services are facing great opportunities as the popularity of these services grow, however they also face significant challenges in assuring that their networks, services and customer experience quality don't suffer as adoption expands.

Business Challenges for Mobile Operators

Today's mobile service providers operate in a very competitive environment. Despite fickle customers and a rapid pace of changing technology, they must continue to attract and retain customers to maintain revenue growth. Hurdles they constantly must overcome include:

- Attracting new customers
- Reducing customer churn /improving customer retention and loyalty despite the ease of changing providers due to number portability
- Creating/defining/promoting differentiation from competitive operators
- Developing new and innovative services at a competitive price
- Maintaining customer service quality and equality throughout mergers and acquisitions

Back office OA&M activities are also a critical component to improving customer retention. Reliable performance by call center applications, CRM, self-service portals, and timely and accurate billing systems are all important factors in the customer satisfaction equation.

CDMA2000 Network Challenges

The CDMA/2000 networks deployed in support of mobile services represent a substantial investment in infrastructure equipment, real-estate, and manpower, so it is no surprise that operators want to ensure that ROI is as strong as possible, the capacity supports the business growth, and the service coverage meets user demand. Other network operations challenges include:

- Traffic Engineering throughout ongoing infrastructure rollout and refresh processes
- Troubleshooting problems affecting service quality or availability, such as intermittent congestion problems on high volume segments, excessive dropped calls, or inability to activate a message waiting icon on handsets
- Trending the demand in services such as ring tone downloads versus IP voice call volume versus demand for internet access, and recognizing impact on the underlying network transporting them

Geography also plays an aggravating role, as operators attempt to support networks that span a single country or may cover multiple countries and continents as well as maintaining connectivity to roaming partners. It is no small endeavor to successfully assure services within the resulting network architectures.

Network Considerations

In the CDMA2000 core, voice, video, and data traffic will traverse within and across the multiple data centers that make up the mobile providers' network. Services will be accessed from many different terminal types, such as cell phones, personal computers, PDAs (personal digital assistants), as well as from various locations including their homes, offices, and an ever increasing number of wireless enabled restaurants, cafes, hotels and public buildings via cell towers and public internet. (See figure 1.) It is critical to have visibility into the services and the network that is carrying those services. Most importantly, visibility is required within the data center and on the network links that inter-connect them.

nGenius Solutions meet the needs for CDMA2000 Service Assurance

The hypothetical CDMA2000 network shown in Figure 1 shows several key types of links where traffic passes through and each one has its own role and set of challenges when it comes to network, service, and customer assurance. The nGenius Performance Management Solution leverages deep packet inspection technology to deliver real-time operational intelligence spanning from high level application and conversation flow information all the way down to actual packets, enabling service providers to reduce MTTR and improve network and service assurance with advanced, customer/service-aware performance monitoring.

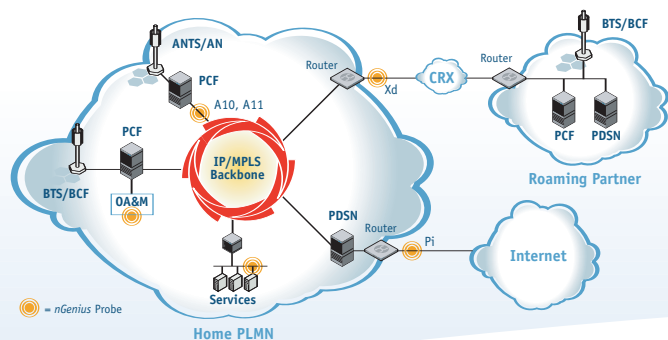


Figure 1. A typical CDMA2000 network deployment for mobile operations will have base stations, edge routers, access to the public switched telephone network for land line call completion and access to the mobile operator core for completing other cell based calls and delivery of IP-based data services. Shown here are key points where NetScout's nGenius Probe and nGenius AFMon instrumentation are placed to provide operations performance intelligence.

A10/A11 Interface Service Assurance

From a service assurance perspective, the A10/A11 interfaces between a PCF and PDSN node represents a critical point for establishing performance visibility. Individual subscriber service packets are transported between nodes in tunnels (GRE, LT2P) across these links, putting them directly in the delivery path for all IP-based services.

nGenius Probes and *nGenius* AFMONs passively and non-intrusively tapping the physical link between the PCF and PDSN nodes provide an ideal means of network and service performance monitoring. *nGenius* Performance Manager gathers and analyzes the statistics collected by the *nGenius* Probes and AFMONs to provide real-time and historical performance information that can be used for troubleshooting, traffic engineering, and/or capacity planning purposes. The *nGenius* Solution provides complete visibility, from KPIs to flow data to packet details, into service metrics and statistical information gathered from monitoring the A10/A11 interface.

In addition to providing visibility into all the services flows and conversations and all the packets on the A10/A11 interface, the *nGenius* Probes and AFMONs provide specific KPIs focused on particular critical monitored information, such as all the GRE tunnels created between the PCF and PDSN nodes. These KPIs include such measures as responsiveness, errors, and the number of successful transactions. *nGenius* Probes and AFMONs are also able to track high-value customer service flows based on MSISDN or IMSI numbers.

Application	Server	Client	Response (ms)	Peak Response (ms)	Min Response (ms)	Responses (Successful)
ORE	CH_PD SN_MMS	SEA_PD SN1	280	281	280	2
ORE	NY_PD SN_PTT	SEA_PD SN1	167	390	61	6
ORE	NY_PD SN_SMS	SEA_PD SN1	166	390	50	6
ORE	CH_PD SN_MMS	SEA_PD SN2	147	176	111	6
ORE	NY_PD SN_PTT	SEA_PD SN2	140	331	51	10
ORE	NY_PD SN_SMS	SEA_PD SN2	140	140	140	2
			91,000	490,000	0,000	507,000

Figure 2. The *nGenius* Solution can provide a break down of services and applications being monitored, as well as a drill down to the response time for services (GRE tunnels, in this example).

Pi Interface Service Assurance

With mobile offerings supporting Internet based services becoming more and more popular, requests for stock prices, news updates, and sports scores will be transported from the PDSN node over a Pi interface to the internet site requested and back again to the subscriber. From a service assurance perspective, the Pi interfaces from the PDSN node to the internet has a substantial volume of conversation traffic that represents high value services to a mobile operator which makes it an essential place to establish performance monitoring and visibility.

nGenius Probes and *nGenius* AFMONs passively and non-intrusively tapping the PDSN's outbound Pi interface link provides an ideal means for monitoring network and service performance. *nGenius* Performance Manager gathers and analyzes the statistics collected by the *nGenius* Probes and AFMONs and provides real-time and historical performance information that can be used for troubleshooting, traffic engineering, and/or capacity planning purposes. It provides complete visibility, from KPIs to flow data to packet details, into the service activity and statistical information gathered from monitoring internet access traffic.

In addition to providing visibility into all the services flows and conversations and all the packets on the Pi interface, the *nGenius* Probes and AFMONs provide deeper, more detailed information, such as inter-

net web-browsing including URLs of sites visited, e-mail traffic, as well as all conversations across the internet interface. KPIs include such measures as responsiveness, errors, and the number of successful transactions. *nGenius* Probes and AFMONs are also able to track high-value internet activity such as for movie clips or music downloads on a URL and/or subscriber basis.

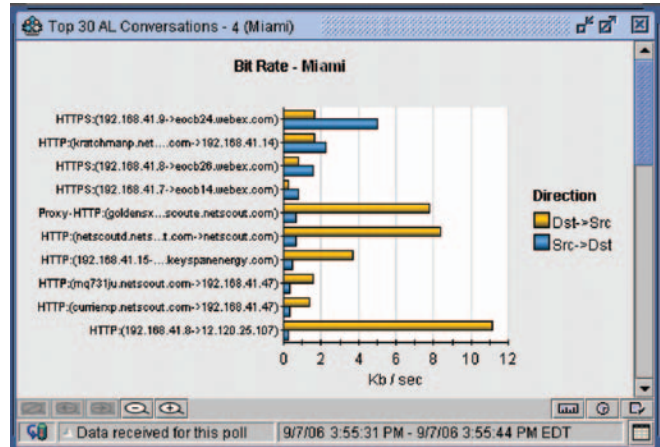


Figure 3. The *nGenius* Solution identifies and presents active conversations from the PDSN node over the Pi interface to the Internet to be used in troubleshooting problems in real time.

Partner Roaming Service Assurance

Subscribers are often outside the service area for their operator and move into a “roaming” mode of operation. In these cases, subscriber services are facilitated by partners. In CDMA2000 network there is an IP-Based interface from PDSN nodes that facilitates roaming services. Typically tunneling (GRE, LT2P) is employed on this interface.

nGenius Probes and *nGenius* AFMONs passively and non-intrusively tap the physical roaming partner interface from the PDSN nodes, providing an excellent means for monitoring network and service performance. *nGenius* Performance Manager gathers and analyzes the statistics collected by the *nGenius* Probes and AFMONs and provides real-time and historical performance information that can be used for troubleshooting, traffic engineering, and/or capacity planning purposes. The *nGenius* Solution provides complete visibility, spanning KPI to flow data to packet details into the service activity and traffic statistics gathered from monitoring the roaming partner interface.

In addition to providing visibility into all the services flows and conversations and all the packets on the roaming partner interface, the *nGenius* Probes and AFMONs provide specific KPIs focused on particular critical monitored information, such as all the GRE tunnels created from the PDSN nodes to the requested roaming partner and back again to the subscriber. These KPIs included such measures as responsiveness, errors, and the number of successful transactions.

In wireless IP-based networks, degradations in DNS services that delay translation of domain names to IP addresses may impede the subscriber's ability to access other services and reduce the service provider's ability to deliver other revenue generating services. Utilizing the *nGenius* Performance Monitoring solution with KPIs for response time, errors and number of successful transactions, DNS conversation flows, and recorded packets, wireless providers can rapidly pinpointed the source of degradations.

Given the revenue importance of roaming traffic, the *nGenius* Probes and AFMONs provide an excellent mechanism to assure performance of conversation flows and delivering visibility based on MSISDN or IMSI.

IP/MPLS Core Bearer Network Service Assurance

High volumes of voice and data traffic are transported across the IP/MPLS Core Bearer Network of a CDMA2000 infrastructure and as a result needs to be monitored for service assurance purposes. However, it isn't the physical plumbing that often needs to be monitored -- it is the traffic flowing across pre-designed virtual route forwarding (VRF) paths. Many mobile service providers establish unique VRFs for each service (i.e. voice, video, SMS, push to talk), while others use VRFs to segment out high profile business customer accounts, or even their own internal traffic when that traffic is sharing a common transport backbone.

The *nGenius* Probes have an innovative, dynamic routing-aware approach to identify VRFs for tracking services or customer traffic groups as they utilize the IP/MPLS core bearer network. Once the VRF virtual interfaces are defined in *nGenius* Performance Manager, it provides complete visibility into all the services activity and traffic statistics gathered from monitoring the core network.

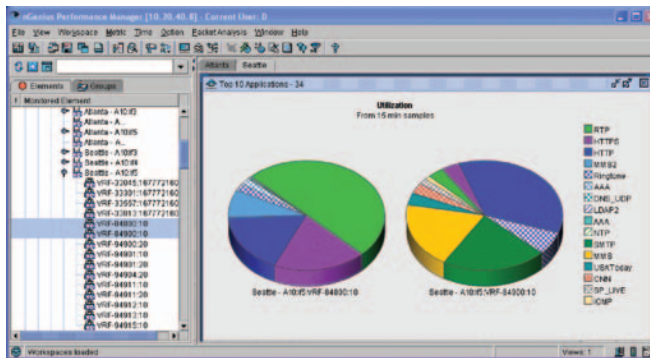


Figure 4. The *nGenius* Performance Manager can provide KPIs to flows to packet information on VRFs individually or allows you to compare two or more VRFs at the same time.

Triple Play Services, for example, are extremely important to mobile operators from a revenue perspective and network service degradations can impact customer satisfaction, loyalty and lead to churn. The *nGenius* Solution can monitor and track all the voice (e.g.: RTP voice, SIP, H.323), video (e.g.: RTP video), as well as data (e.g.: HTTP, e-mail) services and conversations associated with Triple Play offerings and delivered across an IP/MPLS core network.

Further, real-time monitoring and historical analysis of these services can be supported regardless of the particular topology architecture of the core network. The *nGenius* Solution can be flexibly deployed in IP/MPLS with VRFs as described or in ATM, POS, Frame Relay and/or Ethernet environments. Further, it provides insight into the trunk level activity simultaneously with the associated virtual circuits, such as PVCs and VLANs, as well as any QoS service classes configured to deliver services using multi-tiered prioritization.

nGENIUS®

The *nGenius* Performance Management System

The *nGenius* Solution addresses the complex requirements of network and application performance management in today's converged, virtualized environment and is comprised of:

- ***nGenius* Performance Manager:** Software that analyzes the information collected by *nGenius* Probes, Collectors, Application Fabric Monitors, and other intelligent network devices and delivers integrated network and application monitoring, troubleshooting, capacity planning, and reporting in a single product.
- ***nGenius* Probes:** Dedicated hardware monitoring devices that passively identify, collect, and analyze application-level traffic data across the enterprise.
- ***nGenius* Collectors:** Dedicated hardware devices that collect application conversation data via NetFlow records and IP SLA tests.
- ***nGenius* Application Fabric Monitors:** Appliances that combine real-time and historical monitoring and analysis with storage for large packet trace captures for high performance, high reliability, high capacity recording and infrastructure monitoring.
- ***nGenius* Analytics:** Appliance-based software that delivers automated, proactive early detection and diagnosis of network and application performance anomalies.



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