Dialogic®

White Paper

Interconnecting Networks with Dialogic's Global Multimedia Exchange Platform

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Executive Summary

The architecture and approach that network operators have traditionally used for network interconnection have often required them to negotiate individual agreements with every service provider that they wish to connect with, an approach that can be complex, costly, and difficult to scale. The emergence of IP has not simplified this issue, and in many ways has made it more complex. In addition, many operators that own multiple, often heterogeneous networks need to interconnect their own networks across a common private IP backbone.

Fortunately, the GSM Association (GSMA) in 2006 defined a standardized interconnection service specification, the IP Packet Exchange (IPX). The IPX service offers a service-aware IP architecture for interconnecting GSM and CDMA mobile operators, fixed networks, and application service providers. Trials ending in 2008 of packet voice services over IPX-enabled networks demonstrated that IPX networks could deliver high-quality, low latency, and secure services. As of today, in 2010, numerous international wholesale interconnect providers are preparing to roll out IPX networks starting with basic packet voice services, and new services will be added based on demand by the service providers.

Whether used to offer GSMA IPX-compliant services or as part of a private backbone network, the requirements for these types of interconnect networks include the ability to support a diverse set of IP and TDM signaling protocols and to provide both end-to-end Quality of Service (QoS) and low cost but high quality media transport.

This white paper presents a brief introduction to network interconnect, GSMA IP packet exchange, and IPX features such as IPX proxies and services. It also focuses on the Dialogic® ControlSwitch™ System, Dialogic® BorderNet™ 3000 Session Border Controller, and the Dialogic® I-Gate® 4000 Media Gateways, which work together to enable IPX services, and for convenience are collectively referred to in this white paper as the Global Multimedia Exchange (GMX) platform. The GMX platform provides operators with a comprehensive end-to-end architecture, which is applicable to IPX and private IP backbone applications. The GMX platform has been tested by service providers in multiple GSMA-sponsored IPX trials and notable components of it are providing interconnect services in over 50 carrier networks.

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Network Interconnect and the GSMA IP Packet Exchange

Introduction

As service providers move more and more of their services and traffic to IP networks, the complexity required to interconnect with other operators has grown dramatically. This is in part because of the continuing need to support the network operators' existing TDM infrastructure and interwork services provided via both TDM and IP networks (for example, VoIP and traditional TDM voice). Because of this need, the architecture and strategy network operators have used for interconnect have been somewhat ad hoc. Moreover, it generally requires service providers to negotiate individual agreements with every other service provider they wish to connect with, an approach that can be complex, costly, and difficult to scale.

In addition to the need to interconnect different service providers' networks, many network operators own multiple, geographically separated heterogeneous networks (including fixed and mobile networks as well as different generations of mobile; for example, 2G and 3G) and are interested in interconnecting them across a private IP backbone. The requirements for these types of networks are in many ways similar to those for inter-operator interconnect as both necessitate the ability to support a diverse set of IP and TDM signaling protocols as well as to provide end-to-end Quality of Service (QoS) and low cost but high quality media transport.

In response to this issue, the GSM Association (GSMA) defined the IPX specifications in 2006. The final phases of the trials of packet voice services over IPX were completed in 2008, and demonstrated that IPX networks could deliver high-quality, low latency, and secure services. GSMA is open to further trials on-demand. [GSM World]

International operators are preparing to roll out IPX services. These companies will function as IPX providers for fixed and mobile operators and other types of service provider.

While the GSMA serves the GSM mobile community, the IPX offers a standardized architecture for interconnecting GSM and CDMA mobile operators, fixed networks, and application service providers (see an example in Figure 1). The IPX is a service-aware, global, private IP network that provides end-to-end QoS and cascaded billing features in support of interconnect and roaming services.

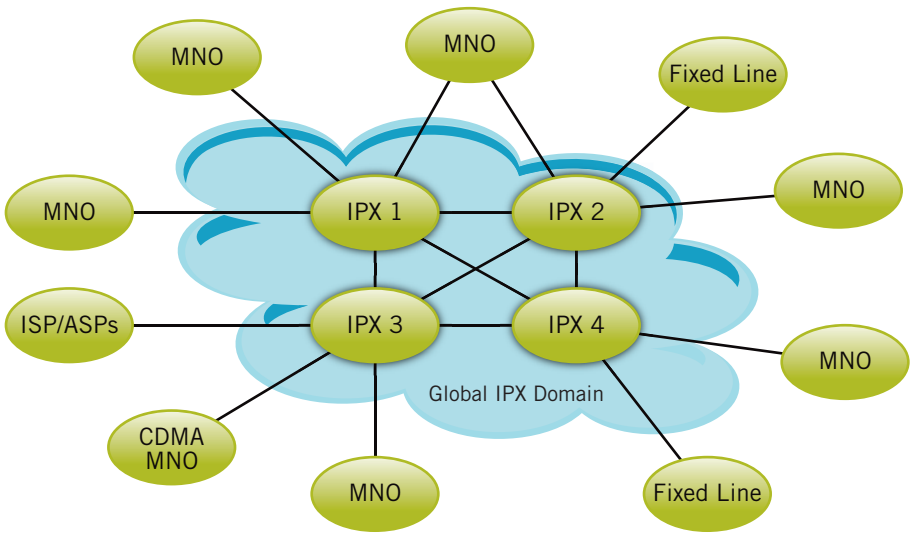

Figure 1. Global IPX Domain

Service providers with multiple, heterogeneous networks can also benefit from the features and capabilities of the IPX, making it likely that they will implement IPX-like networks over time.

Notable IPX Features

The IPX has been designed as an evolution of the GSMA's existing GPRS Roaming Exchange (GRX) service. The GRX was defined during the late 1990s by the GSMA to interconnect GSM service providers' GPRS data networks. Later, GRX was successfully extended to support additional services such as inter-carrier MMS and wireless LAN authentication. The IPX extends the GRX service in a number of significant ways by offering connectivity to non-GSM mobile operators, end-to-end QoS, and support for a variety of charging and interconnect models.

Connectivity to Non-GSM Mobile Operators

Unlike the GRX, which is restricted to GSM mobile operators, the IPX service has been designed to enable interconnection between almost any type of network including 2G and 3G GSM, CDMA, and fixed line, as well as connectivity to application service providers.

End-to-End QoS

The IPX offers service providers a true end-to-end, service-specific QoS guarantee defined by service availability, jitter, packet loss, and delay. Each IPX service provider not only guarantees the performance of its network but also that of any the IPX network to which it connects.

A Variety of Charging Models

Unlike the volume-based GRX charging model, IPX includes support for a wide variety of charging schemes triggered by different factors (for example, originating and terminating party pays, revenue share, volume, and events). This enables service providers to choose a charging model that is well suited for each of the services they wish to interconnect over the IPX.

A Variety of Interconnect Models

IPX offers network operators three models of interconnect: Bilateral Transport Only, Bilateral Service Transport, and Multilateral Service Hub. Each model offers a different level of service and connectivity. The combination of different charging and interconnect models provides IPX customers with a high degree of flexibility in how they use the IPX service.

Bilateral Transport Only

Bilateral Transport Only provides a bilateral IP transport service between two network operators with an end-to-end QoS guarantee. Each network operator pays the IPX provider for capacity and, if appropriate, directly pays termination charges to each other (see an example in Figure 2).

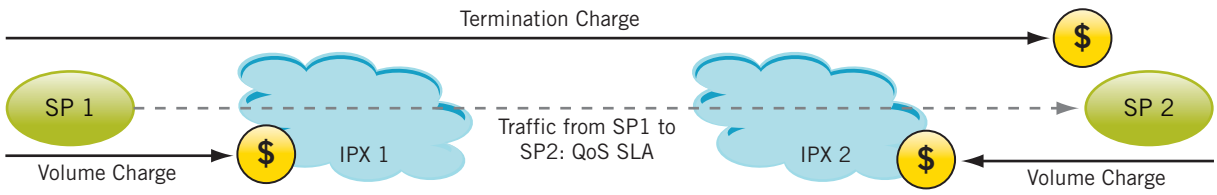

Figure 2. Bilateral Transport Only

Bilateral Service Transit

Like Bilateral Transport Only, Bilateral Service Transit provides an IP transport service between two network operators with an end-to-end QoS guarantee. In addition, Bilateral Service Transit includes service-aware cascaded billing of the IPX transit fee and optionally the termination fees (see an example in Figure 3).

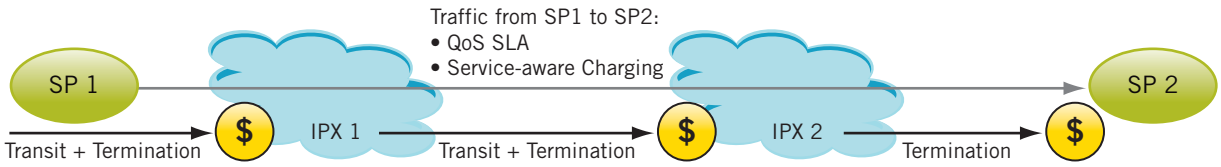

Figure 3. Bilateral Service Transport

Multilateral Service Hub

In the Multilateral Service Hub model, a network operator signs a single contract with the IPX provider and gains access to a number of other network operators. Service providers connecting to an IPX hub can choose either to connect to all other service providers also connected to the hub automatically, or to selectively connect to a subset of them. The network operator pays its IPX hubbing provider a service-specific fee that covers both transit costs and any termination fees. The IPX provider in turn cascades this fee to any required IPX peers and on to the destination network, which receives the termination portion of the fee (see an example in Figure 4).

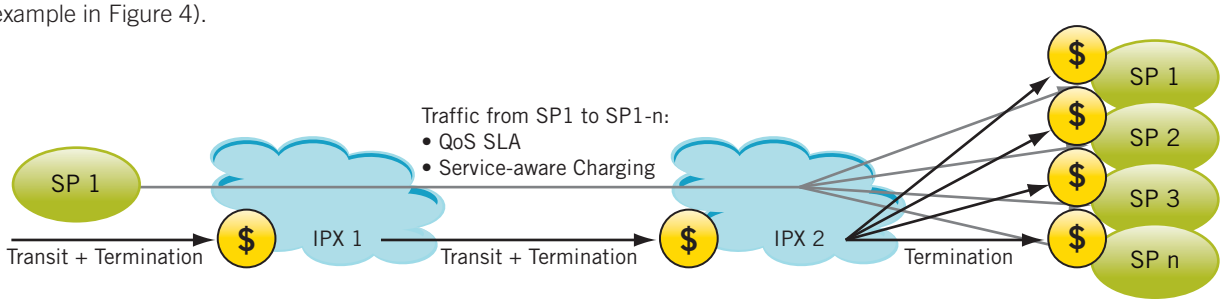

Figure 4. Multilateral Service Hub

IPX Architecture—IPX Proxies

The IPX architecture is based on a private IP network, along with a set of service-specific IPX proxies that support the service-aware billing and bilateral features. To date, the GSMA has defined the IPX SIP, MMS Hub, Wireless LAN roaming, and IM/Presence proxies. In general, IPX proxies can provide a variety of functions including the following:

- Session accounting
- Control and media plane packet handling
- Security
- IPv4/IPv6 interworking
- Transcoding
- Signaling interworking
- Destination network determination, including LNP/MNP
- Session trace

It is not a requirement that a single IPX proxy element perform all of these functions; instead, they can be distributed across a number of IPX proxy elements. While each proxy type has a set of service-specific requirements, a notable generic requirement is that they be as close to transparent as possible. This increases the likelihood that service providers' applications will work correctly over the IPX, and reduces integration and operations costs.

IPX Standardized Services

The GSMA has defined several standardized services that can be offered as part of the IPX. These include IP voice telephony, IP video telephony, Push-to-talk over Cellular (PoC), Instant Messaging (IM), presence, and video share. For each service, the GSMA has defined a service specification that at a minimum includes the required QoS, charging principles, and Service Level Agreement (SLA). In addition to these services, IPX providers are free to offer non-standardized value-added services.

IP Voice Telephony

The Voice over IP (VoIP) service supported by the IPX includes two different protocol architectures:

- **Packet Voice Interworking**—The voice traffic originates on a TDM network, either mobile or fixed. Because the media is converted to IP (RTP) and the SS7 signaling is encapsulated in SIP-I, it is important that the IPX signaling network elements (for example, the IPX proxy) include strong support for SS7 signaling.
- **Pure VoIP** — The voice originates as a VoIP service, and SIP is used for signaling between service providers.

IP Video Telephony

Like the IP voice telephony service, the IPX IP video telephony service supports both circuit- and packet-originated services using either SIP-I (circuit) or SIP (packet).

Push-to-talk over Cellular (PoC)

PoC, as defined by the Open Mobile Alliance (OMA), is a half-duplex VoIP service. The IPX supports the interconnection of PoC servers and the exchange of PoC talk bursts. Presence can be included as an optional part of the IPX PoC service offering.

Instant Messaging (IM)

IPX supports the transport of a variety of protocols used by IM services, including IETF/OMA SIP/SIMPLE, OMA IMPS, and XMPP. In addition to a basic transport capability, IPX service providers can offer protocol interworking (for example, SIP/SIMPLE to OMA IMPS/SSP) as a value-added feature.

Presence

While presence is usually offered in conjunction with another service (for example, PoC), it also can be offered as a generic service. The IPX presence service enables users to exchange presence updates using the OMA-defined SIP/SIMPLE version of presence.

Video Share

The IPX video share service is not based on a standardized definition of a video share service. Instead, video share services that use SIP and RTP can be supported through IPX by using the appropriate QoS levels.

Other Value-Added Services

In addition to GSMA standardized services, IPX operators can support many other services on a bilateral transport basis. For these non-standardized services, the IPX network provides network operators with a bilateral transparent IP transport service with QoS. In addition, IPX operators can provide additional services (for example, transcoding) that complement and extend the standardized IPX service.

The Global Multimedia Exchange Platform

Overview

The Dialogic® ControlSwitch™ System (ControlSwitch System), Dialogic® BorderNet™ 3000 Session Border Controller (BorderNet 3000 SBC), and Dialogic® I-Gate® Media Gateways (I-Gate 4000 Media Gateways) work together to enable IPX services, and for convenience are collectively referred to in this white paper as the Global Multimedia Exchange (GMX) platform. The GMX platform is a comprehensive end-to-end architecture likewise applicable to service providers building GSMA IPX compliant networks and operators building a common IP backbone for their own networks. The GMX platform provides network operators with a powerful platform for interconnecting heterogeneous networks (see an example in Figure 5).

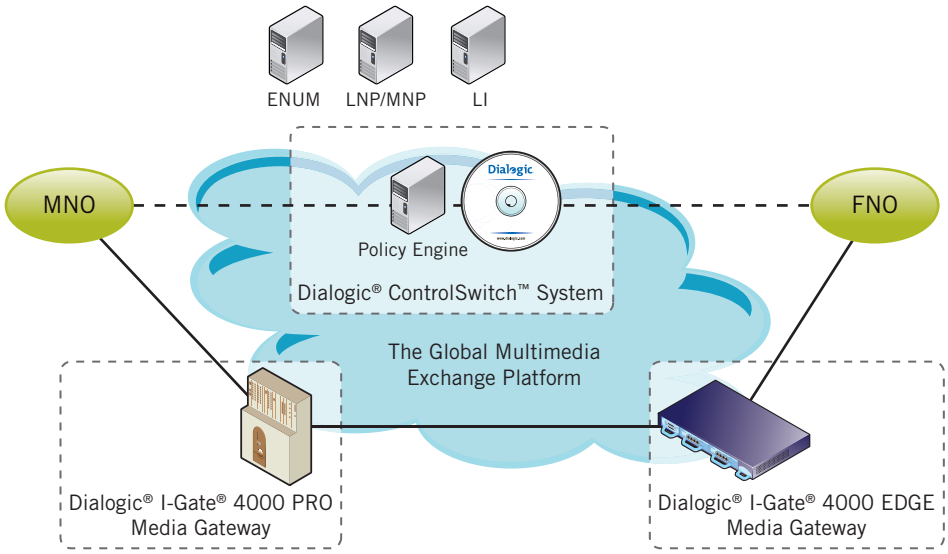

Figure 5. The Global Multimedia Exchange Platform

Service providers interested in either GSMA IPX or private interconnection applications should consider a network architecture that has the following requirements:

- **Protocol interworking**—Supports interworking the largest possible set of IP and TDM protocols and variants
- **Optimized routing**—Provides a flexible platform that enables the use of advanced routing
- **Comprehensive security**—Provides service-transparent security solutions
- **Flexible service-aware QoS**—Defines and delivers global service policies that guarantee end-to-end QoS
- **Value-added services**—Supports value-added services beyond basic interconnection
- **Lowest total network cost**—Provides the lowest possible cost at both the transport and service layer

The GMX platform supports these requirements in a field proven, GSMA IPX compliant, platform.

Protocol Interworking

Breadth of protocol support is an important feature for both IPX service providers and operators who are building a private backbone network. While the IPX is based on the use of IP protocols including SIP-I and SIP for session control, strong support for legacy TDM protocols including SS7 and ISDN is critical. The ControlSwitch System provides comprehensive support and interworking for H.323, SIP, SIP-I, PRI, CAS, and SS7 (40+ variants). These protocols provide that IPX service providers can support the desired number of customers without costly and time-consuming custom development. For operators who want to interconnect their own often heterogeneous networks, comprehensive protocol interworking reduces, if not minimizes, changes required at each mobile network.

In addition, broad protocol support enables value-added service interworking. For example, an IPX provider can transparently interwork IP-based video sharing with a TDM-based version of the same service with the ControlSwitch System.

Optimized Routing

Optimized routing capabilities are an important way for interconnect service providers to differentiate themselves and be able to provide the lowest possible costs. Unlike network architectures based on multiple standalone network elements, each making locally-driven, hop-by-hop routing decisions, the GMX platform architecture centralizes routing decisions in the ControlSwitch System, which enables globally optimal routing.

An example of how this can lower the cost and improve the quality of voice calls is the use of the ControlSwitch System Gateway MSC feature. This feature enables the ControlSwitch System to query a mobile network's Home Location Registrar (HLR) and, for roaming calls destined for a different network, routes the call directly to the destination. Without this feature, calls need to be routed back to the home network and then routed back through the IPX network to the destination (also known as tromboning) (see an example in Figure 6). This routing increases the call setup time, length of the media path, and number of media gateways required, all of which reduce the overall quality of the call. Figure 7 is an example of a Gateway MSC optimal routing.

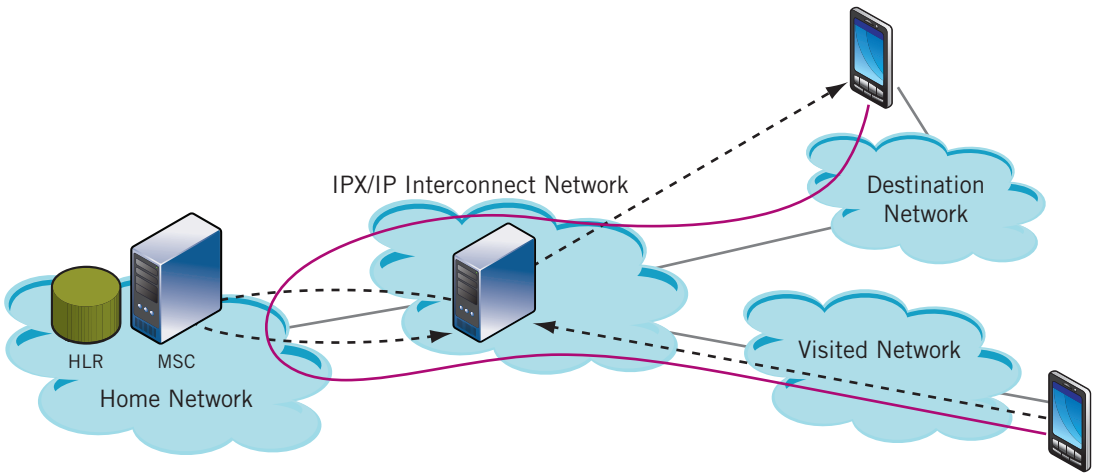

Figure 6. Roaming Call Tromboning

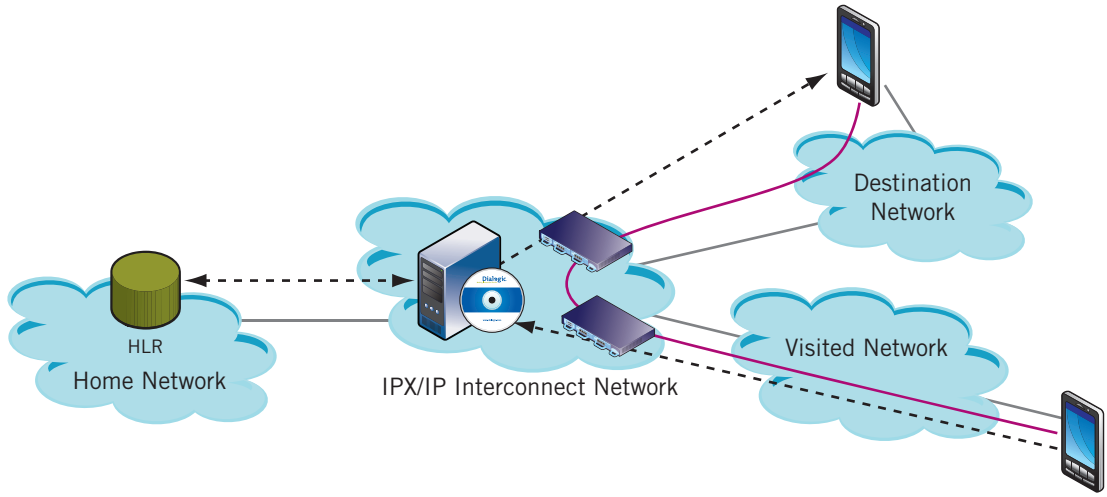

Figure 7. Gateway MSC Optimal Routing

Comprehensive Security

Although the IPX is a private IP network interconnecting trusted customers, IPX service providers still need a comprehensive security solution to reduce the risk of attacks launched from a customer's network, the public internet, or from within its own network. Note that the GSMA requirements strictly require that the IPX network be completely separate from the public internet from a routing and Domain Name System (DNS) perspective. Despite this, there remains the possibility of security attacks where the IPX is connected to the public internet.

At the same time, the security architecture needs to be as service transparent as possible to reduce interworking issues. Other vendors' SBC security solutions that are based on SIP Back-to-Back User Agent (B2BUA) architectures often require service-specific integration such that new services will work as expected. For an IPX provider connected to potentially hundreds of independent service providers each developing and launching new services, this represents a significant on-going cost.

The GMX security platform, the BorderNet 3000 SBC, provides comprehensive security but also is service transparent. This means that service providers can develop and launch new services over the IPX network without the testing and integration required with standalone B2BUA-based security solutions.

In addition to providing security for SIP and SS7, the BorderNet 3000 SBC also provides a security gateway for web protocols including MSRP, XCAP, and HTTP.

Flexible Service-Aware QoS

One of the notable advances of IPX over today's GRX service is that the IPX is service-aware. This enables IPX service providers to offer QoS and charging models that are service-specific and tailored to the requirements of individual customers.

The ControlSwitch System Policy Engine has end-to-end global visibility across the interconnecting operator's domain. Using the Policy Engine, service providers can define and maintain network-wide service level requirements that meet defined QoS metrics including Answer Seizure Ratio (ASR) and the maximum number of concurrent calls. Unlike solutions based on standalone SBCs and softswitches, the ControlSwitch System Policy Engine supports the definition and enforcement of these policies based on both local (for example, calls attempts originating from a specific IP address) and global (for example, total network-wide call attempts destined to an IP or TDM address) conditions.

Value-Added Services

The ControlSwitch System, along with Dialogic's portfolio of advanced services, provides a comprehensive set of services that IPX service providers can use to differentiate their offerings. These include transcoding, lawful intercept, LNP/MNP, fraud detection and prevention, and ENUM.

Transcoding is an especially important service because of the heterogeneous environment of IPX and private backbone applications. The GMX transcoding architecture offers a transcoding solution that can increase voice call quality and can reduce the overall transcoding cost. It does this by centralizing—within the ControlSwitch System and on a call-by-call basis—the decision of how and where to use transcoding resources. This provides that transcoding resources within the network are used so that voice quality is not degraded through repetitive use of transcoders.

Lowest Total Network Cost

IPX services are expected to be offered by multiple network operators that aggressively compete for service providers' interconnect traffic. IPX operators therefore desire network solutions that provide the lowest possible operating and capital costs. The GMX platform can reduce IP transport and operations support costs such that network operators have a low cost platform for interconnect services.

Minimized IP Transport Costs

A significant fraction of the cost of an IPX or private network interconnect solution is transport costs. The I-Gate 4000 Media Gateways support an unmatched 8:1 compression ratio without loss of voice quality. This enables service providers to dramatically lower their IP transport costs.

Minimized Operations Support Costs

The GMX platform can reduce operations support costs by providing a single Element Management System (EMS) that covers the ControlSwitch System, I-Gate 4000 Media Gateways, and the BorderNet 3000 SBC. By integrating the management platform across the GMX architecture, service providers avoid having to deploy and manage multiple standalone management systems, significantly simplifying end-to-end call trace and debug analysis.

Finally, the GMX platform's integrated architecture means that each call generates a single, end-to-end Charging Data Record (CDR) eliminating the need to reconcile multiple CDRs generated by standalone network elements.

References

[GSM World] IPX PCI Trials, http://www.gsmworld.com/our-work/programmes-and-initiatives/ip-networking/ipx_pci_trials.htm.

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