AICENT
Bridging The Mobile World™

Aicent IPX

Aicent IPX Solution Overview

White Paper

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Executive Summary

Mobile and Fixed Network operators are evolving towards IP infrastructures with the advent of 4G, IMS and NGNs. The interconnect medium between these networks and the applications provisioned on top of the network infrastructure are all converged and based-on IP protocols.

Although mobile operators have already been interconnected with each other via the common public IP network infrastructure – the Internet, unmanaged with variable service quality, is so intrinsic to the Internet that it isn't a reliable platform for operators to exchange carrier-class services amongst themselves.

Aicent IPX architecture consists of a global, private, IP transport network which provides end-to-end quality of service, and application level service gateways providing service awareness amongst mobile operators, fixed network carriers, and enterprise entities.

Aicent provides a congestion free private IP infrastructure supporting end-to-end quality of service and service aware proxy gateways to bring following advantages:

Aicent using a carrier class MPLS network to ensure strong quality and extended coverage

End-to-end quality will be a key to the success of the IPX ecosystem. Aicent has deployed a private global resilient Multi Protocol Label Switching (MPLS) based network to provide the GRX/3GRX access service with proven, reliable service performance and dedicated customer care and support for large operators.

Multiple state-of-art service aware gateways integrate multiple services on single network transport

Beyond GRX/3GRX service, Aicent has developed several Value Added Services for mobile operators. These value added solutions and services leverage Aicent's network coverage and address Aicent customers' most urgent needs. Aicent's Value Added Services include:

- LTE Roaming Service
- Roaming Intelligence Service
- Packet Voice Service
- Mobile Wi-Fi Roaming Service
- RIM Service
- MMS Service
- SMS Service

Value added services derive from the integration of service awareness and the network transport

With the assistance of Aicent's RIS, the mobile operator can look into Aicent managed devices and "see" the data roaming sessions from the point of view of Aicent. This third-party view sometimes is vital to troubleshooting data roaming problems between two roaming partners.

Aicent IPX Services & Functions

On top of a secured end-to-end QoS enabled IPX network infrastructure, Aicent deploys a wide range of service functions and features supporting all IP based service communications between two mobile operators and their corresponding enterprise customers. These IPX supporting functions are the essential building blocks for making IPX services successful.

When mobile operators encapsulate their voice and data services for their end-users into IP packets and exchange over the IPX networks, the fast-to-market deployment, the reliable service support, the control of each service aspect and visibility of the service delivery to the individual subscriber level, together demand the full integration of ever growing IPX functions, derived from years of Aicent service implementation and operational support.

Listed in *Figure 1* are a few functions that illustrate the tip of the iceberg of Aicent IPX service framework.

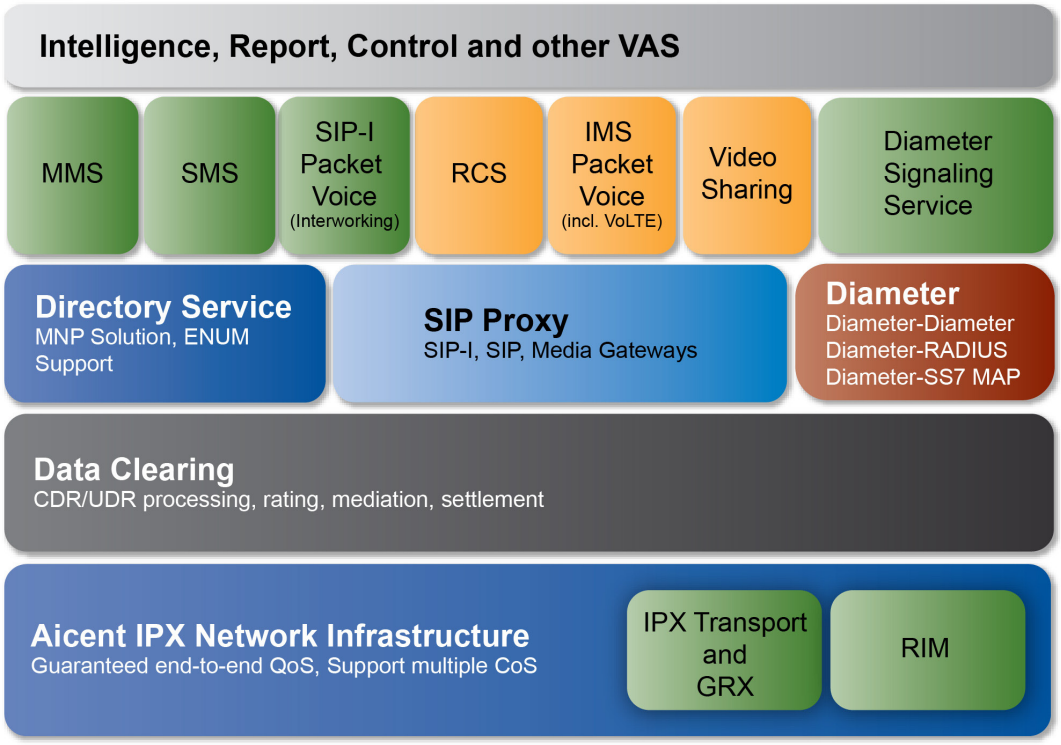

Figure 1 Aicent IPX Service Framework Building Blocks

- Highly secured, resilient and dedicated private IP network with end-to-end QoS for transport
- Directory service including global MNP solution and ENUM support
- Data clearing service and support for multiple services
- RADIUS and DIAMETER proxy gateways for user signaling and control
- SIP proxy gateways for service application signaling and control
- Media gateways for voice and video payload data session management
- Messaging gateways for SMS and MMS
- Service route election and automation tools for implementation
- Security management on network and service access
- Roaming intelligence from GTP session analysis
- Integration of GTP session and DIAMETER session monitoring and control
- Integration of network level and application service level monitoring and support

Aicent IPX Network Infrastructure

Aicent IPX network architecture

Aicent IP Service Network (AISN), Aicent's private IPX network infrastructure consists of a network access layer and a core backbone network. The network architecture is illustrated in *Figure 2*.

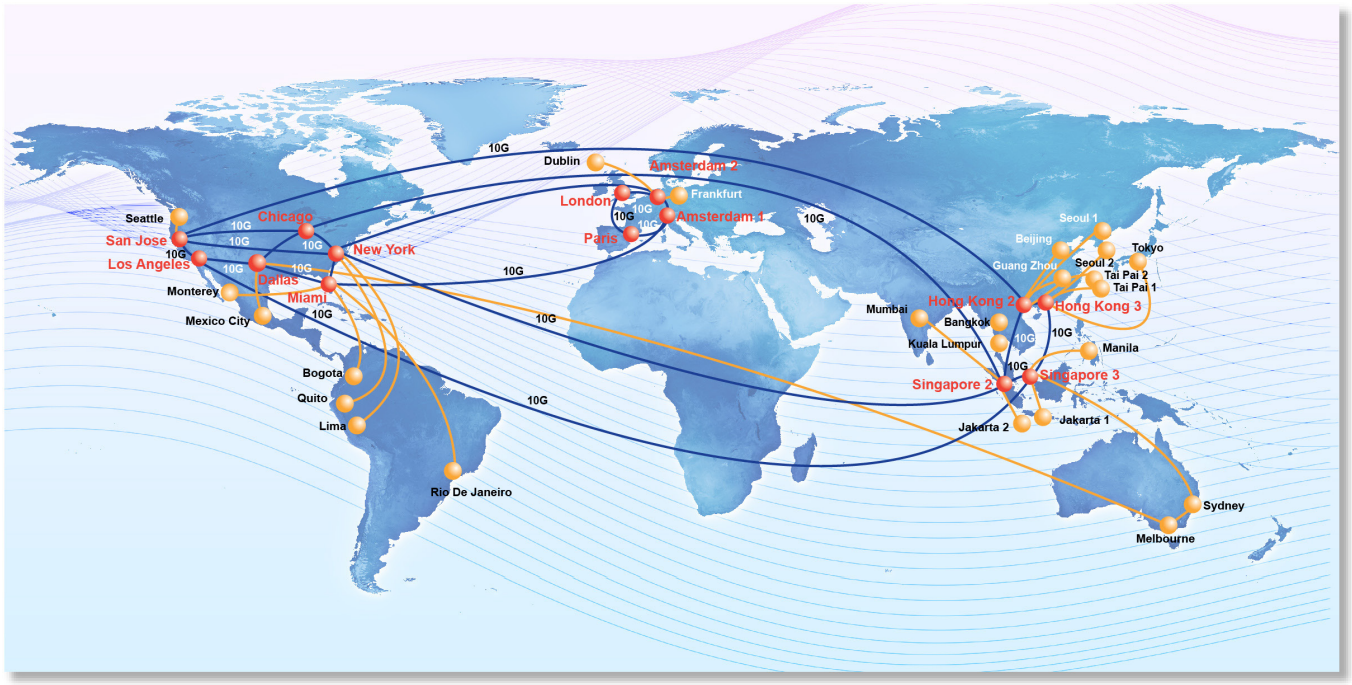

Figure 2 Aicent IPX network architecture

- The network access layer is used to connect mobile operator's networks to AISN. The access layer consists of Aicent POP's in Asia Pacific, the Americas, and Europe.
- The core backbone network is Aicent's MPLS enabled private IP network that provides high speed, reliable and robust networking to the POP's in the access layer.
- The IPX Peering is used for Aicent to exchange traffic with other IPX providers, and Aicent has established presence for IPX peering at Amsterdam, Singapore and Ashburn/USA.
- Aicent's 24X7 operations center proactively monitors core network and each network access for our customers and ensures the highest service availability and network performance.
- Aicent's sophisticated reporting system allows our customers to examine our service delivery against the SLA commitment to help with future planning.

The AISN network infrastructure currently has coverage in Asia, Europe, North and South Americas. Aicent builds its own private IP backbone dedicated for serving mobile operators by working with strategic partners that have business relationships with major cable/fiber companies. These fiber companies have redundant fiber routes, self-healing systems and abundant capacity to expand Aicent's IP reach worldwide. Therefore, the AISN network provides coverage reaching 95 cities globally and covers major cities in the following countries:

Europe and Near/Middle East

Austria	Bahrain	Belgium
Czech Republic	Denmark	Finland
France	Germany	Greece
Hungary	Israel	Italy
Luxembourg	Netherlands	Norway
Palestine	Poland	Portugal
Russia	Saudi	Slovakia
South Africa	Spain	Sweden
Switzerland	Turkey	Uk

Asia Pacific Region

Australia	China	Hong Kong
India	Indonesia	Japan
Macau	Malaysia	Mongolia
Philippines	Singapore	South Korea
Taiwan	Thailand	

The Americas Region

United States	Canada	Mexico
Argentina	Brazil	Columbia
Chile	Panama	Peru
Puerto Rico	Venezuela	

Through strategic partnerships with some of world's largest global backbone carriers, Aicent is able to offer MPLS based network and coverage in over 200 countries across five continents.

Aicent IPX QoS & CoS

Quality of Service

At a high level, "Quality of Service" refers to a set of service requirements met by the network while transporting a connection or flow, and the ability to deliver network services according to the parameters specified in a SLA. "Quality" is characterized by service availability, delay, jitter, throughput and packet loss ratio. At this level, QoS is a set of service quality commitments that carriers will offer to their customers.

At a network resource level, "Quality of Service" refers to a collective effort that allow a service provider to deliver end-to-end service guarantees and policy-based control of a network's performance measures. Such effort includes resource allocation, switching, routing, packet scheduling, and packet drop mechanisms. At this level, QoS is a set of service provisioning mechanisms with the goal of meeting the QoS service requirements.

There are two different approaches to "Quality of Service" on IP networks: Integrated Services [RFC1633], and Differentiated Services [RFC2475]. Diffserv is a popular QoS mechanism implemented in the IP networks widely accepted today for its efficiency, which is also enabled on AISN.

From network provisioning perspective, Diffserv QoS includes the mechanisms that allow a network manager to specify the limits of bandwidth, delay, variances in delay, and packet loss that are permissible to support a specific network service. Support for QoS allows both mission critical and non-mission critical traffic, as well as time-sensitive applications to coexist on the same network infrastructure.

Giving preferential treatment to traffic that has been defined as mission critical or is time-sensitive can result in more efficient network usage. Voice and video traffic are two common types of time-sensitive applications. Aicent's Diffserv enabled network allows a single network to support voice, video, and data simultaneously while giving preferential treatment to certain types of traffic so that network resource is allocated to different applications in the most cost effective way. Aicent's network ensures a satisfied data service experience by applying appropriate network treatment to all applications.

Class of Service

"Class of Service" (CoS) is a method of specifying and grouping traffic into QoS categories – classes – based on some common service requirements. Each traffic class receives different treatment by the network according to the common QoS characteristic assigned for the class. CoS implementation includes a set of QoS provisioning mechanisms such as traffic classification, packet marking and PHB's.

Traffic Class

Traffic class is a group of traffic that has common service requirements in terms of QoS characteristics such as availability, delay, packet loss and jitter.

In practice, the traffic will be segmented into classes that are distinct to each other, so network devices can provide the distinctive behaviors such as queuing and dropping actions to different classes in order to provide differentiated service.

Traffic Classification and Marking

Devices at the network's edge use a classifier function to identify packets belonging to a certain traffic class based on one or more TCP/IP header fields. A marker function is then used to color the classified traffic by several methods:

- Set the Differentiated Service Code Point (DSCP) of the 6-bit DS field that is in the TOS byte of IPv4 or in the Traffic Class byte in IPv6.
- Set the 3-bit IP precedence field of the TOS byte of IPv4.
- Set the 3-bit MPLS EXP field in MPLS label header (or Traffic Class field named in RFC 5462).

Per 3GPP specification, mobile operators should be able to classify and mark packets into different classes so that GRX providers will be able to apply the appropriate network treatment to the 3G application data packets.

Important QoS/SLA Parameters

The most common QoS parameters are service availability, delay, jitter, and packet loss ratio.

Service Availability

Many network service providers use simple router availability or access link availability to assess the service availability. However, in the case where the customer has redundant access links, and/or connection to redundant routers, the availability of the router interface or the router itself is not a good indicator of the service availability. Aicent availability monitoring takes the redundant links and network paths into consideration and do not rely on a single router or site for measuring the service availability.

Packet Delay

Packet delay indicates the time that an IP packet travels across the networks from the source to the destination. The packet delay consists of serialization delay, propagation delay, processing delay.

- **Serialization delay** – The time it takes for a device to put a packet onto the circuit at the given circuit clock rate. Serialization delay depends on the link's bandwidth as well as the size of the packet. Depending on the circuit clock rate, i.e. bit-rate, the serialization delay may be a significant portion of overall delay (for a modem user connected at 33600 baud upstream it would take about 450ms to transmit a 1500 bytes packet (each byte actually takes 10 bits to transmit counting start and stop bits)), or may be negligible (it only takes 73 µs to transmit a 9180-byte packet on a 1Gb/s connection). Serialization delay also is referred to as transmission delay.
- **Propagation delay** – The time it takes the physical signal to traverse the circuit from the transmitter to the receiver at the other end of the circuit. The propagation delay is fairly constant because it is determined by the distance and the speed of the physical signal (e.g. light or electromagnetic energy) in the transmission media (e.g. fiber or copper cable). This delay is the significant component in high speed network because it cannot be changed due to the law of physics.
- **Processing delay** – The time it takes for a device to start transmitting a packet after the device receives the packet. It actually consists of two parts: the switching delay and the queuing delay. The switching delay is the time the device takes to select the outgoing interface and move the packet from incoming interface to the outgoing interface. The switching delay is typically less than 10 µs. The queuing delay is the time the packet spends in the device's queue waiting for the device transmitting other packets. The queuing delay depends naturally on queue lengths: for an unloaded network it would be negligible; for a network that is heavily congested it is usually the main delay component. It is the most variable delay component in a typical modern network and network managers usually tune this parameter to control the delay of a packet in a congested network.

IETF developed a QoS model to leverage the different network QoS requirements from different applications, which is known as the Differentiated Services, or Diffserv model. Diffserv provides differentiated services to a few classes by allocating the resources on a per-class basis.

Aicent's Diffserv enabled network can apply preferential treatment to one class over another so that different queuing delays may be associated with different classes. Hence, Aicent network can transmit the premium data traffic in front of packets from lower class to ensure better QoS to the premium data traffic.

Packet Jitter

Packet jitter is the variation in the delay of receiving packets caused by network congestion, timing drift, or route changes. At the sending side, packets are sent in a continuous stream with the packets being spaced evenly apart. Due to network congestion, improper queuing, or configuration errors, this steady stream can become lumpy, or the delay between each packet can vary instead of remaining constant.

When traffic flow goes through the same network path, the primary reason of having jitter comes is from the processing delay to a data flow, whereas the propagation delay and serialization delay are pretty stable. Aicent can control the jitter of the highest class in its IP network by transmitting the packets in front of other classes with well known priority queuing technology.

Packet Loss

Packet loss may be caused by either network transmission errors or network congestion. If the packet loss is due to link congestion, Aicent's Diffserv aware queuing mechanism can drop lower class packets first to ensure premium data traffic receives more network resource and better QoS.

QoS/CoS Provisioning Mechanisms

Aicent deploys Diffserv as a QoS provisioning mechanism to offer different QoS and SLA per class of applications' need.

In general Internet service is a best-effort service, in which a network treats all traffic the same and delivers traffic with all available capacity it has,often resulting in poor performance for high quality demand services such as voice and video. On the other hand, some so called background applications such as emails, or routine updates, download and etc. are not sensitive to round-trip delay or jitter. When multiple applications are demanding network resource at the same time, the background applications can yield to other delay/jitter sensitive applications so that the network resource can be used more efficiently.

Aicent network supports all CoS and based on the characteristics of classes defined by 3GPP, Aicent maps the UMTS CoS into three distinctive classes: GOLD class, SILVER class, and BRONZE class. By default, all traffic will be classified as SILVER class unless the 3GRX customer requests otherwise.

The GOLD class is designed to support delay/jitter sensitive applications such as voice, video conferencing, video streaming and applications, etc. The GOLD class SLA includes availability, round-trip-delay, packet loss and jitter. The GOLD class cannot exceed the 50% of the total access bandwidth.

The SILVER class is designed to support applications that have a certain delay and packet loss requirement, but don't have strict jitter requirements such as transactions service, web browsing, telnet, and other interactive applications. The SILVER class SLA includes availability, round-trip-delay, and packet loss.

The BRONZE class is designed to support background applications that are not sensitive to round-trip-delay and jitter such as email, NNTP or FTP. The BRONZE class is provisioned as the best-effort service.

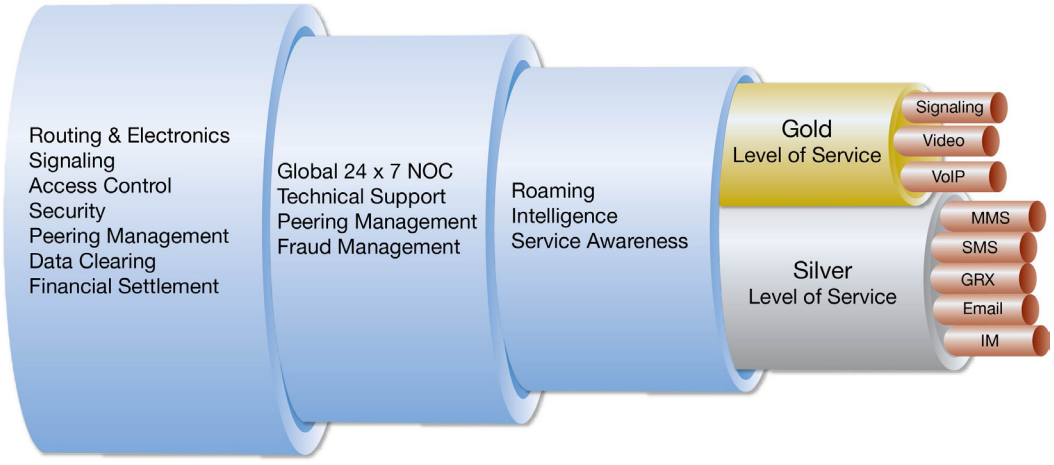

Figure 3 Aicent IPX Framework

Aicent IPX Services

GRX Service

Service Overview

The Aicent GPRS Roaming eXchange (GRX) service enables GPRS/EDGE/UMTS operators to offer global roaming data services to their customers. Since launching this service in early 2002, Aicent has emerged as one of the largest GRX providers in the world, supporting most of the leading GPRS operators in the Asia Pacific region. With extensive peering arrangements, Aicent GRX provides seamless roaming capabilities reaching the vast majority of GPRS operators around the world.

Aicent GRX Network

- Dedicated, high-quality, secured IP network
- Leverages premium network assets of world's leading fiber and cable companies
- Built-in redundancy and high reliability, global reach
- HUBs/POPs throughout Asia, as well as in Europe, North America and Latin America
- Extended infrastructure supporting advanced VAS applications

Service Features

- Flexible operator connections to meet individual customer requirements
- QoS management supporting both 2.5G and 3G applications and traffic
- Bandwidth-on-demand for optimized cost efficiency
- Root DNS service
- Guaranteed security and capacity backed by a SLA
- Real-time operator monitoring tools and traffic reports
- Top-notch technical staff with local language support
- Fully compliant with GSMA guidelines and international standards

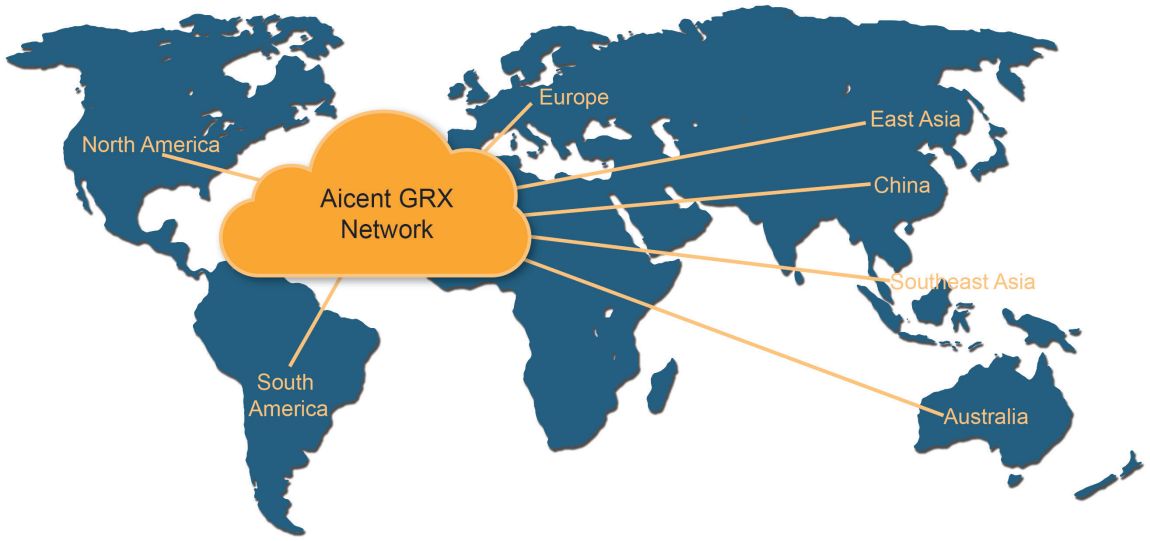

Figure 4 Aicent's GRX Network connects to regional hubs that span the globe

LTE Roaming Service

As the demand for mobile broadband services continues to rise, LTE and its ability to cost-effectively provide fast, multimedia mobile data services, is quickly becoming the network technology of choice for LTE deployments around the world. WIth extensive interworking experience 2G, 3G, and 4G interoperability solutions, Aicent's LTE roaming service is a natural evolution of Aicent's GRX service offering operators carrier-grade connections, delivering exceptional quality and class of service over a single connection.

Supported by a solid platform, Aicent's LTE Roaming Service is built upon Aicent's highly secure IPX Transport backbone offering superior quality and reliability while delivering a seamless experience for users. Helping to ensure the integrity of the network while proactively managing the routing and delivery of Diameter signals, Aicent's Diameter Signaling Service compliments the IPX Transport system by addressing impending signaling surges.

Aicent IPX Transport

Providing operators global reach through a single, secure connection, Aicent's IPX Transport service, an evolution of their GPRS Roaming eXchange (GRX) service, supports the transition to IP-based technologies through the integration of their mobile messaging exchange and global reach infrastructure services, including the world's first and largest multimedia messaging exchange.

A world leading Global IPX Network supporting all MNOs around the world, Aicent's IPX Transport service supports multiple mobile data transit demand with multiple Class of Service (CoS) and end-to-end Quality of Service commitment.

Key Aicent IPX Transport Service features include:

- Single IP connection with QoS for multiple data, signaling and voice transport
- Immediate worldwide roaming coverage
- Flexible operator connections to meet individual customer requirements
- Multiple Class of Service support to meet different applications' demand including LTE signaling and bearer transit
- Guaranteed QoS and end-to-end QoS commitment backed by a SLA
- Real-time operator monitoring tools and traffic reports

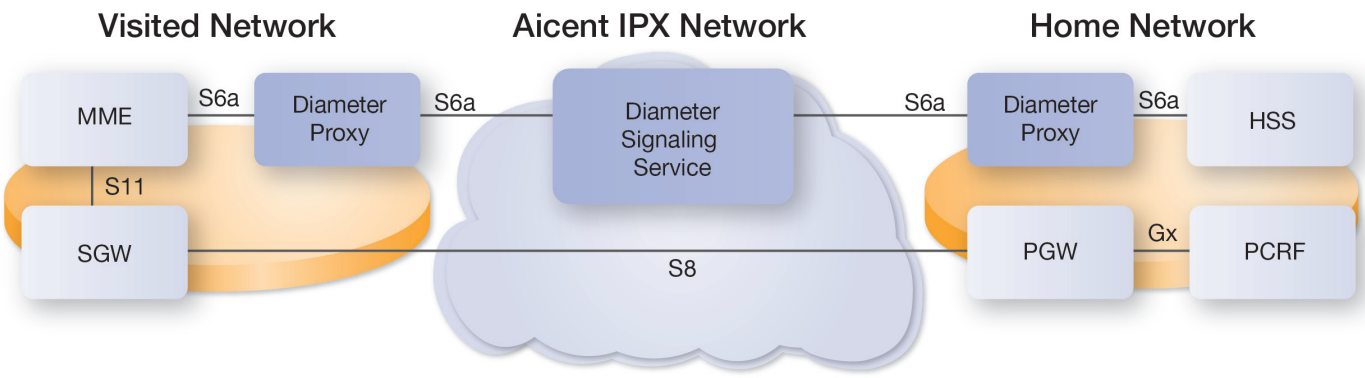

Figure 5 Aicent LTE Roaming Architecture for Home Routed Scenario

Diameter Signaling Service

Aicent's Diameter Signaling Service enabled by a powerful Diameter platform, is designed to help alleviate the challenges operators will face while transitioning to an all IP network by offering robust scalability, security, routing, and subscriber roaming management.

With superior traffic management and load balancing capabilities, Aicent's Diameter solution is uniquely equipped to help control the impending data surge and signaling storm while reducing operator expenses.

The key Diameter proxy benefits are:

- Single Diameter peer implementation for all Diameter interconnections based on Aicent scalable Diameter proxy solution supporting high data roaming volume
- Geographical Diameter proxy gateway deployment for high availability, with automatic failover mechanism
- Ensures incompatible Diameter implementations with flexible AVP mediation capability
- Versatile roaming policy control implementation at the Diameter proxy gateways
- Supports load-sharing between Diameter peers
- Data clearing and report for LTE roaming
- Integration of Diameter sessions inspection together with GTP sessions in Aicent proprietary Roaming Intelligence Suite package
- Optional legacy signaling conversion support between Diameter and MAP

In addition to the standard Aicent Diameter Signal Service, an operational inter-standard Diameter-MAP protocol conversion is also available. This optional service allows LTE mobile operators to maintain only one set of HSS with Diameter to better manage roaming.

Roaming Intelligence Service

Service Overview

International roaming is a significant and growing source of revenue for mobile operators. It is essential for mobile operators to ensure a satisfactory roaming experience for high value travelers and protect roaming revenue sources.

Aicent GPRS Roaming Intelligence Suite (RIS) is a system developed for mobile operators to better understand and manage their data roaming business in order to ensure the roaming quality and protect roaming revenue. Through a sniffer, deployed on the Aicent network or customer access point, and a centralized roaming call-flow-database, a mobile operator can examine their roaming subscribers' GPRS roaming activities in real-time. With Deep Packet Inspection (DPI) technology, the RIS can capture and present roaming session creations on a customer access secured web portal in real-time or retrieve historical user data roaming sessions.

With the assistance of Aicent's RIS, the mobile operator can look into Aicent managed devices and "see" the data roaming sessions from the point of view of Aicent. This third-party view can be vital to troubleshooting data roaming problems between two roaming partners.

Important Features of RIS

- Configurable dashboard
- Routing validation tool
- Data roaming signaling queries
  - GTP signaling queries
- Real-time or historical individual GTP query
- Correlate response with request for easy troubleshooting
  - DNS queries
- Roaming reports
  - Roaming traffic per roaming partner report
  - Roaming signaling report
- Roaming success & failure rate and failure reason distribution or investigation
  - Roaming application report
  - GTP KPI – GTP response delay
- Subscriber level management
  - Enterprise management & VIP user support
- Proactive monitoring and alerts
  - Configurable criteria for automatic alert notice
  - Alert for high data volume roamers

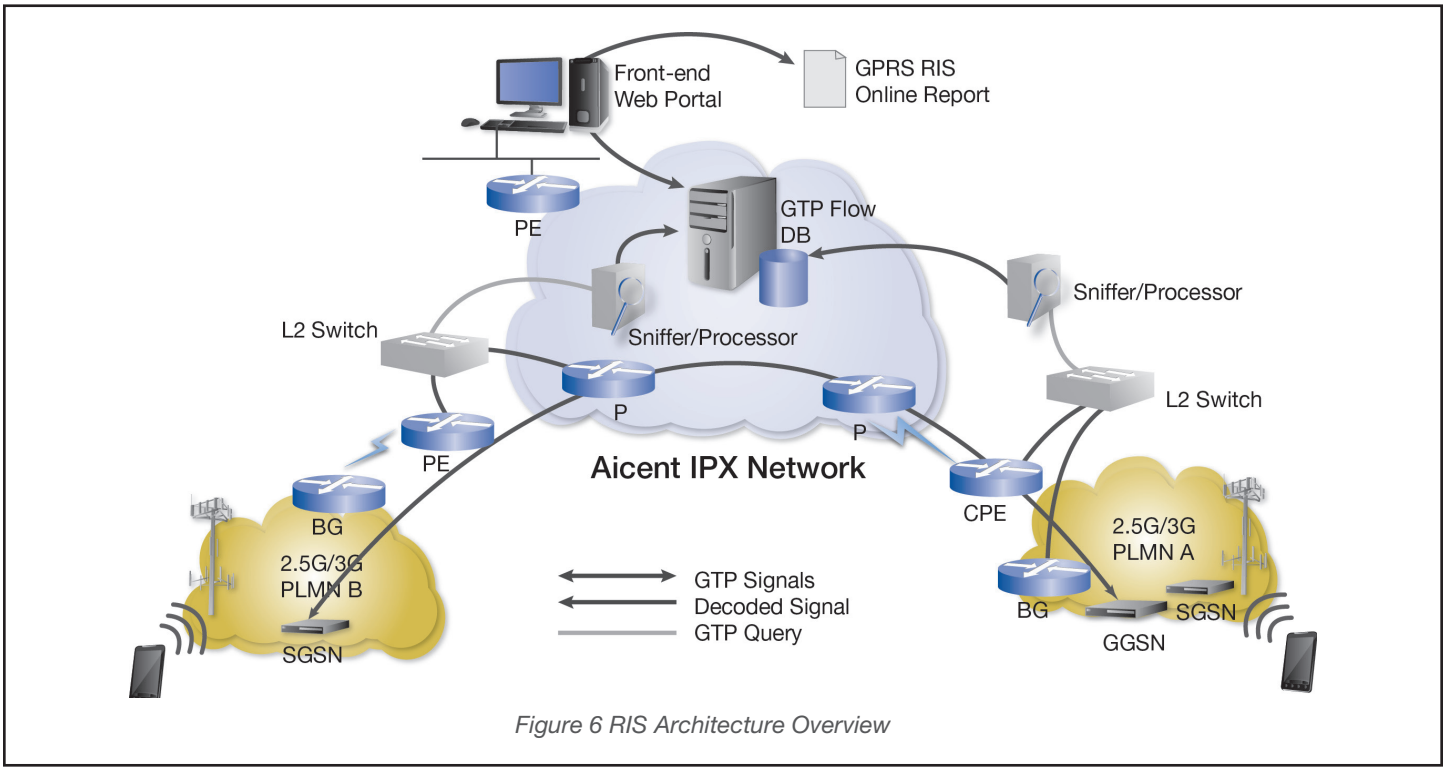

Figure 6 RIS Architecture Overview

Packet Voice Service

Service Overview

Aicent IPX provides Mobile Operators, Fixed Operators, Cable Operators, ISPs, etc. an IP-based voice service in a highly controlled, secure and profitable manner, all with guaranteed QoS as illustrated in Figure 6 below.

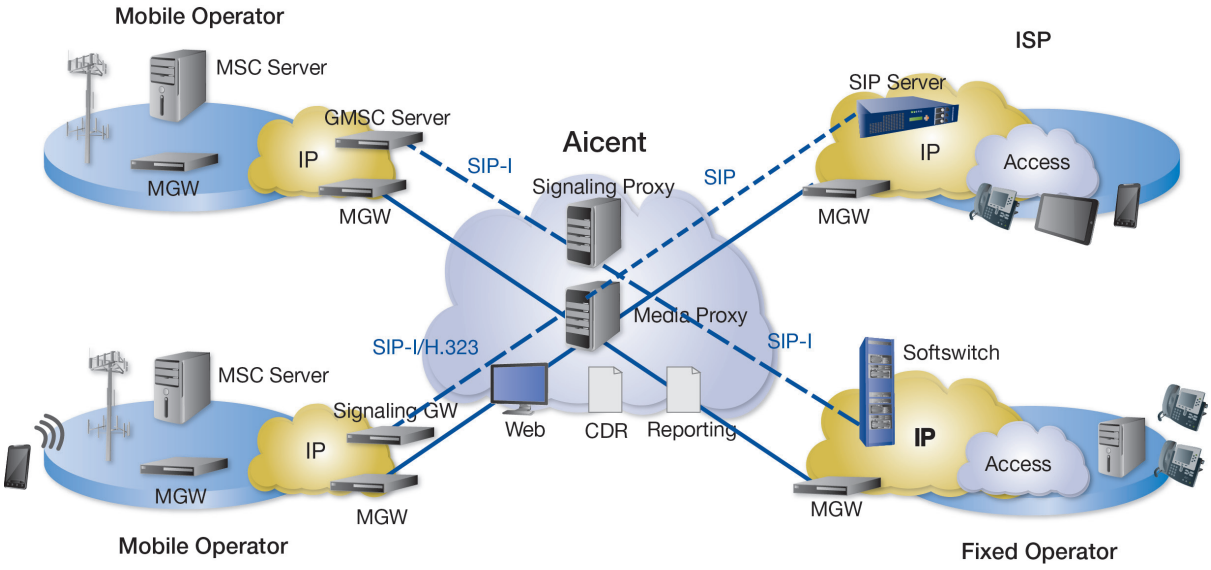

Figure 7 IP-based Voice Service Overview

A comparison between Aicent IPX Voice Service and traditional wholesale roaming service is as follows:

Features	Traditional Wholesale	Aicent IPX Voice
Caller ID	Uncertain	Guaranteed
Voice QoS	Best-effort at given price	Guaranteed
Signaling Transparency	Uncertain	Guaranteed
# of Hops End-to-End	Uncertain	2 at most
# of Cascading Settlement	Uncertain	2 at most

Aicent IPX Voice Service is able to handle off-net voice traffic, however, a different set of SLA and pricing will apply to off-net voice traffic than that of on-net, and different IP addresses might be used to route off-net voice traffic.

Business Models

For off-net voice traffic, Aicent offers a per minute-based charging model in order to work with Voice Wholesaler partners that deliver voice traffic to requested destinations.

For on-net voice traffic, Aicent business models are as follows:

- Open Connectivity Termination model:
  - Participating operators exchange termination rates directly – transparent principle or alternatively, Aicent upon authorization facilitates to pass thru the rate in between
  - On a per minute basis
- Transport Model
  - Aicent charges transportation fees on a per Mbps-basis or alternatively on a per minute-basis
- Data clearing and Financial settlement
  - Participating operators do financial settlement directly with each other
  - Aicent provides data clearing

Signaling and Media Message Flow

Aicent IPX Voice Service supports SIP, SIP-I, SIP-T, H.323, etc. Voice Service signaling and media flow is shown in Figure 7 below:

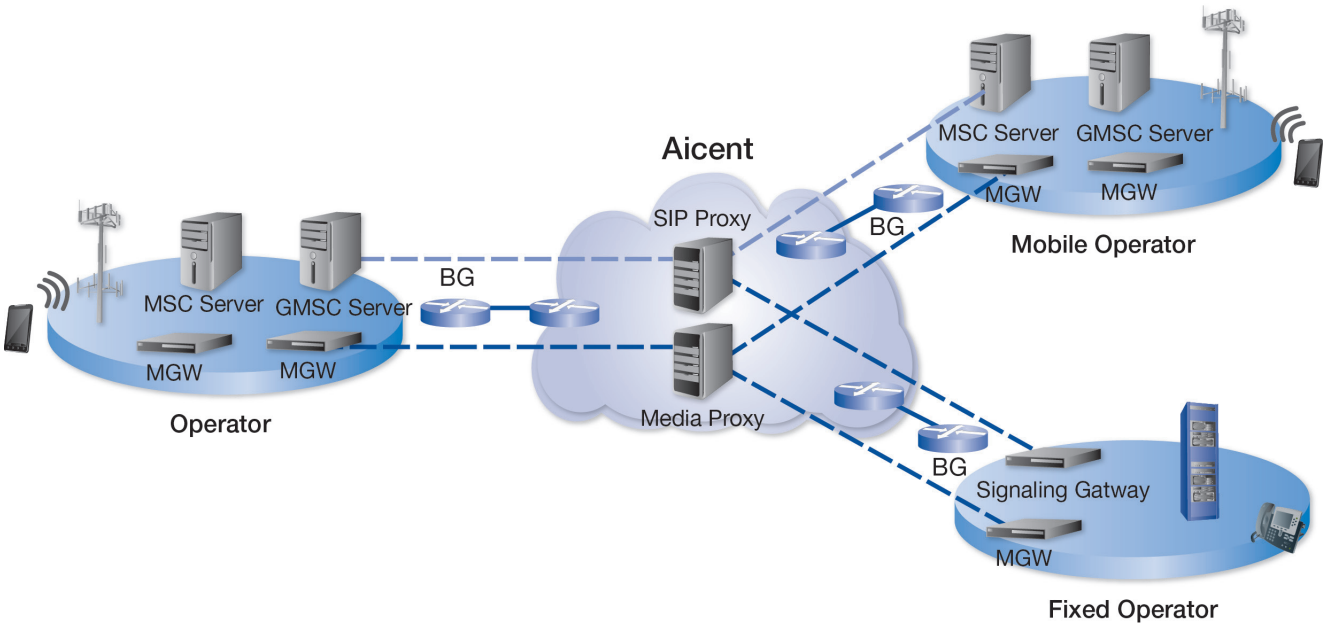

Figure 8 Voice Signaling Media Flow

Mobile Wi-Fi Roaming Service

Service Overview

The wide spread adoption of 3G/Wi-Fi capable smart-phones and devices has seen increased demands for data bandwidth leading operators to find ways offload data traffic from 3G/4G networks. According to ABI Research, about 16 percent of mobile data is diverted from mobile networks today, and is expected to increase to 48 percent by 2015.

With years of experience providing data roaming services to operators, Aicent now delivers a total solution for operators to make mobile Wi-Fi roaming as seamless as 3G data roaming by leveraging existing mobile network infrastructures.

Aicent's Mobile Wi-Fi Advantages

- The Aicent Connection Manager available for all types of networks, supports both SIM based and legacy (user name and password) based authentication in one client, enabling seamless authentication and access to any type of Wi-Fi network regardless of SIM capability.

  Aicent Connection Manager supports various popular smart-phone platforms including iPhone, Android, Windows Mobile and Blackberry, as well as Windows laptop/PC.

- Fully integrated into current mobile network infrastructure
  - Aicent's solution integrates legacy AAA and SS7 by using standard RADIUS, MAP signaling and TAP3 billing interfaces, making mobile Wi-Fi roaming consistent and scalable.
- NO changes required from operators
  - Requires no equipment change or upgrade on visited Wi-Fi networks, nor equipment change or upgrade on home 3G mobile networks for operators.
- Fast roll-out
  - Aicent leverages its existing global Wi-Fi roaming hub and its global SS7 assets to quickly roll out mobile Wi-Fi roaming among operators on the hub.
- Potential value added service extension
  - The solution also provides the capability for SIP voice and message to be integrated into the solution as option.

Architecture Overview

- Web Server for EAP-SIM / SIM over WISPr1.0
- MAP Gateway interfaces with Web server (via IP) & Home Operator HLR (via SS7)
- Account Database to host the temporary user ID and authorization result for EAP-SIM / SIM over WISPr1.0
- Billing System for RADIUS and TAP billing mediation

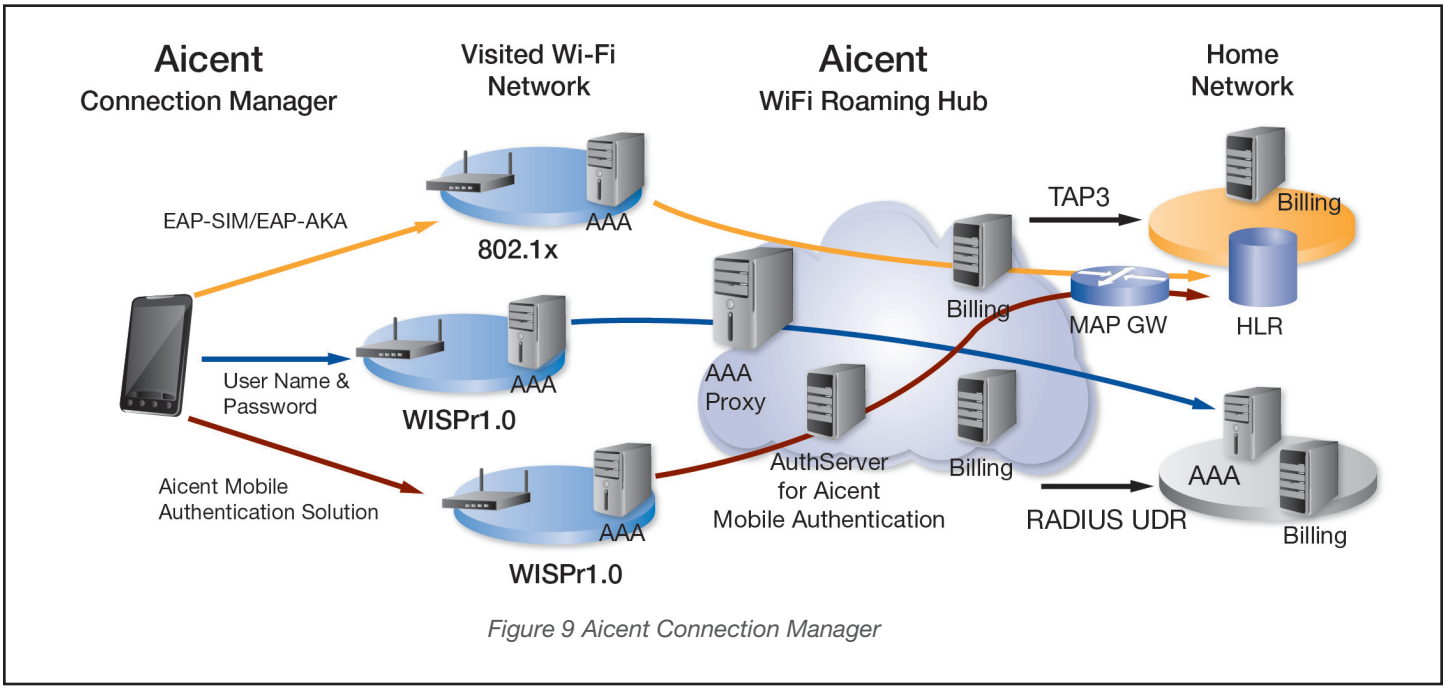

Figure 9 Aicent Connection Manager

Key Features of Aicent Connection Manager

Features	Note
Auto usable AP detection	Running in background
Automatic authentication mode detection	SIM based, non SIM-based
Connection on demand	
Auto and manual phone book update	Incremental update supported
On-line CM software upgrade	
SSL supported	
CM software downloadable from web portal	Apple App Store, Android Market
Backend server support for phonebook upgrade	In conjunction with Aicent phonebook server
Legacy WISPr1.0 network support	User name and password based
EAP-SIM/AKA (802.1x) Hotspot support	(U)SIM based
(U)SIM authentication over WISPr1.0 support	In conjunction with Aicent AuthServer
Next Generation Hotspot (802.11u) support	(U)SIM based
QoS reporting	In conjunction with Aicent RIS.Wi-Fi
SIP voice module	Optional
SIP message module	Optional
OTA for CM download	Optional
Advertisement interface	Optional
LBS interface	Optional

RIM Service

Service Overview

Under a network partnership agreement with Research In Motion (RIM) with the objective to assist mobile operators to easily and economically access the RIM network nodes, Aicent has interconnected its global private IP backbone, AISN with RIM's network nodes around the world including: Europe (Amsterdam and Paris), North America (Chicago and Dallas), and Asia.

With an innovative architecture, Aicent offers a value added BlackBerry® relay connectivity service through a dedicated VPN over our global MPLS based AISN. Operators can access the Aicent network with variety of options from Layer 3 MPLS, Layer 2 MPLS to GRE Tunnel. IPSec VPN over Internet is also an option for low speed transport and backup.

Aicent customers can quickly roll-out the BlackBerry service and easily expand their interconnection capacity with RIM data centers by leveraging our widely available Aicent global backbone. Compared to traditional IPLC interconnections, the cost effective Aicent connectivity service for BlackBerry, comes with higher service reliability and better end-to-end support, critical to a mobile operator's BlackBerry subscribers. Thanks to the inclusive end-to-end transport management and integrated network approach.

AISN, provides mobile operators redundant, flexible, reliable, secure, and cost-effective network connections to access RIM network nodes.

Key Features

- Provisioning efficiency to meet tight schedules
  - Fast time-to-market rollout
  - Aicent backbone provisioning ensures easy and flexible bandwidth upgrade - pay as you grow
  - Flexible access media support: T1/E1, T3/E3, Ethernet/ Fast Ethernet to OC3/STM-1
  - Flexible access bandwidth from 1 mbps to 155 mbps and beyond
- End-to-end QoS and management for better service
  - Redundant and diverse backbone and local access network provisioning provides the maximum reliability
  - Highly secured, resilient, reliable and dedicated private IP network for transportation
  - End-to-end support with QoS and SLA
  - Proactive monitoring and alert system
  - Routine network service reports for great visibility
- Cost and management efficiency
  - More cost-efficient than IPLC, directly saves capex
  - Off-loads international circuit provisioning and management overhead
  - Single physical access link can be shared for 2.5G/3G roaming, MMS, and BlackBerry traffic
  - Single point contact for GRX, MMS and BlackBerry Connectivity Service support

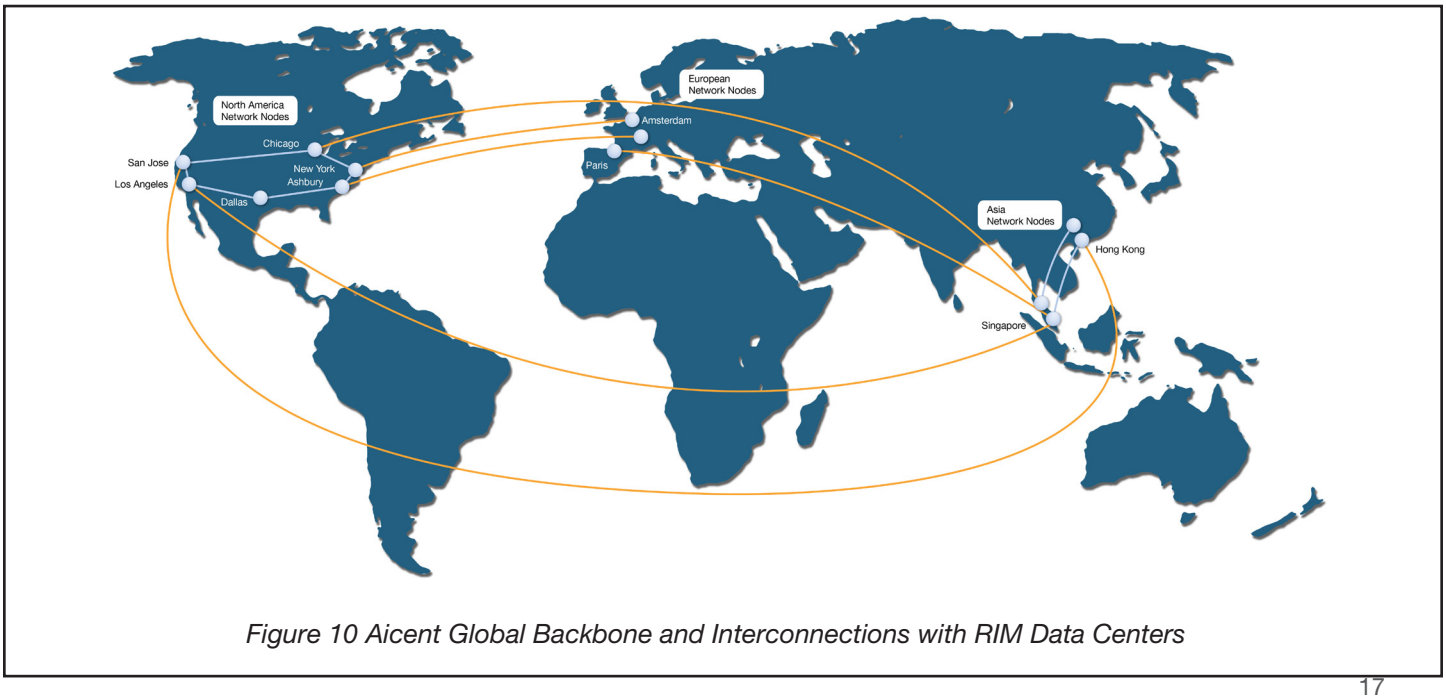

Figure 10 Aicent Global Backbone and Interconnections with RIM Data Centers

Benefits of Aicent Managing GRE Tunnel to RIM Data Centers on Behalf of Mobile Operators

- Aicent can proactively monitor GRE tunnels to RIM data centers
- Better routing convergence time when fail-over occurs
- Change management for GRE tunnel maintenance does not involve mobile carriers
- RIM data center changes become transparent to mobile operators
- Easy to separate BlackBerry traffic from GRX if mixed at access
- No additional management charges

RIM Service Transit		IPSec VPN	IPLC's	Aicent
Scalability (# of Blackberry Subs)		Up to 5,000	Unlimited	Unlimited
Quality of Service	Availability	Good	Limited to Correlation of dual circuits	Best
	Packet Loss	Unmanageable	Negligible	Negligible
	Round-trip Delay	Unmanageable	Good	Good
Flexible Bandwidth		N/A	No	Yes
Easy Upgrade		N/A	No	Yes
Local Loop for Multiple Services		N/A	No	Available
Cost		Inexpensive	Expensive	Moderate
Provisioning Lead-time		Less than 30 days	Less than 30 days	Less than 30 days
Pay as You Grow		N/A	No	Yes

Aicent Relay Comparison

Inter-Carrier MMS Service

Service Overview

The first company in the world to offer a commercial Inter-Carrier MMS service, the Aicent Inter-Carrier MMS service offers the mobile operator and service providers the ultimate solution to their MMS interworking and roaming requirements.

Single Connection

With a one-time connection setup, the Aicent Inter-Carrier MMS service provides worldwide mobile operators with unprecedented convenience and cost efficiency in establishing global MMS interoperability. The Aicent MMS Gateway resides in the global GRX and CRX network and is accessible over an operator's existing GRX/CRX links. Upon setup an operator's MMSC is instantly interoperable with all other connection MMSCs, eliminating the need to invest expensive engineering resources. Aicent handles special implementations and requirements for each connected operator with its broad experience and multiple MMSC vendor relationships.

Open Connectivity

Through Aicent Inter-Carrier MMS service, mobile operators can efficiently and reliably exchange MMS messages with other operators, agree on termination fees, and provide a clearing and settlement solution between operators and around the globe. The Aicent MMS Gateway reduces the operational burden for establishing operator agreements and increases the reach, reliability, and time to market, so operators can maximize their revenues for mobile-to-mobile MMS.

Global Reach

The Aicent Inter-Carrier MMS service connects to more operators globally than any competing service. Aicent connects directly to more than 150 operators and an additional 170+ operators through peering. In addition, the Aicent MMS Virtual Delivery service feature extends MMS interoperability to mobile subscribers unconnected by traditional MMS interworking services by leveraging global SMS coverage. The MMS Virtual Delivery service delivers MMS by allowing the recipient to view and reply to MMS messages from Aicent or Operator co-branded web portal after an SMS notification received. With MMS Virtual Delivery, Aicent customers can experience global MMS interoperability even before operators establish MMS interworking.

System Architecture

The Aicent MMS Gateway System supports the MMS interface as defined by 3GPP, and is implemented according to GSMA and CDG guidelines for interworking MMS. It ensures interoperability among different MM4 versions and implementations to achieve transparent interworking between connected mobile operators. An ENUM-based MNP solution, integrated with the different regional MNP infrastructures, guaranties the correct delivery of SMS to an MNP-mandated region. Integrated message records, rating capabilities, and flexible billing engines enable complete billing mediation and settlement services. Web-based traffic reporting with a secured operator interface and in-depth analysis tools provide added value to meet every operator's needs.

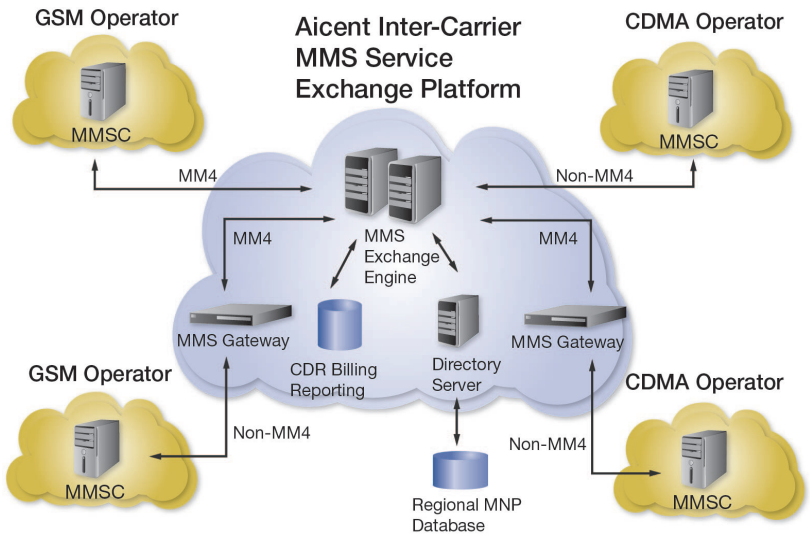

Figure 11 Inter-operator MMS Architecture

MMS Key Features

Functional Features	
Existing GRX/CRX IP Connection	• Aicent MMS gateway service supports GSMA PRD IR.52 and CDG GSMNA-CDG MMS Inter-carrier Implementation Guideline • Mobile operators can simply use their existing GRX or CRX connection to access Aicent's MMS Gateway
Adaptable MM4 Interface	• 3GPP TS 23.140 • 3GPP TS 32.235 • 3GPP2 X.S0016-000-C_v1.0_060124 • 3GPP2 X.S0016-200-A_v1.0_060124 • 3GPP2 X.S0016-340-A_v1.0_060124 • Customized MM4 Extension
Intelligent Number Based Addressing Resolution	• Converts +E164 address into ENUM query string • Resolves recipient MMSC via Aicent Directory Sava, where multi-resources are queried (Inca DO, GPRSDNS, Region MNP DB, sic)
Seamless MM4 Message Routing	• Checks the headers of received MM4 message; Applying number-based addressing resolution as needed • Ensures MM4 compatibility between originating and terminating MMSC with correct header mapping in SMTP protocol
High Usage Fraud Alert	• Near real-time fraudulent usage detection • Supports operator defined fraud criteria
Text2Image	• Supports 18 language • Converts foreign text message to MMS format

Service Features	
Existing GRX/CRX IP Connection	• Onetime setup with Aicent MMS Gateway Full interoperability with all other operators connected to Aicent MMS Gateway
CDR Generation and Customization	• MM4 message transaction logging • Customized CDR format supported as per operator requirements
Settlement and Billing Mediation	• Aicent MMS Gateway provides, message rating, billing, and settlement for traffic between Aicent MMS gateway and each operator, adhere to GSMA AA.70 • No need for sign agreement and settle with other operators who are connected to Aicent MMS Gateway
Monthly Traffic Analysis Report	• Consolidated Traffic Summary of Standard Incoming/Outgoing detail reports • Optional partner traffic analysis, failure and fraud alert service reports
Guaranteed SLA and 24x7 Support	• Server availability and KPI report • 24x7 Customer Support Hotline and escalation procedures by dedicated support team
MMS Virtual Delivery or MMSVD	• Increase satisfaction of mobile subscriber user experience • Facilitate delivery of oversized MMS • Enable operator to instantly offer global reach by delivering messages anywhere in the world • Facilitate 2 way conversation by enabling reply from both Mobile and PC

Inter-Carrier SMS Service

Service Overview

Aicent's carrier-grade, high-availability SMS eXchange is a comprehensive services platform that provides Operator the services required for a commercially successful SMS business. The diagram below shows a high level view of the platform. Services such as message delivery, 24x7 O&M functions, fraud and spam control, efficiently connecting elected operators, billing and settlement, currency rate conversion, traffic and billing reports, and real time monitoring are all provided when an operator connects with Aicent's Inter-Carrier SMS service.

System Architecture

Aicent Inter-Carrier SMS service offers multiple inter-connectivity options for incoming SMS from the originating operator as well as for delivery into the terminating operator. The Inter-Carrier SMS service supports both SS7 and IP/SMPP connections.

As for IP connection, Aicent SMS exchange system provides versatile connection interface options including SMPP 3.2/3.3/3.4, HTTP, CIMD2, and various proprietary IP protocol. Operators can choose their own preferred connection method to meet engineering and time-to-market requirements. The system flexibility ensures interoperability among different protocols and implementations to achieve transparent inter-working SMS between any connected mobile operators.

An ENUM-based MNP solution, integrated with the different regional MNP infrastructures, guarantees the correct delivery of SMS to an MNP-mandated region. Integrated message records, rating capabilities, and flexible billing engines enable complete billing mediation and settlement services.

Web-based traffic reporting with a secured operator interface and in-depth analysis tools provide added value to meet every operator's needs.

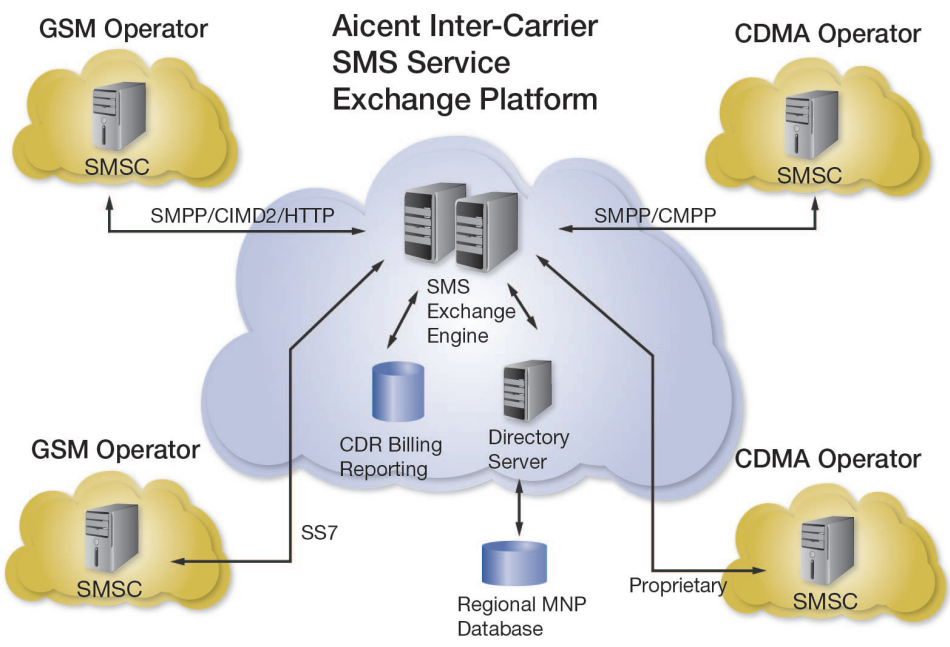

Figure 12 Inter-operator SMS Architecture

SMS Key Features

Functional Features	
Carrier Grade	• High Availability platform with Geo-Diversity
GSMA OC Compliance	• Transparency on Charging and Routing • Cascade Billing • End-to-End Quality of Service • Network configuration, testing, and management • Mobile Operator Opt-Out • Full outsourcing of the O&M function
SMSC Inter-working Compatibility	• Consolidated Traffic Summary report • Standard Incoming/Outgoing reports
MNP Solution	• Proprietary solution for number portability • Supports SS7 MNP query using SRI for SM
Anti-Spam	• Message header and body tests • Detection and blocking using blacklist • Content-Filtering, and incident reporting
Fraud Checking	• Detection and blocking for : Flooding, Faking, Spoofing, Complete reporting of all incidents
Black/White List	• Blacklisting MNO for MT-FSM Origination & Termination • Blacklisting MSISDN for MT-FS Origination & Termination • Blacklisting Service Center Address • Restrict allowable destination MSISDN length • Blocks SS7 messages from unknown Hub/Operator
Throttling Control	• Controls how many messages originator can send or recipient can receive
Store & forward / Proxy mode	• Support Store & Forward and proxy • Supports IP<>SS7, SS7<>SS7, SS7<>IP
Transparency	• MM4 message transaction logging • Customized CDR format supported as per operator requirements
Text2Image Conversion	• Converts text to MMS for local language support • Currently supports double byte char-sets
Language Transcoding	• Trans-coding codecs to local language encoding for correct language display
Support Delivery Report	• Transmits recipient delivery receipt back to originating operator • Generates system delivery receipt • Supports both client pull / server push method to retrieve delivery receipt
Data Coding	• 7bit ASCII text SMS, GBK, KSC5601, UCS2, Latin 8-bit • Supports conversion between GSM 7 bit and SMPP
Support Binary SMS	• Support Binary SMS (EMS)
Split Message	• Split long message based operator requirements (original or destination)
Multiple short message	• Concatenation of multiple SMS in SS7<>IP
Error code mapping	• Mapping of error codes between SS7 & IP
CDR	• Support logging all messages into CDR and UDR
Real-Time Monitoring	• Support monitoring of all processes • Real-time system alerts

Serving more than three billion mobile users around the world, Aicent, Inc. is a leading provider of data network services and solutions for global mobile operators and operates one of the largest GPRS and 3G network exchanges, connecting to over 180 operators, including the world's ten largest. The company also operates integrated mobile messaging services, including one of the first and largest multimedia messaging exchanges, and offers other value-added services to help carriers maximize revenue opportunities.

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