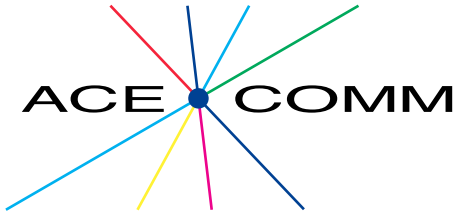

Convergent Mediation™

The Strategic Technology Tool for Communications Service Providers

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Executive Summary

A review of the recent history of telecommunications reveals that the rise of newer and more cost-effective technology, the addition of data services by existing voice carriers, and the network consolidation within the industry have established an irreversible trend of hybrid or convergent networks. The need for networks to be profitable has mandated a renewed focus on operations support systems (OSS).

Mediation is defined by ACE*COMM as the process of facilitating communications and information between two incompatible parties. With the diversity in the current network environment, incompatibilities exist all around—between protocols and formats, between network elements, and between networks and the downstream OSS. Therein lies the role of, and need for, mediation in today's service provider network environment.

Mediation does more, however, than merely get the converging elements to talk to each other. It is very useful to the service provider as a central auditing function, and to create knowledge from the network—knowledge the service provider uses to extract revenue from otherwise unusable usage records, as well as for trending and other forms of network and usage analysis.

ACE*COMM's approach to mediation is discussed, along with breakdowns of some product functions and data flows.

Background

Over the past few years, the telecommunications landscape has undergone an evolutionary growth spurt. Deregulation in the telecommunications market spawned many new communication providers challenging the near-monopolistic domains of existing carriers. Many of the new entrants have tried to differentiate themselves by adopting new technologies as replacements for legacy networking infrastructure, boasting cost savings and the ability to deploy "next-generation" services. Others have focused exclusively on the delivery of data services driven by the emergence of the Internet. Much of this buildup was technology driven—better, faster, cheaper. In response, many existing carriers countered with data strategies of their own, although this usually involved add-on functions or complementary systems, due to the massive capital investments in existing traditional network infrastructure.

In the burgeoning data industry, the simplistic free or fixed pricing model became the norm. Little emphasis was placed on the ability to perform network "accounting" functions—accounting being a general term that covers many aspects of revenue generation and revenue assurance. It includes the ability to bill for the services used, to ensure that all chargeable items are in fact billed, and to provide strategies to combat fraudulent access and usage. Additionally, validating access charges from partner carriers highlights one of the largest cost components to carriers. Identifying and correcting invalid data could reduce the amount of unbilled network utilization. Understanding how the network and services are being used, and by whom, allows carriers to perform analysis for capacity planning and to develop marketing strategies.

It is not realistic to think that data network usage will continue to be free or billed at flat rates

It is not realistic to think that data network usage will continue to be free or billed at flat rates. Investments in the development of network infrastructure will need to be recouped. Older billing models relying on undifferentiated usage overlook the revenue opportunities in usage-based models. Enhanced broadband requires differentiated billing methods to allow customers and service providers greater choice of services. Recently, financial realities have caught up with many communications service providers. Significant numbers of these new entrants have failed to deploy their solutions or have simply gone out of business. Their equipment has been added to other carriers' inventory, creating an environment of consolidation.

The rise of newer and more cost-effective technology, the addition of data services by existing voice carriers, and the network consolidation within the industry have established an irreversible trend of hybrid or convergent networks. It has become increasingly clear that networks have to be profitable, and having the most accurate data available is the first step toward this goal. This has mandated a renewed focus on revenue and quality assurance, and the operational support systems (OSS) that provide them.

The Role of Mediation

Definition

In ACE*COMM's view, mediation is the process of facilitating communication and information exchanges between two incompatible parties. In the telecommunications world, the two parties correspond to the network and the OSS infrastructure, such as billing, fraud and customer care systems. Incompatibilities may exist because:

- The two parties don't currently understand each other (i.e., different protocols and data formats)
- The two parties don't want to understand each other (i.e., the network element (NE) vendor or the OSS vendor do not want to implement the specifics of each other's interface)
- There are multiple parties involved, each speaking a different language (i.e., multiple element vendors, multiple protocols, multiple OSS)

These incompatibilities prevent carriers from effectively performing the network accounting functions. Mediation bridges these incompatibilities.

Key Mediation Vendor Segments

As the mediation market evolves, vendors in this sector are evolving their product suites to offer greater product capabilities. Mediation vendors operate in three segments as defined by Michael Allen, OSS analyst, Vertigo Research:

1. Single system mediation, IP-focused. Vendors using this approach are new entrants to the market, hoping to garner market share through restricted product capability. Products in this segment offer specialized capability focused only on IP-based services or networks.
2. Complex mediation, circuit-switched and packet-capable. Vendors with more experience usually offer product suites capable of mediating complex mixes of protocols. Often these vendors started by offering legacy-based mediation, and then expanded their product suites as providers rolled out enhanced services.
3. Complex mediation with other OSS functions. As vendors develop

experience, product extensions enable links with other OSS functions. Some of these vendors offer mediation systems to supplement billing systems. Experienced vendors also find that their products can be deployed in other industries as well, dividing products into "telecom" and "enterprise" segments.

ACE*COMM encompasses the latter two vendor segments in that its mediation capabilities are complex, circuit-switched and packet-capable, are deployed in multiple vertical industries, and provide OSS functional links. ACE*COMM's strength lies in its focused mediation expertise. With a broad, global installed base and years of field experience, ACE*COMM possesses a keen understanding of the technological issues surrounding the design and installation of a mediation solution and an extensive history with service providers and their networks.

The Need for Mediation

Mediation creates a layer of abstraction

Traditionally, OSSs were developed to address specific network elements, protocols and data formats. This was acceptable given the maturity of the standardization of voice and voiceband services. However, in the new world of convergent networks, adding support for new network elements and their associated services becomes a monumental undertaking, due to the narrowly-focused design of such systems. Considering the number of new network elements—and the OSS platforms that must support them—the multiplication factor results in an explosion of new interfaces that need to be developed.

Mediation serves as an intermediary, creating a layer of abstraction between the network and the OSS

This is where the basic need for mediation becomes apparent. Mediation serves as an intermediary, creating a layer of abstraction between the network and the OSS. By providing data capture and transformation of the information from the network elements, the mediation system can present a unified view of the different services, independent of the specific network elements, protocols and data formats. This simplifies the work of the OSS team, and allows them to focus on where their expertise is most critical—the job of network accounting. It is important to note that mediation systems do not seek to replace OSSs. Rather, their complementary purpose is to translate many of the external differences to make them invisible to the OSS.

This benefit is not only pertinent to carriers who offer both voice and data services. Voice carriers often have a heterogeneous network of traditional switches. Others offer both wireline and wireless services. Data-centric providers may also have different network elements from multiple vendors, different switching types, and different management interfaces and protocols. Others offer new services using technology that no existing OSS can process. In all cases, having a mediation abstraction layer bridges the gap not only between old and new technologies, but also between same-generation technologies with different idiosyncrasies

Mediation enables and simplifies OSS transitions

Often, carriers have no OSS support for new services

An abstraction layer is also beneficial when the OSS infrastructure is evolving. Often, carriers have no OSS support for new services, or have incompatible OSSs to address specific network elements and services. At the least, having a mediation system allows them to solve the data capture and translation function once, rather than solving it within each OSS. This "electronic stapling" of different systems allows for the uninterrupted operation of existing services while the OSS strategy is being finalized. The approach for some of the new services may be to reuse existing OSS technology. For example, it may be possible to mediate voice-over-data (e.g., VoIP, VoATM, etc.) services into the same information required by traditional PSTN-oriented OSSs, effectively taking advantage of the current OSS investment. Alternatively, it may be possible to mediate traditional PSTN services into a new OSS that already has voice-over-data support. In either case, mediation enables not only the transition for the addition of new network elements, but also for the introduction and consolidation of the OSS infrastructure.

Mediation provides a central auditing function

In its role as the collector and dispatcher of usage information, mediation is frequently the only system to see all the data that comes from the network. Most OSSs receive only a subset of the data, or are interested only in certain types of data. For example, billing systems rarely care about unanswered calls or unsuccessful connection attempts. On the other hand, capacity planning systems need to know about all calls, whether they are billable or not. In fact, knowing the error conditions is probably more important from a network planning perspective. Typically, different systems are deployed to

solve these distinctive accounting functions. Very often, however, the use of different systems produces inconsistent results. For example, the capacity planning system may see five million calls per day, but the billing system may report only three million billable calls. By having a single logical platform responsible for the capture, validation and routing of usage information to the different platforms, the mediation performs an implicit revenue assurance function. Inconsistencies may be better understood by keeping track of how much data comes from each network element, how much is sent to the different downstream systems, and how much is rejected due to errors. In addition, the mediation system is able to report the reason why the errors occurred.

Mediation creates knowledge from the network

Many OSSs cannot, or will not, process partial and often incomplete pieces

At this point in the discussion it may seem that the mediation spectrum only encompasses the collection of network usage information, mapping of input records to output records, and distribution of the resulting records to downstream OSSs. While this may be true in some networks, the desired information is often not readily available without additional mediation functions. For example, some of the required accounting attributes may not be directly available. In many cases a computation or lookup from a database or another server may be required. This data augmentation is the process of enriching the raw data content with supplementary information.

Frequently, especially with newer switching technologies, much of the usage information is reported in pieces. The initiation, establishment, and eventual termination of a connection are often reported in these different pieces of information rather than as a complete record. Progress updates may also be reported. In addition, other significant events such as invoking a lookup transaction request from another server may result in additional records. One connection could potentially result in tens, if not hundreds, of usage records. Many OSSs cannot, or will not, process the partial and often incomplete pieces. Even if they could, the per-record processing overhead may actually cost more than the revenue that can be derived. Thus, aggregation is the process of taking the partial records and creating a single record that accumulates all the reported information.

Other services may be reported from a variety of sources. For example, if a call is routed through multiple switches, each switch may generate usage information for the call. A multimedia session may produce information representing the different services used. While it may process each of these

services individually, some of the accounting attributes (i.e., bundling of services) may not be obvious without the others. Correlation associates these different perspectives of a call or session to provide a complete view of the service. All these functions can be provided by a flexible mediation solution.

Advanced mediation offers real-time trending, analysis, identification, and validation

By enhancing the basic audit capabilities, advanced mediation functions offer real-time trending and analysis, as well as validation of the OSSs. Some mediation vendors have added the ability to generate summarized information based on the network utilization. This allows for real-time reports on which services are being used, when they are being used, where they are being used, and who is using them. These reports can be used to analyze the network for capacity planning, to understand usage trends for marketing purposes, to troubleshoot for engineering purposes, and to predict revenues and contractual traffic limits for financial purposes.

Clearly, the check-and-balance of an independent system provides a desirable feature in a revenue generating system

When rating functionality is added, the ability to summarize charges also allows the mediation system to predict and verify what the billing system should charge. Clearly, the check-and-balance of an independent system provides a desirable feature in a revenue generating system.

Inter-carrier access charges represent a very significant portion of any carrier's costs and revenue, especially for long distance and backbone providers. Intercarrier accounting solutions have been around for a long time, but not all carriers have access to such systems. Mediation allows for the real-time detection of inter-carrier calls and identification of the parties involved. When inter-carrier calls are monitored, it provides the ability to predict and validate charges made by inter-carrier accounting systems. This verification can be used to verify not only the carrier charges, but also the invoices from partner carriers. When both cost and price accounting is performed, margin analysis becomes possible for any call (or combination of calls).

It will become increasingly important to identify and separate distinct traffic flows

As telecommunications delivers more and more commercial content, a new wave of interconnection points will be introduced in networks. Similar to the multiplication of interconnects that came with deregulation and competition, content delivery will increase the need for measured traffic at network interfaces. Everyone will want their share of the pie, and it will become increasingly important to identify and separate distinct traffic flows. In a

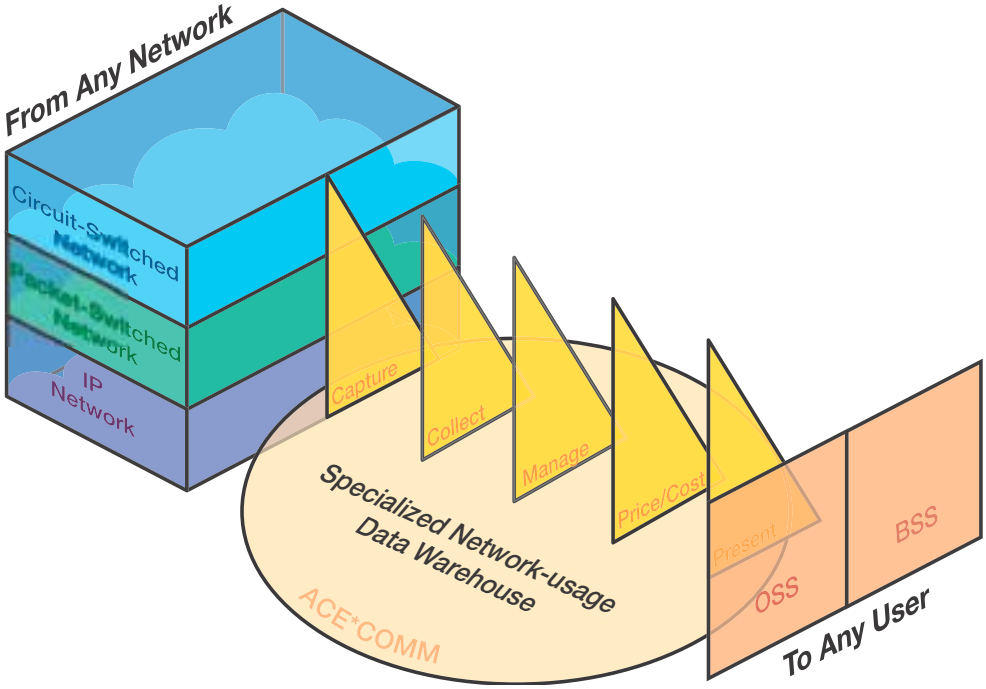
world where specialization is the norm, it is best to leave the analysis, understanding and identification of the data to the systems that are the closest to the source. It would not be cost effective to expect the back office system to understand the intricacies of the network interconnections and to process the appropriate usage data. The mediation layer can best solve this problem, and provide the correct information to the appropriate OSS in the appropriate format.

Mediation provides a centralized data repository

A comprehensive data storage strategy provides many benefits.

Given its intermediary position, the mediation system can also serve as, or manage, a centralized network data repository. Most mediation systems provide a pass-through function—essentially a store-and-forward system with no historic retention. Extending the mediation system to provide a comprehensive data storage strategy for long-term storage management provides many benefits. Often, each of the different OSSs fed by the common mediation system have their own data format specifications. Due to the difference in data content, it is possible that no one location may have all the information provided by the network. In addition, the replication of data not only contributes to additional storage overhead, but also introduces the possibility of data integrity problems where data is modified at one site, but not another. The central data repository can be as simple as a set of procedures that identifies where files are stored, or as complex as specialized network-usage data warehouse.

ACE*COMM
Convergent Mediation™ Functions



Capture and Collection

Capture and Collection refer to the processes involved in the securing of network usage data. The mandate for these processes is to gather and secure all of the data once and once only—to ensure there are no duplicates or gaps. This includes associated audits to ensure that data exchange is performed correctly, and to generate alarms when an error is detected.

Typically, the term "capture" is used where the data extraction interface requires a co-located adjunct to the network element. The need for the adjunct is usually due to physical or electrical limitations of the data exchange protocol, such as when using tape, SCSI, or serial interfaces. Also, co-location may be used to provide redundancy when the risk of network outages is high.

"Collection" generally refers to the process of centralizing data from several sites. Data is gathered directly from multiple network elements and from other data capture adjunct processors.

In establishing a data capture and collection strategy, the mediation vendor has two primary methods to choose from: the use of probes or of direct interfaces to network elements. Probes are passive data-gathering hardware

devices that "spy" on the network, recording all data that passes through the point in the transmission medium where the probe resides. The direct interface method, on the other hand, uses a data-exchange mechanism to retrieve selected data directly from the network element.

The best choice is often a mixed strategy

In complex network environments, the best choice is often a mixed strategy. This is the approach taken by ACE*COMM, in which both probes and direct interface methods may be used when creating a mediation solution. When considering a mediation vendor, service providers should look for a vendor who not only understands the technology they are selling, but has a thorough understanding of the client's network environment and makes decisions based on each unique situation.

Any interface may use either a push or a pull mechanism. This distinction is not significant, and is important only in that it identifies which party—the network element or the mediation system—is responsible for initiating the data exchange.

Manage

Data management refers to the different data processing capabilities of the mediation system. For example, data is validated for syntactical and semantic errors. Duplicate data is weeded out, gaps in the data sequence are identified, and alarms are generated. Different record formats can be normalized into a common format to ensure that downstream processing modules have only a single record format to deal with. Records can be augmented with customer, service, cost, and other billing information. Fragmented records can be reassembled to provide a single view of the call session. Also, error correction and reprocessing can be applied to data that failed any of the processing stems from a previous run.

Price/Cost

Pricing and costing identifies and monitors inbound and outbound data flows in real time from a financial perspective. This enables the measurement of individual records and summarized usage records, support for multiple rating dimension and flexible plans for intercarrier invoice reconciliation and pre-billing processing, rate changes on a scheduled basis or in real-time for rapid response, and the management of termination costs.

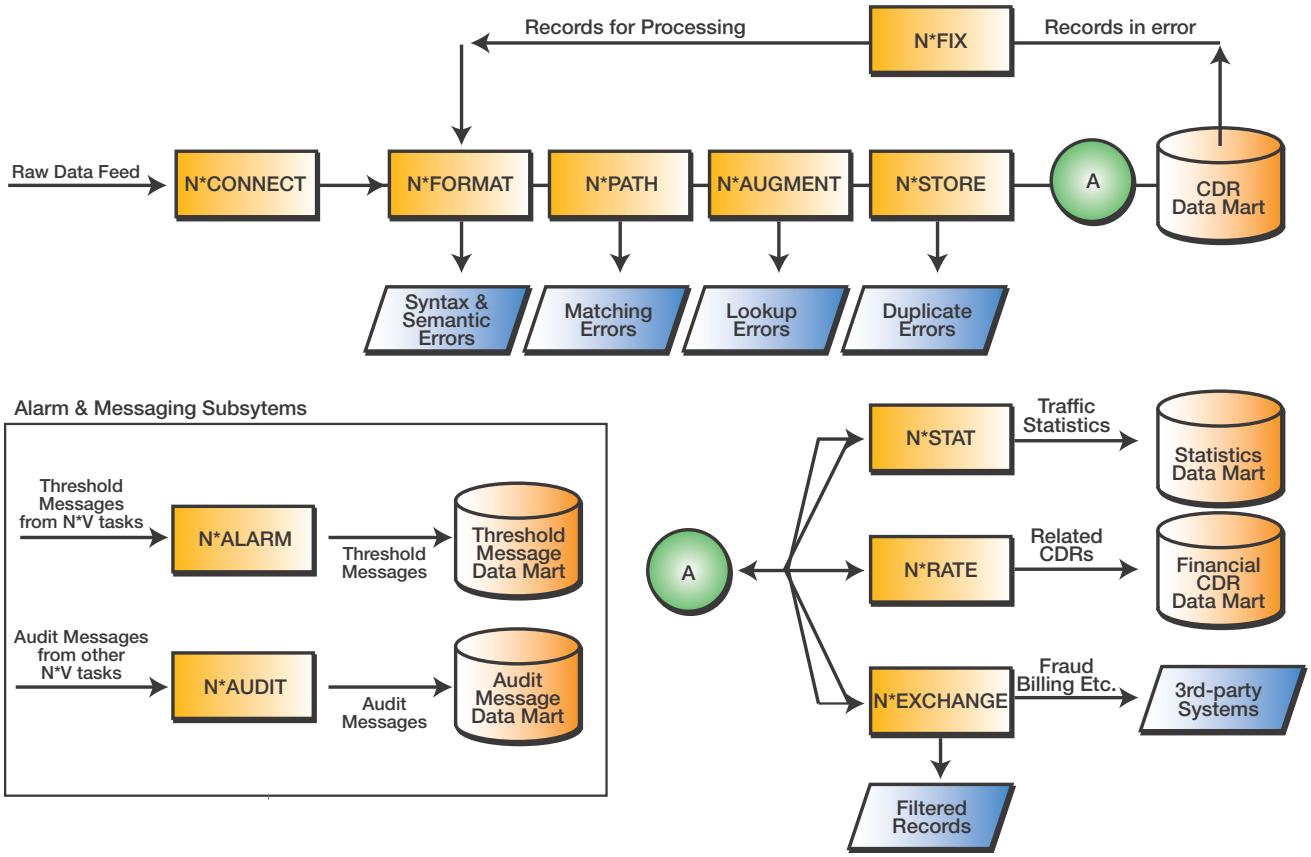
Present

Presentation functions reformat and summarize network usage records for numerous downstream applications such as billing and fraud systems. The presentation layer may perform the transformation on a per-record basis (one output record per input record) or on a summary-basis in which many detail records are aggregated into one record. A single source of data is used for all business operations, which ends duplication, discrepancies, and the need for data reconciliation, and provides the ability to plan and make decisions based on solid business analysis.

Warehouse

Specialized network-usage data warehousing adds value to data by correlating, aggregating, and augmenting it to an individual customer's specifications. It can turn large volumes of network data into the knowledge required to maintain a competitive advantage, quickly detect and correct traffic flow problems, profile customer usage and gain knowledge for effective marketing, filter out unbillable data, and reprocess erroneous data until it is resolved.

N*VISION® DATA FLOW



The N*FORMAT™ module of N*VISION validates the data for structural and content integrity. Erroneous data triggers alarms, highlighting the specific problems encountered. Data is then converted to a generic format—the "call detail" —which accommodates not only current customer record formats, but a variety of other formats previously processed by ACE*COMM. Errors are automatically recycled for a user-defined period, after which erroneous records will be flagged and sent to the data warehouse for analysis and reprocessing.

The N*PATH™ module, based on the network topology information added by N*FORMAT, creates chains of records that identify the path of the call through the network. A "call summary" data entity is created, presenting an overview of the call from a network perspective—as if the whole network was a single switch. Records that cannot be correlated are automatically recycled periodically for a user-defined period, after which they are forwarded to the data warehouse and identified as being in error.

The N*AUGMENT™ module enriches the raw information contained in the original records from a variety of reference tables, the most common being the LERG tables. Information can also be added, for example, about the service, customer, or destination. Filtering and distribution criteria are also added at this stage. The N*AUGMENT module is responsible for the calculation of various duration information such as set up, holding, conversation and seizure. Rounded duration as well as minimum duration can additionally be added. Errors are automatically recycled for a user-defined period, after which erroneous records are flagged and sent to the data warehouse for analysis and reprocessing.

Once the data as been reformatted, correlated and augmented, it can be replicated and distributed to other N*VISION processes, as well as other consumers such as the billing system and other OSS/BSS.

The N*STORE™ module creates a specialized data warehouse of network usage. This includes a real-time environment as well as a repository organized by date and time. The real-time environment is designed to be a circular buffer that holds from a few minutes to a few hours of the latest data received from the network. It enables the CDR Watch feature of the system that allows an operator to view in real time all records received matching the search criteria that can be based on any information contained in the "call detail". This feature is of great use in troubleshooting mode. All entities of the call are also stored in tables organized or partitioned by date and time. The user controls the length of time the data is warehoused.

The N*RATE™ module applies either a cost or a price to each record. Rating can be by origin, destination or other parameters. All rate/cost tables can be managed or viewed using the provided GUIs. Rating of the usage can enable functions such as wholesale billing. Costing enables such functions as least-cost-routing analysis or intercarrier invoice reconciliation or validation.

The N*STAT™ module summarizes the usage data along a variety of dimensions. Standard perspectives include an "engineering" or "switch" view, a "business" or "network" view and a "revenue assurance" view. Network usage can be summarized with an hourly, daily and monthly time slice. The N*STAT module can also summarize the rating and costing

information. Usage can be summarized to create "aggregate" records that represent, for example, a whole day of traffic between carriers. These aggregate records can then be fed to the billing or CABS system for processing.

The N*EXCHANGE™ module is responsible for two functions: to create the records that need to be sent to "consumer" or OSS systems such as billing, CABS or fraud, and to support the protocol or communication/ distribution interface to these systems.

The N*SEARCH™ module is a group of graphical user interfaces (GUIs) that can be used to query and manage all collected and generated usage information, as well as all data either imported or entered into reference tables used in the augmentation process. This module is not depicted in the diagram above.

The N*REPORT™ module is a group of GUIs and reports built using off-the-shelf reporting products. They are used to analyze and trend the usage, which was created by the N*STAT module. This module is not depicted in the diagram above.

The N*FIX™ module provides an environment to manage and repair and reprocess erroneous data. To facilitate the recovery of billable erroneous data, a set of GUIs guide the user through the various steps of reprocessing. Data is first selected for reprocessing, then a copy is made in a reprocessing environment. The user can then look at the data, modify it, or resubmit it for reprocessing. The N*FIX module includes a comprehensive audit trail that includes the "before" and "after" versions of the data as well as tracking of the user who requested the reprocessing and the time and date of the event. Reprocessed records are also flagged in the data warehouse.

The N*ACCESS™ module provides an environment to manage users of the system as well as the privileges that they have. Users can be grouped by their role or roles and be given access to modify or view certain data. This module is not depicted in the diagram above.

The N*AUDIT™ module provides a comprehensive system audit trail. Every record and every file processed by N*VISION can be tracked through each module, highlighting the number of records, the number of errors, etc., as seen by each task. It is possible, for example, to track a file from the collection process to the distribution to the billing system. This module is not depicted in the diagram above.

N*VISION addresses the service provider's data needs while protecting their investment in OSS/BSS infrastructure. Users gain the competitive edge through cross-generational integration, increased service levels, and new opportunities for profitability.

Conclusions

Industry analysts and service providers often praise new enhanced services as the future of telecommunications. Convergence is the new way of life, but the steep investments in existing network infrastructures will likely guarantee their existence for the foreseeable future. The reality of revenue growth depends on a complex mixture of infrastructure to deliver both traditional and packet-based services. This mixed infrastructure demands mediation products with broad capabilities that can enable and simplify the carriers' life-sustaining accounting responsibilities.

At a minimum, mediation allows service providers to implement new services and technologies in a heterogeneous environment while continuing to perform the accounting function. It provides the environment for validating, correcting, translating and reprocessing erroneous data to maximize revenue. It also provides added visibility to the flow of data, providing an audit trail from each network element, all the way to delivery of the appropriate data to each OSS. With the advanced features of mediation, better insight into the flow of revenue creates business intelligence that enables a better understanding of the network and how it is being used. Optionally, a comprehensive data storage strategy can provide the central repository for all network data, rather than the segmented and partial information maintained by different OSS applications.

ACE*COMM's Convergent Mediation solutions connect to a service provider's existing network infrastructures. They accurately collect call and usage records, as well as performance data, from virtually any network element types. The data is processed and used for billing, performance management, fraud detection, business decision support, and other operations support functions. These products are designed to enhance the communications service provider's competitive position by allowing them to quickly and efficiently offer new features and services, minimize network down-time, increase revenue through more accurate and timely billing, and improve network productivity.