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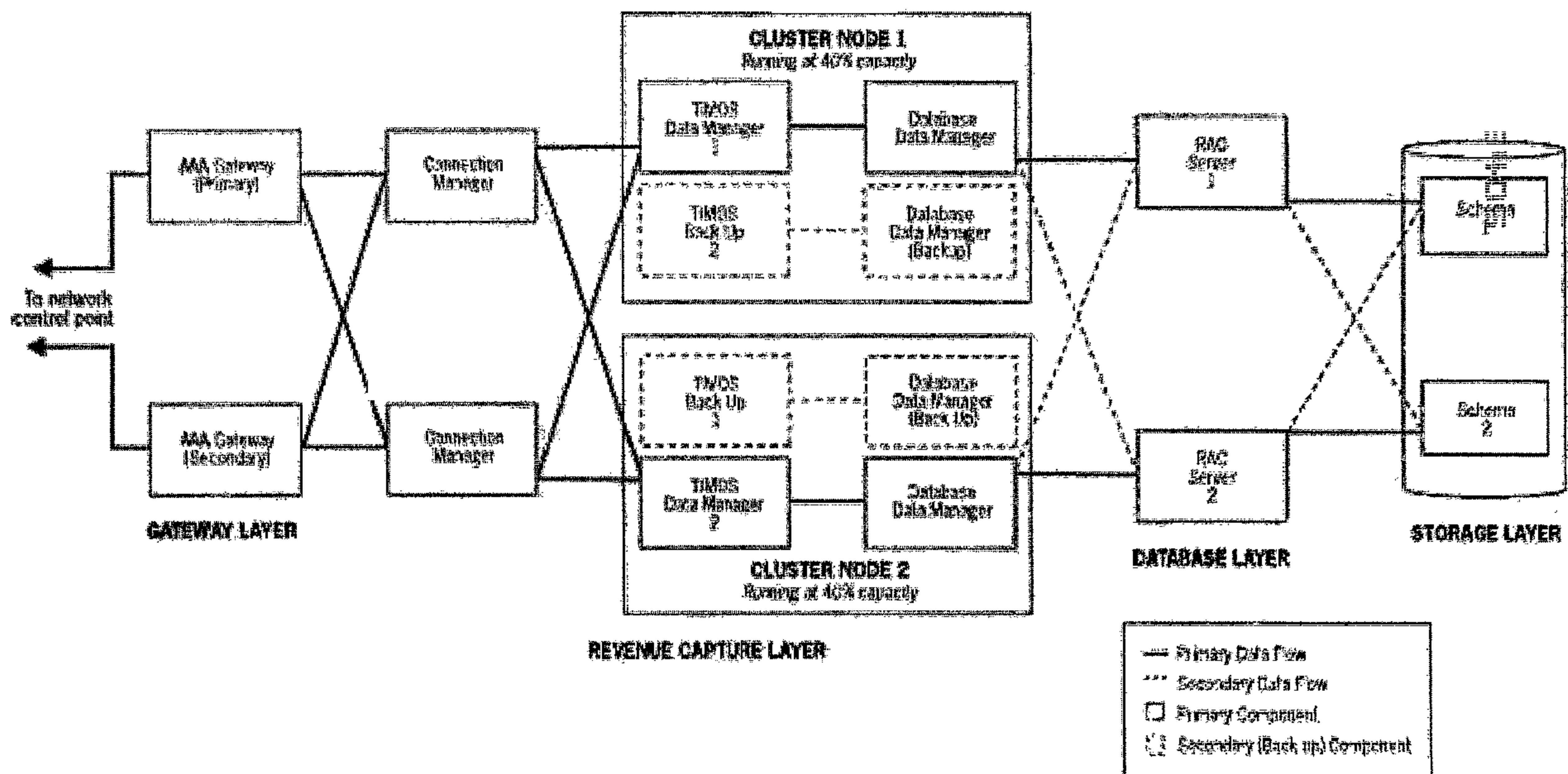
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(54) Titre : SYSTEME ET PROCEDE DE GESTION DE REVENUS

(54) Title: REVENUE MANAGEMENT SYSTEM AND METHOD



(57) Abrégé/Abstract:

A revenue management system and method for telecommunication network use is disclosed. The revenue management system can be integrated with the internet protocol multimedia subsystem (IMS). The revenue management system and method can have a hardware and/or software revenue generation module or architecture, revenue capture module or architecture, revenue collection module or architecture, revenue analysis module or architecture, or combinations thereof.

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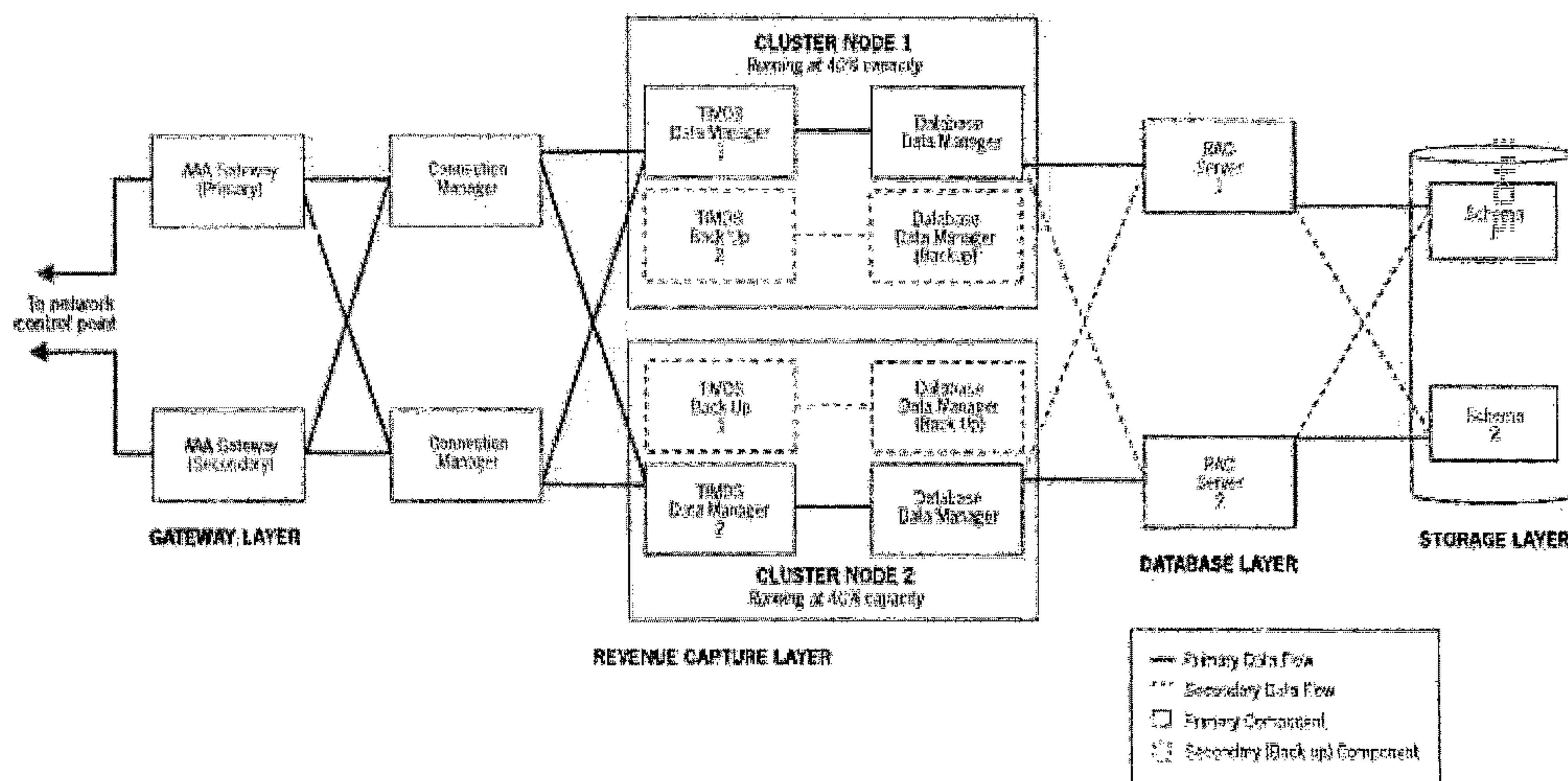
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1 TITLE OF THE INVENTION

2 REVENUE MANAGEMENT SYSTEM AND METHOD

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10
11 CROSS-REFERENCE TO RELATED APPLICATIONS

12 [0001] This application claims the benefit of Provisional Application No. 60/694,743,
13 filed 28 June 2005, and 60/694,743, filed 28 July 2005 .

14
15
16 BACKGROUND OF THE INVENTION

17 [0002] Telecommunication network operators and service providers are currently
18 implementing the internet protocol multimedia subsystem (IMS). IMS is a set of Internet
19 Protocol (IP) standards for session-based control of multimedia and telephony services on
20 any network type, including circuit switched networks, packet-switched networks, and
21 the public switched telephone network (PSTN). IMS manages the communication,
22 collaboration, and entertainment media over internet protocol. IMS enables users to
23 access both content and other users in ways that are natural and intuitive.

1 [0003] IMS provides users with functionality that is not dependent on fixed or mobile
2 networks and also retains existing protocols, including the session initiation protocol
3 (SIP). The SIP is central to IMS. Originally developed for voice over Internet Protocol
4 (VoIP), SIP enables multiple users to enter and exit at will an ongoing communications
5 session (i.e. a connection between two or more communications terminals such as a
6 mobile handset a content server, or a personal computer). Moreover, SIP enables users to
7 add or remove media (voice, video, content, etc.) dynamically during a session and run
8 multiple sessions in parallel.

9 [0004] IMS enabled services will include combinations of push-to-talk, click-to-dial,
10 multi-player gaming, video telephony, SMS, dynamic push content, including file
11 sharing, and video conferencing, and location-based commerce among other
12 communication, collaboration, and entertainment services.

13 [0005] These services previously existed in independent silos: that is, users must exit one
14 service (i.e., terminate a session) before they can access a new service (i.e., initiate a
15 session). The routing, network location, addressing, and session management of IMS
16 eliminates the walls of the silos to effect a so-called blended functionality that lets users
17 move freely between networks and services while maintaining multiple concurrent
18 sessions. In this way, IMS transforms a sequence of discrete communication events into a
19 single shared communications environment.

20 [0006] For example, users will be able to select a communications mode (voice, voice
21 with video, text-to-speech email, and so on) that best suits their circumstances while
22 retaining the freedom to change that selection dynamically by adding a video stream
23 midway through a voice call for example. Users will also be able to access familiar

1 services on any device and via any network type, fixed or mobile. And they'll enjoy these
2 freedoms along with new functionalities such as broader payment options, credit control
3 presence management, and convenient connectivity to groups.

4 [0007] IMS also provides operators and service providers opportunities for cost
5 reductions and revenue growth. They can expect cost reductions because IMS enabled
6 services, unlike today's siloed services, do not require replication of every functionality:
7 charging, routing, provisioning, and subscriber management, for example. Rather, IMS
8 services can reuse the same functionality across all services, thereby accruing for their
9 operators significant savings in capital and operational expenditures. Revenue growth
10 through enabling enhanced services is IMS's other benefit. In this way, IMS is the
11 panacea-in-waiting to communications and media companies, who face the threat of
12 commoditization.

13 [0008] Telecommunication network Operators and service providers will need a
14 convergent charging system to realize the value of IMS. Such a system - with its
15 integrated view of the customer - is necessary to apply cross-service discounts on
16 bundled offerings and other marketing promotions, as well as a single consolidated bill
17 for each customer - even when services originate from multiple third-party providers.

18 [0009] Legacy billing applications have become increasingly inadequate to the demands
19 of charging for IMS-enabled services as charging has undergone a profound
20 transformation in recent years: from batch to real-time processing, from a back-office
21 support function to a front-office mission-critical function, from a cost to be minimized to
22 a strategic opportunity for revenue maximization.

1 [0010] Further, operators know that consumers have choices. In this environment, CSP's
2 have difficulty remaining competitive if unable to maintain an uptime of at least 99.999%
3 - so-called "five-nines" availability. Five-nines, which amounts to barely five minutes of
4 downtime per year, is unprecedented in traditional billing.

5 [0011] As batch-processing systems, traditional billing vendors did not have to provide
6 highly-available solutions. If the billing system failed during a batch run, the job could
7 simply be restarted once the system became available. For this reason CSPs were forced
8 to maintain separate systems to handle their prepaid and postpaid subscribers and
9 services. Prepaid voice services were generally managed by the network equipment
10 vendors, who traditionally provided prepaid solutions in the form of a service control
11 point (SCP) or service node. These systems - built with the network in mind, especially
12 prepaid voice - were designed to achieve the high-availability and low latency
13 requirements of tier-1 service providers. However, this design focus, together with
14 support for only very simple rating capabilities, resulted in these systems being much
15 more restrictive than their postpaid counterparts.

16 [0012] Because no single system provided support for all the revenue management
17 functions, CSPs have often had to deploy dozens of separate systems to support those
18 functions. Different "stovepipe" systems managed prepaid and postpaid services, while
19 still other systems managed services such as voice, data, content, and messaging. Such a
20 multifarious environment has driven operational costs higher and hampered CSPs' ability
21 to meet increasingly aggressive market requirements.

22 [0013] CSPs can no longer afford the operational excess of maintaining multiple
23 systems: instead CSPs need a simple, convergent, and modular revenue management

1 solution that delivers high performance and high availability as well as flexibility and
2 scalability. The revenue management system must also meet the demands of consumer
3 marketing-a complex function that increasingly entails bundled offerings, conditional
4 multiservice discounts, highly segmented promotions, and revenue sharing across a
5 multipartner value chain of content providers, service providers, and network operators.

6 [0014] Unlike telecommunications networks, which must route their transport (calls in
7 circuit-switched networks and packets in packet-switched networks) in real time, legacy
8 billing systems for telecommunications providers have customarily fulfilled a back-office
9 function, batch processing records such as call detail records and IP detail records. If a
10 billing system weren't available when scheduled to process a particular batch, engineers
11 could fix the problem, then run the process a few hours behind schedule. In the worst-
12 case scenario, customers' bills would arrive in their mail boxes a day or two later than
13 usual. But new expectations of communications service users are now changing the rules
14 of the billing game.

15 [0015] Today's users demand diverse payment options in line with their varied personal,
16 business, and family needs.

17 [0016] Whereas some will continue to favor long-standing relationships in which they
18 settle their accounts with operators in the traditional manner of postpayment via invoice,
19 more and more users now require the freedom to prepay – perhaps by purchasing a
20 prepaid card at a grocery store as credit towards service from potentially multiple CSPs
21 over a period of time. Still other users want to pay for products and services as they
22 consume them-so-called now-pay - by providing a debit- or credit-card number at the
23 commencement of each transaction.

1 [0017] In the absence of a convergent real-time solution, CSPs have had to address the
2 bang needs of their prepaid, postpaid, and now-pay customers by maintaining multiple,
3 non-integrated billing and customer-care systems. Indeed, they've had no alternative
4 because legacy billing systems were never designed to accommodate the transactional
5 real-time requirements for prepay and now-pay services. And they certainly weren't built
6 with the requisite low latency and five-nines availability that a revenue management
7 system needs to process as many as several hundred million transactions per day in real
8 time via a direct connection to the telecommunications network.

9 [0018] The absence of a billing system that could meet the high performance/low-latency
10 and high-availability requirements for prepaid has imposed significant costs on CSPs
11 since they were forced to maintain multiple separate systems for their prepaid/postpaid
12 environments and services.

14 BRIEF SUMMARY OF THE INVENTION

15 [0019] A revenue management system and method for revenue management are
16 disclosed. The revenue management system can be a network of computers, a single
17 computer, a program on computer readable medium, software and/or hardware
18 architecture, or combinations thereof. The revenue management system can be used, for
19 example by telecommunication network operators and service providers, to manage the
20 use of and revenue generated by telecommunications networks. The telecommunications
21 networks can be wired and/or wireless.

22 [0020] The revenue management system can perform convergent real-time charging for
23 prepaid, postpaid, and now-pay telecommunication network user accounts. The revenue

1 management system can manage revenues through the entire service cycle, from revenue
2 generation to revenue capture to revenue collection to revenue analysis. The revenue
3 management system can have a hardware and/or software revenue generation module or
4 architecture, revenue capture module or architecture, revenue collection module or
5 architecture, revenue analysis module or architecture, or combinations thereof. (Any
6 elements or characteristics denoted or described as being modules, architectures, layers,
7 or platforms, herein, can be any of the other of modules, architectures, layers or
8 platforms.)

9 **[0021]** The revenue generation module or architecture can minimize delays of
10 deployment of new-services on the telecommunication network. The revenue generation
11 module or architecture can have GUI-based applications for rapidly provisioning, pricing,
12 discounting, and managing all aspects of customer and partner relationships such as
13 personalized promotions and revenue sharing.

14 **[0022]** The revenue capture module or architecture can leverages a high-performance and
15 high-availability platform that converts all transactions into revenue with zero leakage
16 from fraud or system downtime. The high availability platform further minimizes
17 customer churn.

18 **[0023]** The revenue collection module or architecture can ensure accurate bills for
19 postpaid accounts while collecting all prepaid and now-pay revenue in real-time. The
20 revenue collection module can generate partner (e.g., business partner) statements and
21 provide a real-time view of finances, for example, to suggest changes in marketing
22 strategy.

1 [0024] The revenue analysis module or architecture can process the transactions that pass
2 through the revenue management system and can provide data for predetermined
3 mathematical functions (i.e., data analysis). The revenue analysis module can be used
4 with IMS-enabled services.

5 [0025] The revenue management system can provide carrier-grade performance, high
6 availability, unlimited scalability, flexibility to rapidly launch and manage IMS-enabled
7 services, perform end-to-end revenue management, and combinations thereof.

8 [0026] The revenue management system can be a single convergent platform for service
9 providers to manage revenue in real time across customer type, network, service,
10 payment method and geography. The revenue management system can have high-
11 performance, high-availability, and scalability, for example equal to that of a front-end
12 carrier-grade network element, with the functionality and flexibility of a convergent
13 revenue management system.

14 [0027] The revenue management system can be a unified system that manages revenue in
15 real time across any customer type (residential or business), network type (packet- or
16 circuit-switched), service type (voice, data, commerce, and so on), payment method
17 (prepaid, postpaid, and now-pay), and geography (multiple currencies and tax regimens).

18 After examining the implications of inadequate performance and availability in CSPs'
19 billing and customer-care platforms. The revenue management system can have a
20 revenue capture platform and an in-memory object store (e.g., TIMOS or other
21 technology) for high performance/low latency and an active/active staged architecture for
22 high availability.

1 [0028] The revenue management system can deliver carrier-grade performance,
2 unlimited scalability, five-nines availability, the flexibility to rapidly launch and manage
3 new services, and combinations thereof.

4 [0029] The revenue management system can give operators a unified view of their
5 subscribers (e.g., rapid and organized viewing of database information for users across
6 various networks). The revenue management system can be configured to analyze
7 database data for market segmentation, to create discounts (e.g., multiservice discounts),
8 and promote and deliver functionality, such as consolidation of all services onto a single
9 bill.

10 [0030] The revenue management system can accurately manage multiple revenue touch
11 points with end-customers, for example, to enable networks to provide and bill a variety
12 of voice and multimedia services.

13 [0031] The convergent revenue management system can eliminating duplication and
14 exploiting economies of scope, it can thus incur lower operational costs than multiple
15 non- integrated systems. Such efficiencies can translate into substantial savings in
16 resources, skills, training, hardware, etc. The convergent revenue management system
17 can have greater flexibility and scalability than multiple stand-alone systems. The system
18 can provide an integrated view of the customer with important functionality benefits such
19 as the ability to apply cross-service discounts to bundled offerings and the capacity to
20 generate a single bill for each customer, even when services originate from multiple
21 providers.

22
23 BRIEF DESCRIPTION OF THE DRAWINGS

1 [0032] Figure 1 illustrates a variation of the revenue management system integrated into
2 the IMS framework.

3 [0033] Figure 2 illustrates a variation of the revenue management system with a network
4 layer.

5 [0034] Figure 3 illustrate a variation of the revenue management system.

6 [0035] Figure 4 illustrates a variation of the revenue management system with exemplary
7 load distributions.

8 [0036] Figure 5 illustrates a variation of the revenue management system having multi-
9 database subsystems.

10 [0037] Figure 6 illustrates the set-up for benchmark testing of the revenue management
11 system.

12 13 DETAILED DESCRIPTION

14 [0038] Figure 1 illustrates that the revenue management system can be integrated (i.e., in
15 data communication with) the IMS framework. Users can access IP-based services via
16 any device and any access network through a standardized access point, the CSCF (call
17 session control function) or SIP server. The CSCF sets up and manages sessions,
18 forwarding messages and content from other users or from content and application
19 servers. The CSCF works in partnership with the HSS (home subscriber service), which
20 manages subscriber data and preferences, enabling users to find one another and access
21 subscribed services. A CGF (charging gateway function) can mediate access to other
22 operators' networks and support application for charging, provisioning, and customer
23 service.

1 [0039] Figure 2 illustrates that the architecture of the revenue management system can
2 have a gateway layer (e.g., a AAA Gateway), a revenue capture layer, and a database and
3 storage layer. The gateway layer can connect to the external network via a service
4 platform such as HP OpenCall (from Hewlett Packard, Inc., Palo Alto, CA) , which in
5 turn can connects to a network switch.

6 [0040] The gateway layer can be an interface to the network layer. Connections to the
7 network layer can be maintained via one, two or more AAA (authentication,
8 authorization, accounting) Gateway managers. The AAA Gateway managers, which can
9 include one primary and one or more idle-but-running back up, connect to the network
10 SCP via TCP/IP, and manage a number of tasks. The tasks can include protocol
11 translation, asynchronous interface, load balancing, service-level agreement (SLA)
12 latency enforcement, failure detection, failure handling, failure recovery, and
13 combinations thereof.

14 [0041] The protocol translation can provide high-speed translation from the protocol used
15 by the network SCP to a communication protocol (e.g., Portal Communications Protocol
16 (PCP)). The AAA Gateway can support the HP OpenCall's Message Based Interface
17 (MBI) protocol, Diameter Charging, and PCP. The AAA Gateway can provide extension
18 to support additional protocols.

19 [0042] In asynchronous connection to the SCP, requests can be received from the SCP
20 and acknowledged. Following completion of the requested operation, the asynchronous
21 interface of the AAA Gateway can send a response to the SCP with the final results.

22 [0043] The load balancing element can distribute requests evenly across the available
23 Connection Managers using a round-robin algorithm.

1 [0044] The SLA enforcement can monitor and guarantee conformance to a service-level
2 agreement's latency requirements.

3 [0045] The failure detection element can detect failures such as a broken link between a
4 AAA Gateway and a connection manager in the revenue capture platform.

5 [0046] The failure handling element can provide an interim request storage facility for
6 requests processed during back-end failures and pending recovery, and a degraded mode
7 of operation for cases in which the back end is not available or simply not responding
8 within the specified latency levels.

9 [0047] The failure recovery element can replay requests into the revenue capture
10 platform following a failure.

11 [0048] When the call (or other connection) comes to the network, the SCP can query the
12 AAA Gateway in order to grant the service (i.e. authorize the call). During the call the
13 SCP keeps the revenue management system apprised of the call status by passing call-
14 start and call-end requests-as well as Reauthorizing requests if the previously authorized
15 quantity is close to exhaustion.

16 [0049] The AAA Gateway can convert the SCP requests into event data records (EDR).
17 The AAA Gateway can then forward the EDR to a specialized processing pipeline-
18 authentication, authorization, or accounting, for example, depending on the service and
19 request type. The processing pipelines can contain a module that can call an API of the
20 CM in the Revenue Capture Platform. This is a synchronous call that blocks processing
21 until receipt of a response. The response can then undergo translation into the EDR, and
22 the EDR can pass to the network output module, which can send the response back to the
23 SCP.

1 [0050] This process can be monitored for latency by a timeout monitoring facility in the
2 AAA Gateway. If the timeout facility detects an unacceptable latency, the timeout
3 facility can pass the EDR to a timeout pipeline. The timeout pipeline can then execute
4 business logic to handle the request in a degraded mode in order to ensure a response
5 with required latency levels. The degraded mode can allow the timeout pipeline to make
6 a decision on how to proceed based on a configurable set of rules. For example, if the
7 request is for authorization of a local call, the rules might indicate approval by default
8 following the timeout of such a request. A timed-out request for authorization of an
9 international call, in contrast, might receive a default denial.

10 [0051] Two other pipelines - the exception pipeline and the replay pipeline - can lean up,
11 store, and replay timed-out requests to prevent any revenue leakage. If a timeout was
12 caused by a failure in the Revenue Capture Platform, the replay pipeline can read the
13 replay log after the Revenue Capture Platform is back online and send it the logged
14 requests. If a timeout happened for other reasons, the replay can start immediately.

15 [0052] The revenue capture layer can implement the authentication and authorization that
16 is necessary for prepaid and now-pay transactions. The revenue capture layer can handle
17 the accounting tasks of event rating and recording all transactions. Figure 3 illustrates
18 that the revenue capture layer can have one, two or more Connection Managers, Database
19 Data Managers, and TIMOS (transactional in-memory object store) Data Managers, a
20 high-performance in-memory store that can synchronize with the database. The elements
21 of the revenue capture layer can be encompassed by the Revenue Capture Platform.

22 [0053] Each AAA Gateway manager can connect to one, two or more distinct connection
23 managers via TCP/IP. As opposed to the primary/backup model, these two connections

1 are always in use during normal processing. Initial requests to the CAIs are distributed
2 evenly by a simple round-robin algorithm. Cross-machine distribution of the connections
3 can provide fault-tolerance at the hardware level. (The number of Connection Managers
4 could be determined by the operator's availability and scalability requirements).

5 [0054] The Connection Managers can route requests to the appropriate TIMOS Data
6 Manager or back-end Database Manager. The design of the revenue management system
7 can provide time-sensitive requests such as authentication and authorization to be
8 performed by accessing data from the high-speed in-memory TIMOS cache only.
9 Accounting requests, which can tolerate higher latencies, can access both the TIMOS
10 cache and the back-end database.

11 [0055] The system can be configured so non-real-time requests bypass the TIMOS Data.
12 Non-real-time requests can include, for example, batch rating or billing jobs, or real-time
13 requests that do not require millisecond-level response times, such as an account query by
14 a customer service representative.

15 [0056] Figure 4 illustrates a variation of the revenue management system with exemplary
16 load distributions shown. The architecture of the system can have one, two or more
17 TIMOS instances and their back-up counterparts. Each TIMOS instance can have three
18 components: a reference object cache, a data migratory, and a transient object store.

19 [0057] The reference object cache can be a cache area for database objects such as
20 customer account records, required for read-only reference during real-time
21 authentication and authorization processes.

22 [0058] The data migratory can be a subsystem to fill the reference object cache from the
23 database.

1 [0059] The transient object store can be an area used to store temporary objects for
2 TIMOS-only use such as active-session objects and resource-reservation objects.

3 [0060] The TIMOS instances can serve distinct sets of the subscriber base. For example,
4 approximately 50% of subscribers per instance for the minimal two-instance
5 configuration shown in Figure 4. Each primary TIMOS instance can run on an
6 independent server with that same server running the back-up instance of another primary
7 TIMOS instance.

8 [0061] Meanwhile, the Connection Managers can consult a directory server in order to
9 route requests to the correct instance. The directory server can be configurable as a
10 separate process or as a part of any TIMOS instance.

11 [0062] The TIMOS Data Managers in turn can connect to at least two Database Data
12 Managers, both of which are active and can take over the workload of the other in the
13 case of a failure. The Database Data Managers interface with the back-end relational
14 database.

15 [0063] The database and storage layers can have one or more server clusters, cluster
16 software, one or more storage area networks, and combinations thereof. The server
17 cluster can be a configuration of at least two database servers, which process data for a
18 single database. The cluster software can manage prepaid payment accounts (e.g., Oracle
19 RAC (Real Application Cluster) cluster software or to execute with the same). The
20 storage area network can support high-speed and high-availability disk storage.

21 [0064] The revenue management system can access a high-performance relational
22 database such as Oracle RAC via a high-speed storage-area network. The system can
23 utilize multithreading and TIMOS data management. TIMOS can access system memory

1 (i.e. RAM). Requests for data in RAM can be processed much faster than requests for
2 data in the disk-based database. Throughput and latency can be reduced compared to the
3 relational database because of the following differences between TIMOS data
4 management and the RDBMS:

5 [0065] TIMOS can store in-memory data and avoid the time delays of database access
6 and the translation between a relational representation and the database's physical format.

7 [0066] The revenue management system employs internal search and storage algorithms
8 that have been optimized for in-memory data, further reducing latencies.

9 [0067] Read-only requests for TIMOS-managed data can avoid round trips to the back-
10 end database and subsequent disk storage, thereby avoiding multiple network hops and
11 their associated latencies. The creation and update of transient objects can be performed
12 entirely in memory by TIMOS, requiring no disk access operations.

13 [0068] The system can have a distribution of operations via a staged-availability
14 architecture, an active/active redundancy configuration, and controllable system renewal.

15 [0069] The revenue management system can have staged-availability architecture that
16 allow higher layers with very high availabilities to maintain system operation—in a
17 degraded mode if necessary—in the event of a failure in a lower-layer component within
18 the Revenue Capture Platform. For example, the Gateway layer can maintain service
19 authorization availability if the primary AAA Gateway loses connectivity to its
20 Connection Manager in the revenue capture layer. Even when operating in a degraded
21 mode, the system can prevent revenue leakage by ensuring that all events are captured in
22 a replay log and persisted to disk for durability. Use of the replay log can ensure that
23 each event undergoes charging as soon as the system recovers.

1 [0070]

Table 1—Layer Availability and Recovery

Layer	Percentage Availability
Network	99.999%
Gateway	99.999%
Revenue Capture	99.95%
Database & Storage	99.999%

2

3 [0071]

4 [0072] Table 1 illustrates the exemplary percentages for each of the revenue management
 5 system's layers. Because the AAA Gateway is designed to provide 99.999% availability
 6 for service authorization and is able to run in a degraded mode, service availability is
 7 significantly higher than the availability of the least-available component. The front-
 8 office (e.g., RAM) real-time processing can enable the high availability.

9 [0073] The system can have an active/active redundancy or an active/passive
 10 redundancy. The active/active redundancy can detect failures in components
 11 substantially immediately and automatically switch the load of the failed component and
 12 to its counterpart. The counterpart can assume the additional load of a failed component
 13 because the system can be configured (e.g., appropriately scaled) so nodes run
 14 sufficiently below capacity under normal operation and can therefore absorb an
 15 additional load during failover.

16 [0074] The AAA Gateways can divide traffic 50/50 between two active Connection
 17 Managers. Each connection manager can route the requests to the appropriate TIMOS
 18 Data Manager or Database Data Manager. Each cluster node can run at 40% capacity

1 during normal operation. If one of the TIMOS Data Managers fail to respond to the
2 Connection Managers, the system can automatically failover to a back-up instance of a
3 TIMOS Data Manager that runs on the other cluster node.

4 [0075] Upon failover, the data migrator can begin to load the backup TIMOS cache with
5 any reference data that had not been preloaded. Processing on the backup system can
6 resume immediately after failover (e.g., the system need not to wait for completion of the
7 data migration). If a request comes in to the back-up TIMOS DM for which the needed
8 data has not yet been loaded into the TIMOS cache, the request can be passed on to the
9 appropriate database DM. The timeout monitor can ensure that the response is made
10 within the required latency limits, although the latency will be higher than for requests to
11 a filled cache. In addition, the requested object can be cached as a side effect for a
12 request to an un-cached object, for example, making subsequent requests for the same
13 data much faster.

14 [0076] The system can support other types of failover. For example, if the connection
15 between the AAA Gateway and a Connection Manager fails, the Connection Manager
16 whose connection remains operable can assume the full load. Meanwhile, the AAA
17 Gateway can automatically execute custom business logic if it does not receive a
18 response from a Connection Manger within a specified latency. For example, if a
19 Connection Manager failed to respond to a database-update request, the business logic
20 can ensure that the AAA Gateway saves the request for subsequent processing once the
21 system had recovered. Custom business logic can maintain operation—albeit in a
22 degraded mode—under severe failure conditions that deny access to customer balance
23 information.

1 [0077] High Availability at the database and storage layer can be supported by a
2 combination of a Storage Area Network, a Cluster Server, and Oracle's RAC software.

3 Figure 4 illustrates a database configuration which can have at least two independent
4 servers (e.g., RAC servers), for example *serving distinct customer segments*, located in
5 different database schemas. Each RAC server can dedicated to one database schema.

6 During normal operation, the traffic for both halves of the system can follow different
7 paths and not interfere with each other. In a failure situation, Oracle can redirect the
8 traffic to the remaining RAC server. Oracle RAC can ensure a smooth transition of the
9 traffic to the remaining node.

10 [0078] Other optional approaches such as storage arrays and disk mirroring can provide
11 additional resilience in the database and storage layers.

12 [0079] The revenue management system can have a controllable system renewal module,
13 for example to further supplement the high availability. The controllable system renewal
14 can be configured to cause the CSP to limit the lifetime of all system processes, with
15 processes set to restart automatically at designated intervals. Controllable system
16 renewal (i.e., similar to a scheduled failover) can ensure that any cumulative errors that
17 might otherwise endanger system stability cannot become critical. By detecting such
18 errors in a relatively benign state, controllable system renewal can affords time for
19 engineers to fix the source of the error accumulation. More importantly, the controllable
20 system renewal module can ensure that unscheduled failovers, when they do occur,
21 execute properly.

22 [0080] The Content Manager module can provide a secure billing interface to link
23 operators with value-added service providers. The revenue management module can

1 enable business partners access (e.g., through an internet or other GUI interface) to the
2 revenue manager module's real-time functionality without the need for business partners
3 to purchase and support a full system of their own.

4 [0081] The system can have flexible GUI applications for pricing management, customer
5 management, partner management, and service enablement. For example, the system can
6 have a Pricing Center/Management module. The pricing center/management module can
7 have pricing management functionality, such as tools to quickly define a product and
8 service catalog together with the associated rules for pricing and discounting.

9 [0082] The pricing management module can define pricing, promotions and service
10 bundles with a unified pricing interface (e.g., one tool/one process) for any payment
11 method. The pricing management module can use any attribute from within the rating
12 record as part of the rating scheme. The pricing management module can support one-
13 time non-recurring events (e.g., registration/cancellation charges, m-commerce, content,
14 and various service usage) as well as prepaid support for recurring events of varying
15 duration (e.g. weekly, monthly, multi-monthly, and annual events). The pricing
16 management module can manage tiered, volume, and multi-service discounting options
17 as well as user-defined discounting. The pricing management module can track time of
18 day/week and special days. The pricing management module can group pricing options
19 such as closed user groups and friends and family. The pricing management module can
20 provide support for zone- and location-based pricing. The pricing management module
21 can manage unlimited numbers of pricing metrics: transport based (per minute, per
22 kilobyte, etc.), value-based (per ring tone, per game, per message, etc.), hybrid, or any
23 metric that the CSP may wish to define in the future. The pricing management module

1 can assign one or more balance impact to any number of balances assigned—monetary or
2 non-monetary. The pricing management module can define proration rules. The pricing
3 management module can define linkage between products and services to entries in the
4 general ledger (G/L).

5 [0083] The system can have a customer management interface module. The customer
6 management interface can support creation and management of customer and partner
7 accounts, for example, natively within the revenue management system, via real-time or
8 batch CRM/PRM integration, via integration with legacy applications, or combinations
9 thereof.

10 [0084] The revenue management system can have other modules to activate, deactivate,
11 provision, and maintain device-related information on services. For example, some
12 services (e.g., GSM telephony) can be provisioned in real time and other services (e.g.,
13 high-speed Internet access) can have staged provisioning. The system can have one or
14 more service manager modules to provide specific service management capabilities based
15 on industry requirements for services and standards such as GPRS, GSM, WAP, LDAP,
16 and SIM.

17 [0085] The revenue management system can support unlimited and near-linear scalability
18 with little or no software modification and no loss of performance. As subscriber or
19 transaction volume grows, operators can add capacity at any time through either vertical
20 scaling (e.g., adding CPUs to an existing server) or horizontal scaling (e.g., deploying
21 additional servers). With this additional capacity, the system's high performance and high
22 availability can remain undiminished.

1 [0086] The operator can add the necessary hardware to support another TIMOS instance
2 pair, for example, if growth in transaction volume approaches the capacity of existing
3 TIMOS instances. The system is readily scalable by the addition of multiple databases
4 such as Oracle RAC clusters, for example if TIMOS is not the limiting factor in the
5 system's capacity. Figure 5—an extension of the minimal configuration of Figure 3—
6 depicts a variation of multi-DB scalability.

7 [0087] The revenue management system can manage credit in a variety of customer-
8 centric methods. For example, families can have separate pre-pay, and/or post-pay,
9 and/or now-pay sub-accounts on the same family plan (e.g., if each member of the family
10 wants a different payment scheme). Companies can divide accounts between personal
11 and business use for the company's communications devices (e.g., an employee can make
12 personal calls and business calls and be billed into separate accounts).

13 [0088] For service providers accustomed to billing via a monthly batch process that
14 prepares, prints, and mails invoices to customers, customer-centric billing in the era of
15 IMS means an end to business as usual. Instead, service providers must implement a
16 more flexible real-time system that can manage a customer's credit and charge on the
17 customer's terms, offering prepay and now-pay options as well as traditional postpaid
18 invoicing.

19 [0089] Figure 6 illustrates the configuration for a benchmarking test for the revenue
20 management system. The test was conducted at Hewlett-Packard's laboratory in
21 Cupertino, California. The test was performed on a single *HP* Superdome computer with
22 72 1-GHz CPUs partitioned into multiple domains. Test driver software running on an 8-
23 CPU partition simulated an authentic traffic load (1.5 million prepaid subscribers)

through the revenue management system. The Connection Manager and Database Data Manager each also ran on 8-CPU partitions, whereas a single instance of the transaction in-memory object store (TIMOS) data manager ran on a 16-CPU partition. An Oracle RDBMS ran on another 16-CPU partition.

Table 2

Sessions per second	Operations per second	Average authorization latency (ms)	Sessions per second per CPU
179	494	34	9.0

[0090] Table 2 illustrates the benchmark test results. A session represents a user's access to the network from beginning to end. In the case of a prepaid voice call, for example, the session begins when, following authorization of the caller's payment, a callee answers the call. This session ends when the caller hangs up. In the case of, for example, a prepaid SMS message, the session, likely much shorter, begins immediately after payment authorization and ends once the message has been transmitted across the network.

[0091] Each session may comprise multiple operations. A prepaid voice call, for instance, typically comprises three operations: service authorization and, if granted, start accounting and stop accounting operations. A prepaid call may cause operations within the system, for example, for reauthorization and reservation of more minutes on the network in the case of long call durations. SMS messages generally require just two operations per message: authorization and stop accounting.

1 [0092] The system under test supported as many as 179 concurrent sessions per second--
2 equivalent to 9.0 sessions per second per CPU-and 494 operations per second. Moreover,
3 because the system is linearly scalable, the establishment of additional TIMOS instances
4 and the inclusion of more CPUs can provide a proportionate performance increase to
5 meet any conceivable load demand at five-nines service availability.

6 [0093] A scaled-up version of the benchmark test system can support tens of millions of
7 subscribers. The average authorization latency in the benchmark test results is 34
8 milliseconds (i.e., a substantially instantaneous response).

9 [0100] It is apparent to one skilled in the art that various changes and modifications can
10 be made to this disclosure, and equivalents employed, without departing from the
11 scope of the invention. Elements shown with any embodiment are exemplary for the
12 specific embodiment and can be used on other embodiments within this disclosure.

Claims:

1. A system comprising:
 - a processor; and
 - a memory coupled with and readable by the processor and having stored therein a sequence of instructions which, when executed by the processor, cause the processor to implement a revenue management system for a communications network, the revenue management system performing convergent charging for telecommunication services for each of prepaid, postpaid, and now-pay user accounts, the revenue management system including a gateway layer coupled with the communications network, a revenue capture layer communicatively coupled with the gateway layer, and a database and storage layer communicatively coupled with the revenue capture layer,
 - wherein the gateway layer:
 - receives a request related to a communication on the communications network,
 - performs authentication of the request and authorization for services to support the communication based on the request,
 - converts the request to an event data record, and
 - forwards the event data record based on the services authorized and a type of the request, and
 - wherein the revenue capture layer includes a transactional in-memory object store including a read-only reference object cache of data objects from the database and storage layer,
 - wherein the revenue capture layer:
 - receives the event data record from the gateway layer, and
 - routes the event data record to the transactional in-memory object store or the database and storage layer depending upon the type of the request and a configurable directory server consulted, wherein routing the event data record comprises routing real-time requests to the transactional in-memory object store and routing non-real-time requests to the database and storage layer, wherein the reference object cache comprises customer account records used for read-only reference during processing of the real-time requests, wherein the real-time requests comprise authentication and authorization requests, and wherein non-real-time requests comprise batch rating and billing requests.

2. The system of claim 1, wherein the transactional in-memory object store includes a reference object cache of database objects from the database and storage layer.
3. The system of claim 1, wherein the transactional in-memory object store includes a data migratory object and wherein the data migratory object fills the reference object cache from a database of the database and storage layer.
4. The system of claim 1, wherein the transactional in-memory object store includes a transient object store and wherein the transient object store includes temporary objects used only by the transactional in-memory object store.
5. The system of claim 4, wherein the temporary objects include active-session objects.
6. The system of claim 5, wherein the temporary objects further include resource-reservation objects.
7. A method for managing revenue from services of a communication network, the method comprising:
 - receiving at a gateway layer of a revenue management system a request related to a communication on the communications network, the revenue management system performing convergent charging for telecommunication services for each of prepaid, postpaid, and now-pay user accounts;
 - performing by the gateway layer of the revenue management system authentication of the request and authorization for services to support the communication based on the request;
 - converting the request to an event data record by the gateway layer of the revenue management system;
 - forwarding the event data record from the gateway layer of the revenue management system based on the services authorized and a type of the request;
 - receiving the event data record at a transactional in-memory object store from the gateway layer, wherein a revenue capture layer includes the transactional in-memory object store

including a read-only reference object cache of data objects from the database and storage layer;
and

routing the event data record to the transactional in-memory object store or the database and storage layer by the transactional in-memory object store by the revenue capture layer depending upon the type of the request and a configurable directory server consulted, wherein routing the event data record comprises routing real-time requests to the transactional in-memory object store and routing non-real-time requests to the database and storage layer, wherein the reference object cache comprises customer account records used for read-only reference during processing of the real-time requests, wherein the real-time requests comprise authentication and authorization requests, and wherein non-real-time requests comprise batch rating and billing requests.

8. The method of claim 7, wherein the transactional in-memory object store includes a reference object cache of database objects from the database and storage layer.

9. The method of claim 7, wherein the transactional in-memory object store includes a data migratory object and wherein the data migratory object fills the reference object cache from a database of the database and storage layer.

10. The method of claim 7, wherein the transactional in-memory object store includes a transient object store and wherein the transient object store includes temporary objects used only by the transactional in-memory object store.

11. The method of claim 10, wherein the temporary objects include active-session objects.

12. The method of claim 11, wherein the temporary objects further include resource-reservation objects.

Figure 1—

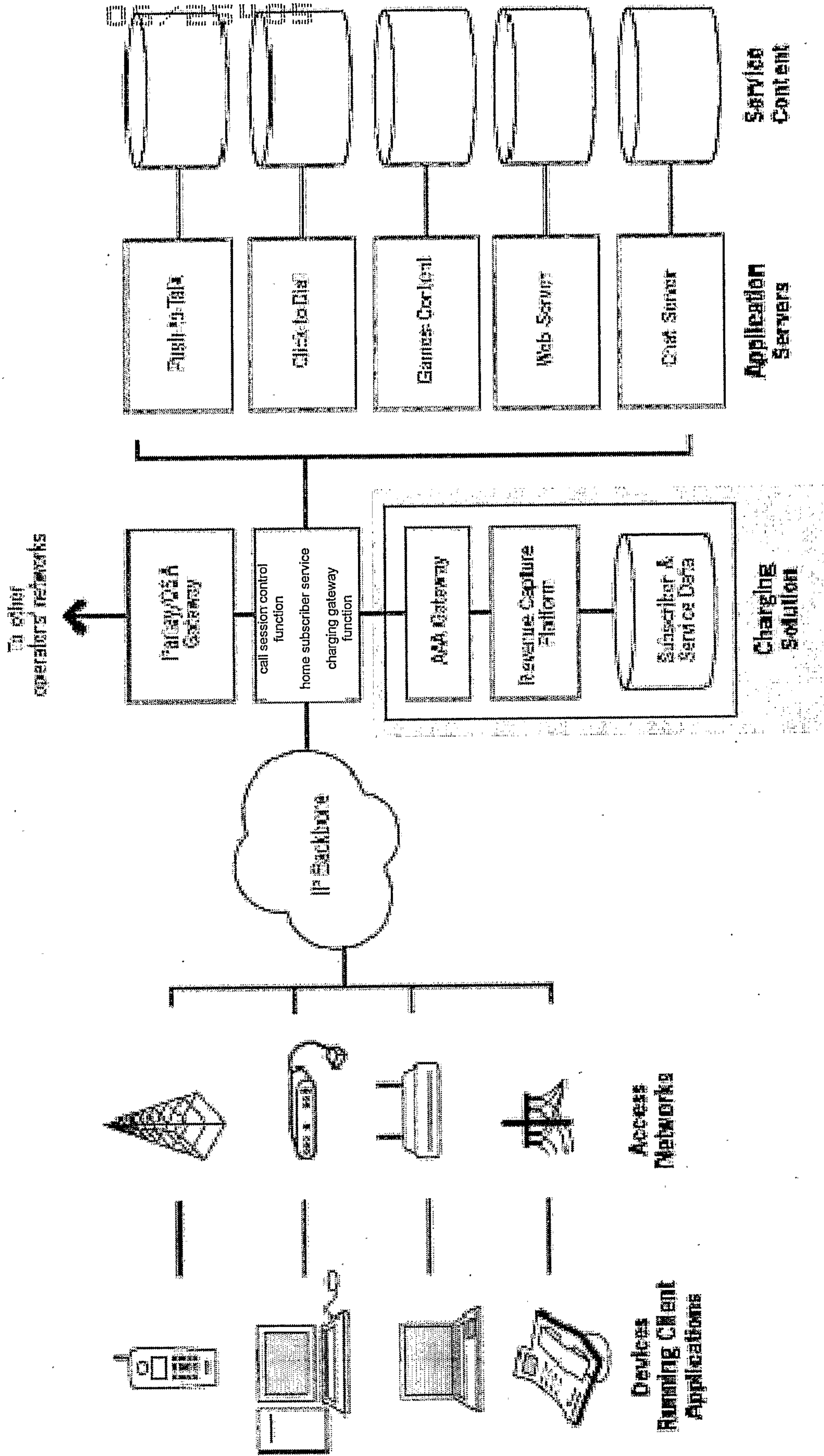
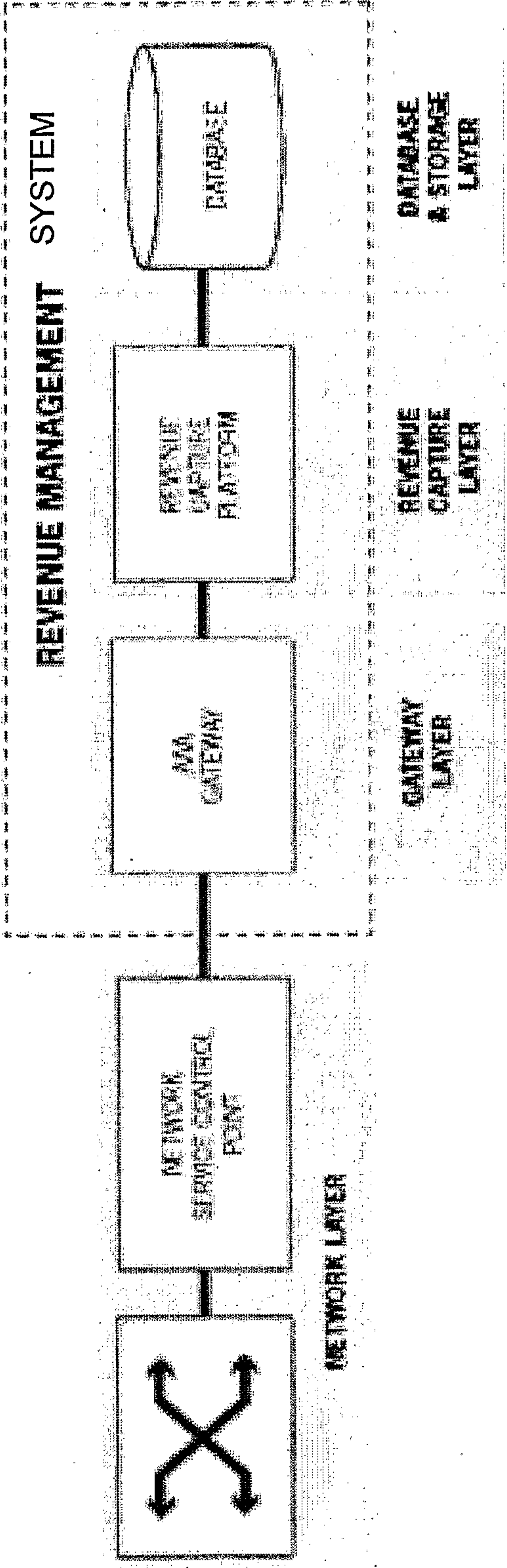


Figure 2



3/6

Figure 3

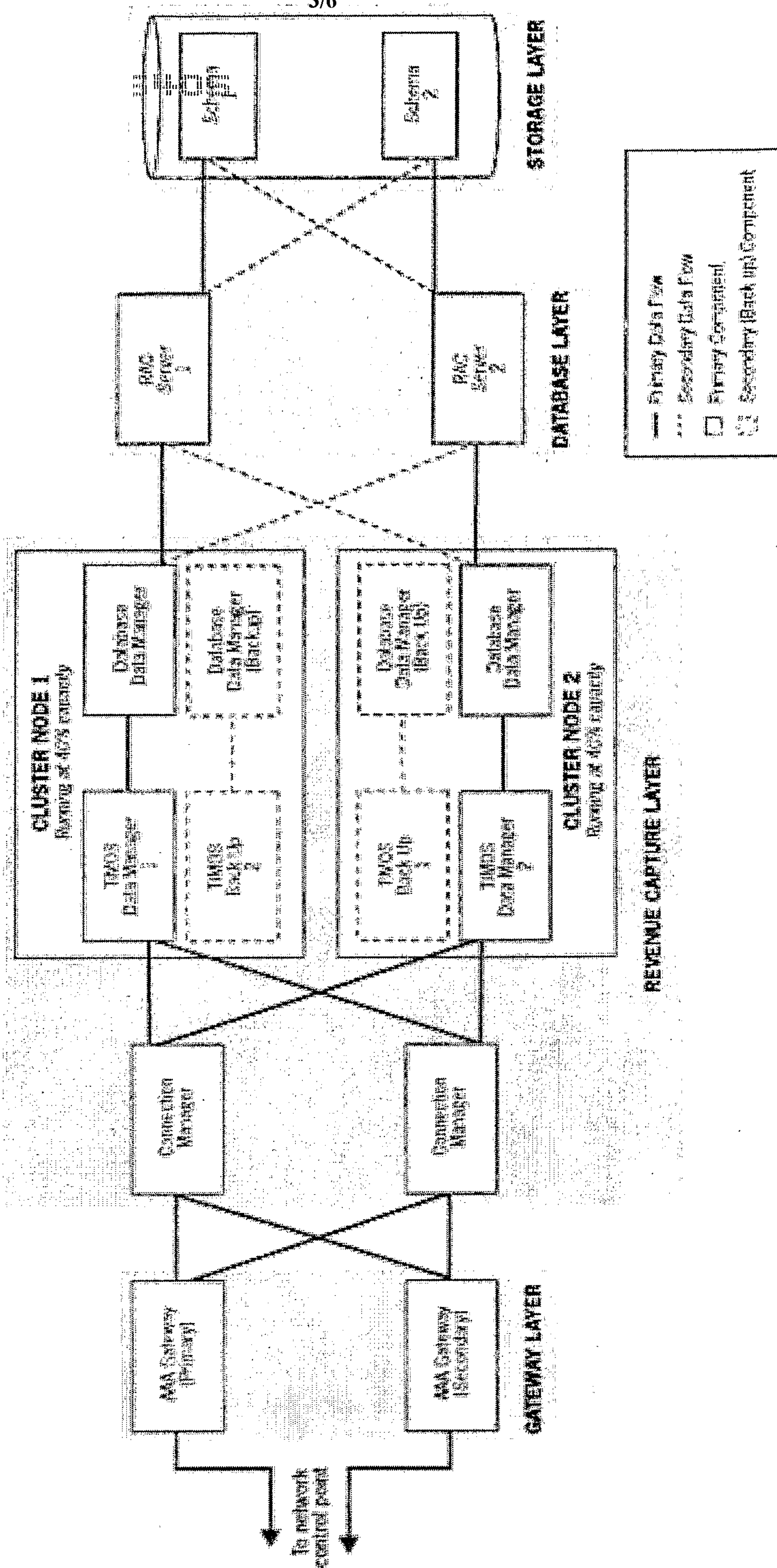


Figure 4

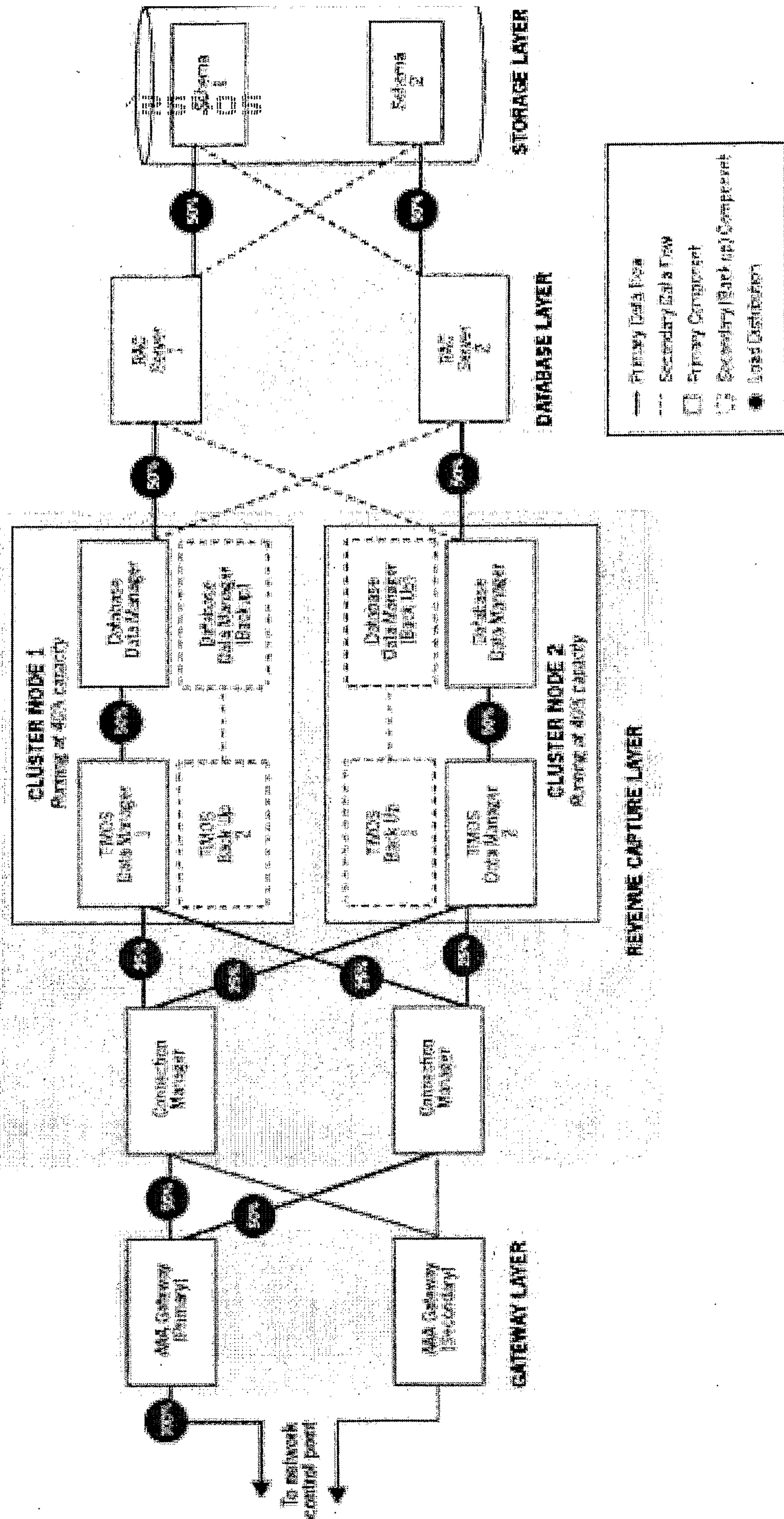


Figure 5

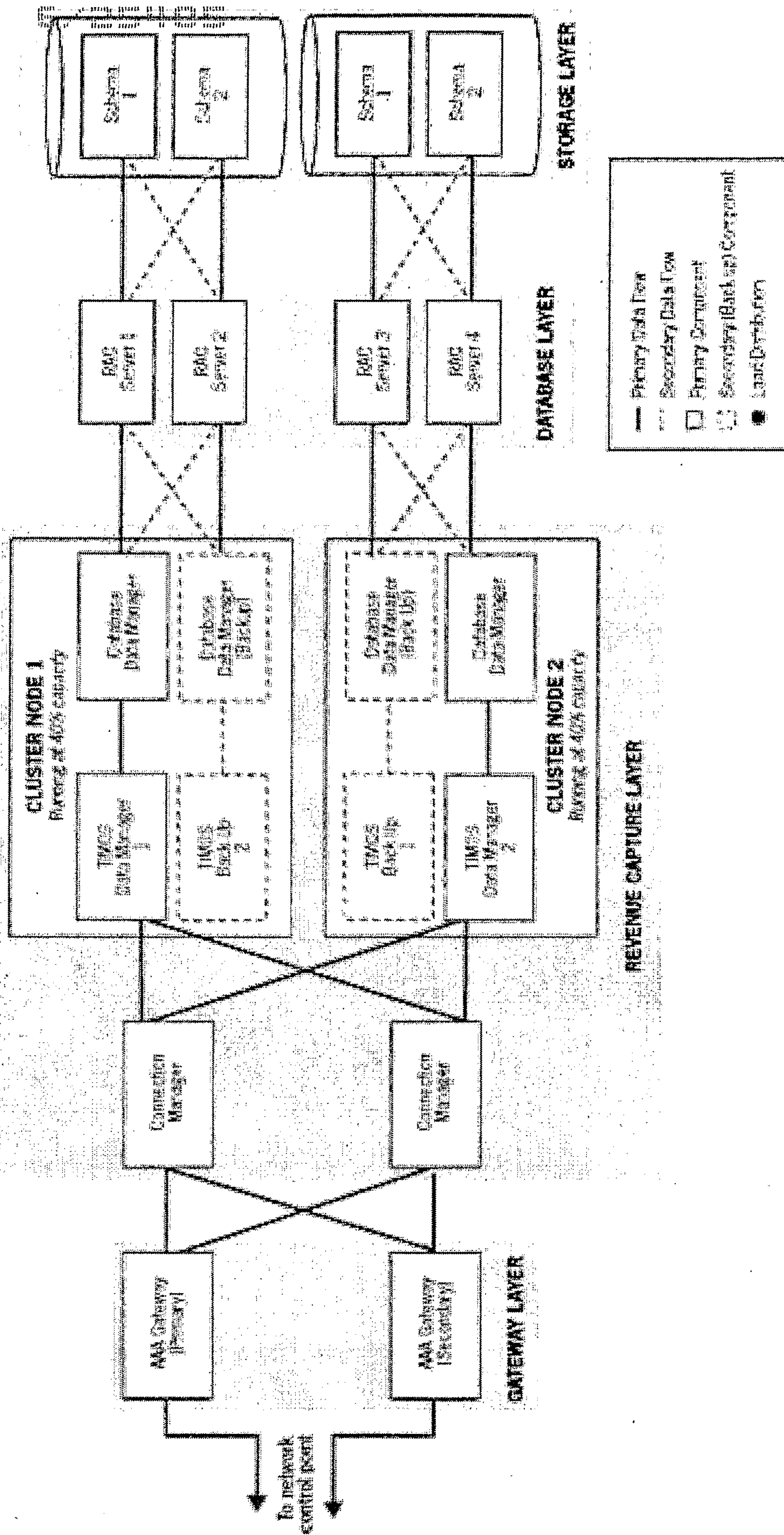


Figure 6

