WHITE PAPER

The Business Case for an Integrated Policy and Charging Control (PCC) Solution in the Multimedia Core

MANAGEMENT CONSULTANTS TO THE NETWORKING INDUSTRY

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Network Strategy Partners, LLC (NSP)

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Executive Summary

Mobile broadband is the fastest growing telecommunications market, however, mobile broadband revenue is lagging behind traffic growth and creating a profitability squeeze. This is caused by new billing models combined with new devices and new technologies.

Policy management addresses this challenge of traffic growth while enabling real-time charging rules to implement differentiated pricing strategies that precisely match service delivery to the subscriber's willingness to pay. Fair usage policies help manage network infrastructure costs and ensure balanced performance at any given time. Differentiated pricing strategies also regulate network usage and simultaneously increase revenue by providing individual subscribers with financial incentives to use only the services that they value.

Policy and Charging Control (PCC) used with 3GPP, 3GPP2/CDMA and 4G architectures provides a vehicle for delivering the needed policy management functions. It supports three forms of policy management: network resource management, personalization and new revenue creation.

Network resource management prioritizes and controls traffic through network based traffic optimization. Personalization services support service offerings that meet the individual needs of subscribers while maximizing the value of network assets. New revenue creation can be achieved, for example, by offering an upgrade option to the quality of service for an individual subscriber based on the application they are running. Where operators are subjected to network neutrality or equal access regulations, Policy and Charging Control enables them to offer these types of tiered services packages to help regulate network usage and increase revenue.

The total cost of ownership (TCO) of two PCC architectures is compared over a five-year period for a typical 3GPP mobile application using a TCO modeling tool. The TCO modeling tool also supports modeling of 3GPP2/CDMA and 4G architectures. The PCC architectures are:

- Integrated PCC – The Gateway GPRS Support Node (GGSN) and Policy Control Enforcement Function (PCEF) are provided as a single integrated system. Charging and Deep Packet Inspection (DPI) functions are also integrated into the GGSN.
- Multi-chassis PCC – IP networking is used to interconnect three separate systems as well as the line and processor cards within the systems. The systems are GGSN, Charging System, and standalone DPI. Policy Control Enforcement function is integrated into the GGSN.

<u>The analysis finds that the TCO for a system serving one million concurrent subscribers is 17% less for the integrated PCC architecture than that of the multi-chassis PCC architecture. Total operations expense is 38% less than the integrated PCC architecture</u>. The largest savings are found in:

- Network Care
- Policy Development and Support
- Training
- O&M Consultancy

The integrated PCC architecture yields these savings by eliminating the complexity associated with managing the many redundant logical data flows of the multi-chassis architecture as well as that derived from the need to configure, manage and maintain multiple systems.

The integrated PCC architecture also provides significant investment leverage to add capabilities that generate incremental revenue. Four incremental revenue initiatives are examined as an example in a deployment to 1.5 million subscribers. They are:

1. Eliminate overbilling
2. Provide tiered pricing
3. Sell advertizing inserts into mobile data services
4. Offer parental controls

They produce a total of $300 million in incremental revenue where the required investment in the necessary service delivery capabilities is $4 million. The investment cost in the service delivery capabilities is kept low because the integrated PCC architecture allows the capabilities to be shared across multiple revenue opportunities.

Introduction

Mobile broadband is the fastest growing telecommunications market. Mobile broadband traffic is expected to grow by as much as 35 times its current volume over the next five years. However, revenue derived from mobile broadband services is expected to grow at about a quarter of this rate while total wireless revenue has dropped from double digit growth rates to slightly below 10%. Fundamental drivers for underlying rapid traffic growth coupled with much slower revenue growth include:

- Mobile broadband technologies such as HSPA and LTE
- Consumer friendly (flat rate) billing plans
- True mobile multimedia devices with intelligent applications

Better broadband technologies, including HSPA and LTE, coupled with Smartphones, such as the Apple iPhone, Droid, Palm Pre, and Nokia Nseries, are enabling the explosion in mobile broadband traffic while new billing plans with incremental pricing at or close to zero add further demand side stimulus.

Policy management is designed to address the challenge of traffic growth while enabling real-time charging rules used to implement differentiated pricing strategies that precisely match service delivery to the value of the service. Traffic managed through fair usage policies help manage network infrastructure costs and ensure balanced performance. Differentiated pricing strategies regulate network usage and simultaneously increase revenue by providing individual subscribers with financial incentives to use only the services that they value.

Policy and Charging Control used with 3GPP, 3GPP2/CDMA and 4G architectures provides a vehicle for delivering the needed policy management functions. It supports three forms of policy management.

- Network Resource Management – Traffic can be prioritized to meet customer service expectations and SLAs. Network resource management also can be used to manage capacity growth through network based traffic optimization. This assures efficient use of expensive radio access network resources and scarce spectrum.

  Examples of resource management include traffic optimization with real-time adjustments of allowance caps based on network congestion levels and fair usage policies that track and enforce compliance of usage and allowance caps.

- Personalization Services – The value of network assets can be maximized by offering services that meet the individual needs of subscribers. Services such as automated usage notifications give subscribers more control over their services and provide opportunities to top up or upgrade service when they have reached their limit. This improves customer satisfaction and reduces churn.

- New Revenue Creation and Monetization – The ability to dynamically change the quality of service (QoS) for an individual subscriber creates incremental revenue and monetization opportunities. For example, sports fans would pay extra to increase video bandwidth of a controversial play or to view the highlights of a big game. As another example, lower rates could be offered to subscribers when they use their mobile device at home or in their office.

This creates additional revenue because it provides an incentive to use the mobile device rather than a wireline alternative.

Policy and Charging Control is particularly valuable in countries where operators are subject to network neutrality or equal access regulations because it enables the creation of differentiated services and tiered pricing plans allowing users the option to upgrade to a higher quality of service for a particular fee as an example.

The TCO of two architectures—integrated PCC and multi-chassis PCC—for implementing PCC is analyzed. In addition an example is presented to show investment leverage provided by the integrated PCC architecture to generate incremental revenue. In the example four incremental revenue opportunities are examined.

1. Eliminate overbilling
2. Provide tiered pricing
3. Sell advertizing inserts into mobile data services
4. Offer parental controls

Functions being modeled include:

GGSN: Gateway GPRS Support Node is responsible for interworking between GPRS network and external switched networks such as the internet. This could also be a 3GPP2/CDMA or 4G element.

DPI: Deep Packet Inspection is the ability to analyze and understand what a data packet contains, what sort of application or service it belongs to. It has layer 4-7 visibility.

PCEF: Policy and Charging Enforcement Function is responsible for enforcing policies with respect to authentication of subscribers, authorization to access services, accounting and mobility.

Charging System: Leveraging DPI, the Charging System interacts with external rating and charging systems as well as policy control subsystems to bill subscribers based on time, volume, content, event and transaction type.

Integrated PCC

The Gateway GPRS Support Node, Policy Control Enforcement Function, Charging System and DPI functions are provided as a single integrated system.

Pros

Potential advantages of the integrated architecture include:

- Efficiency derived from opening each packet once to perform multiple services
- Higher reliability due to elimination of complexity and reduction of points of failure with one carrier-grade platform
- Lower operating cost and total cost of ownership as analyzed in this paper

Cons

Potential disadvantages of the integrated architecture include:

- Performance can be degraded by integrating more functionality into a single system than the underlying processing engines can handle
- It can be difficult to introduce an integrated architecture without altering existing mobile core elements

Multi-Chassis PCC

This architecture uses IP networking to interconnect three separate systems as well as the line and processor cards within the systems. The chassis are:

a. GGSN – GGSN function is implemented as a series of processor blades in an IP Switch/Router chassis

b. Charging System – The charging system is implemented in a server based system.

c. Standalone DPI – A standalone system embodying DPI capabilities relays policy enforcement information back to the GGSN for actual enforcement.

Pros

- CapEx of the multi-chassis architecture is lower because it uses mature IP routing technology as the foundation of the design
- High modularity and flexibility because interoperability employs industry standard IP networking

Cons

- Increased complexity due to the need to interconnect blades within chassis and among chassis to assure interworking of all mobile core functions
- Reduced efficiency due to redundant tasks performed by separate network elements
- Reduced architectural reliability due to more points of failure (chassis, interfaces, ports and blades)
- Bearer latency due to multiple hops and processing of the packet by GGSN, DPI platform and the Charging system.

The following sections provide a total cost of ownership analysis of the integrated PCC architecture versus the multi-chassis PCC architecture

Total Cost of Ownership Model

An engineering model is used to calculate the TCO of the integrated and multi-chassis PCC architectures. The model is available for use by Cisco's customers. Figure 1 describes the TCO modeling process.

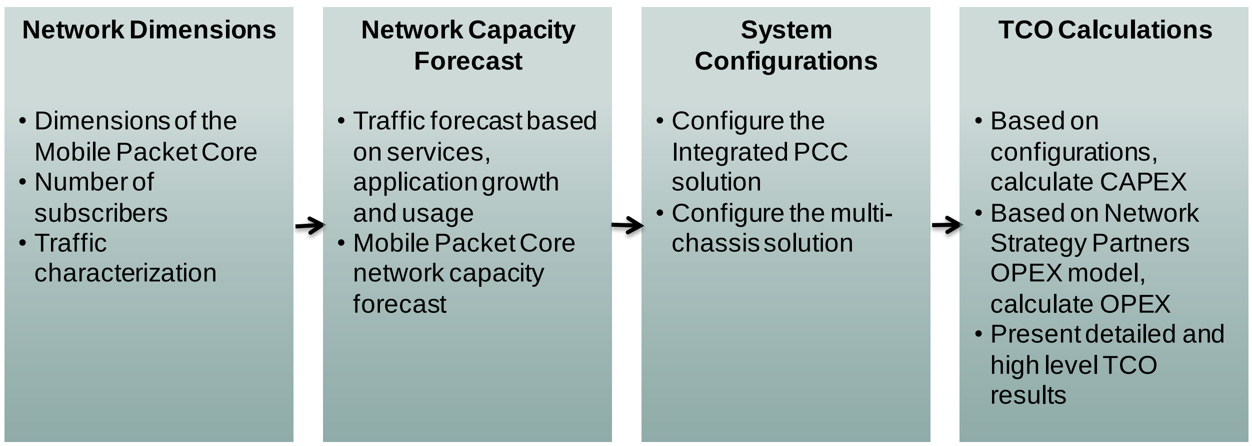

Figure 1. TCO Modeling Process

TCO is modeled in four steps. First the network is dimensioned in terms of its topology, number of subscribers and traffic characteristics such as downlink and uplink data rates and the number of flows per active subscriber. This data then is used to project network capacity requirements such as Transactions Per Second (TPS) and bandwidth requirements for communications links. In Step 3 each network element is configured by determining how many processors, line cards and chassis are required. Finally CAPEX is determined by applying average selling price (includes discount) to each network chassis, i/o card, and processor and OPEX is computed using an operations expense model developed by Network Strategy Partners.

Table 1 shows the network dimensioning used by this TCO analysis.

NETWORK PROFILE	AMOUNT
Total subscribers base	3,703,704
Percentage of concurrent subscribers	27%
Real prepaid percentage	9%

SUBSCRIBER TRAFFIC PROFILE	AMOUNT
Subscriber average throughput (bps)	5,877
Avg. Uplink Data Rate (kbps/session)	0.88
Avg. Downlink Data Rate (kbps/session)	5.00
Average flows per user	5
Average packet size (bytes)	559

TOTAL SUBSCRIBERS	AMOUNT
Total concurrent subscribers	1,000,000
Total concurrent prepaid subscribers	90,000
Total concurrent postpaid subscribers	910,000

Table 1. Network Dimensioning

The model network has 3,703,704 subscribers with 27% concurrency which results in one million concurrent subscribers. The average downlink data rate is 5 Kbps over a session of 6,500 seconds (1.8 hours). Note that the downlink data rate may seem low, however, the average data rate over the session recognizes that during most of the session the mobile device will not be in use and that even during active use the subscriber will spend much more time entering data or reading the screen than actually downloading data. This average data rate is consistent with a maximum download data rate of 4.5 Mbps for an HSPA cell site at its 50% coverage point with maximum loading.

The network dimensioning also has 90,000 concurrent prepaid and 910,000 concurrent postpaid subscribers.

Table 2 shows the forecast of network capacity requirements.

TRAFFIC DISTRIBUTION	AMOUNT
Total TPS	847
Total Flows	5,000,000
Total throughput (Gbps)	5
Total packet processed (Mpps)	1314

Table 2. Network Capacity Forecast

Integrated PCC Architecture

Figure 2 shows the physical configuration of the integrated PCC architecture and Figure 3 shows its logical data flows.

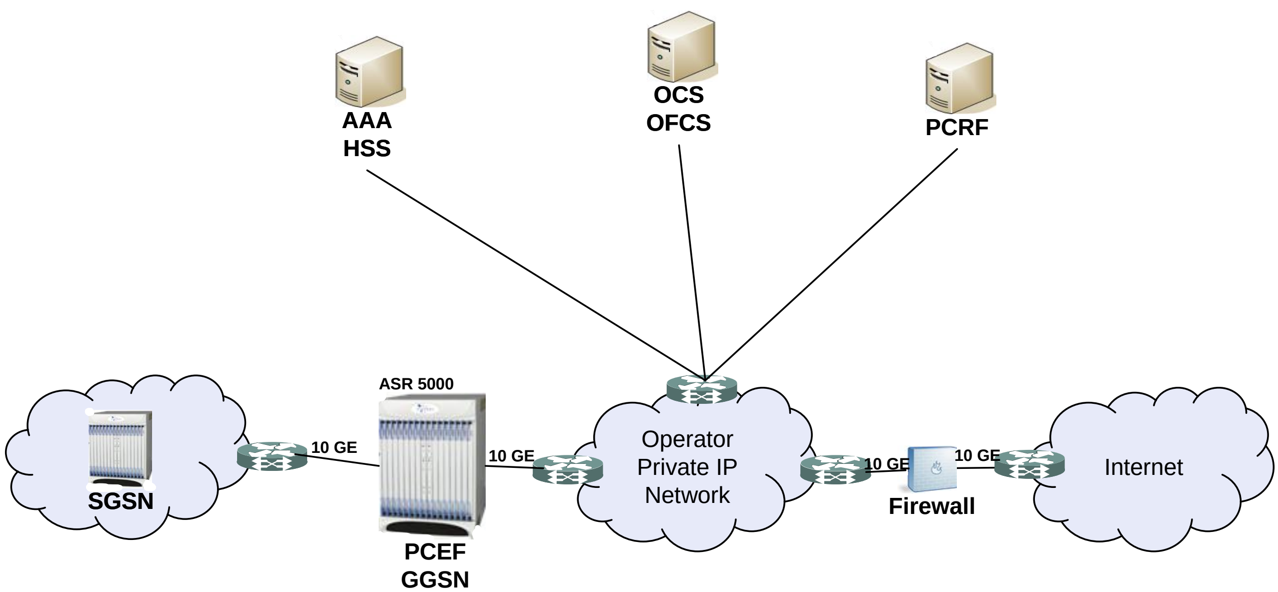

Figure 2. Physical Configuration for Integrated PCC Architecture

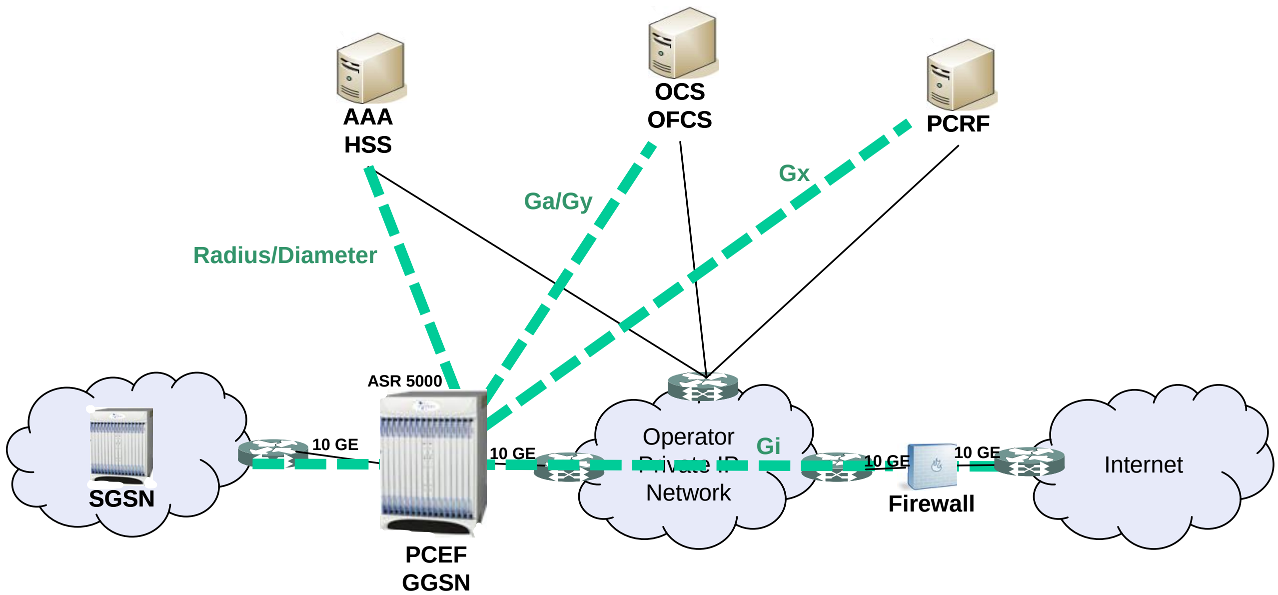

Figure 3. Logical Data Flows for Integrated Architecture

Cisco provides an integrated PCC architecture using DPI and In-Line Services, which integrate services or applications into the bearer traffic plane at the mobile gateway. Services are enabled through a simple license key, ensuring mobile gateway functions are not impacted. Deep Packet Inspection with In-Line Services reduce the cost of the network as they simplify the network through integrated functions and services, simpler manageability and control, fewer points of configuration, and provide consolidated accounting and billing. This technology provides the ability to not only detect appropriate traffic from Layer 3 through 7 through shallow and deep packet inspection, but also provides the enforcement function (PCEF) of the subscriber management solution, including:

- Application-aware multi-flow Quality of Service
- Traffic classification and content service steering
- Traffic performance optimization
- Personalized service plans
- Application detection/optimization
- Intelligent volume/time-based billing

A key part of the PCEF function is Cisco's suite of In-line Services that improves the subscriber experience and network services, including:

- **Enhanced traffic monitoring, metering, and charging** – provides subscriber and application aware billing/reporting, CDR generation, and quota metering based on how mobile subscribers utilize their devices through deep-packet inspection of data
- **Application detection and optimization** – detects specific applications and allows the network to appropriately manage those applications, e.g., peer-to-peer

- **Network-based traffic optimization** – optimizes sessions or flows and provides quality of service based on parameters such as volume, usage, time-of-day, and traffic type, e.g., increasing or restricting bandwidth based on service policies
- **Stateful firewall** – protects subscribers from external attacks and spurious packets, in particular from attacks coming from other subscribers that would be difficult to prevent from any other network location.
- **Content filtering** – provides static and dynamic content analysis plus controls access to defined content allowing services such as parental controls and blacklisting

Multi-Chassis PCC Architecture

Figure 4 shows the physical configuration of the multi-chassis PCC architecture while Figure 5 shows its logical data flows.

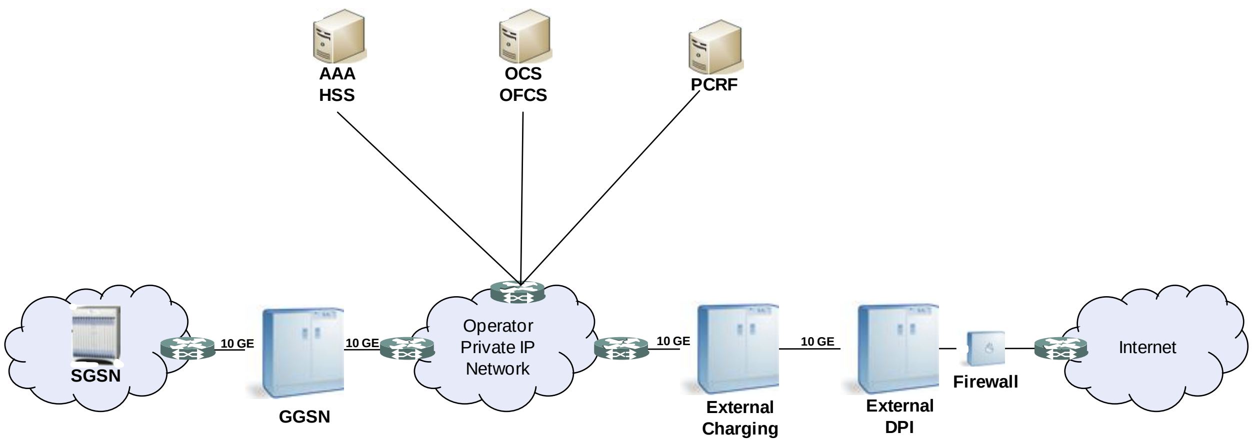

Figure 4. Physical Configuration for Multi-Chassis PCC Architecture

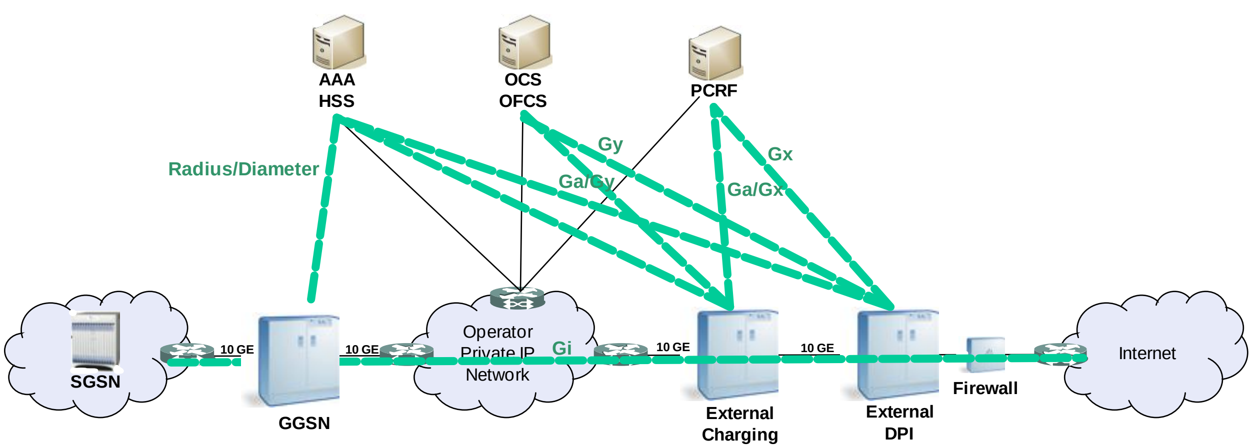

Figure 5. Logical Data Flows for Multi-Chassis PCC Architecture

The multi-chassis PCC architecture is built upon an open switching and IP routing platform that provides an intelligent enforcement layer within the Operator Private IP Network. It is interoperable with RAN, AAA, content billing, and content filtering and compression solutions. It provides three primary functions—access and service control, easy mobility, and deep packet inspection. The multi-chassis PCC architecture used in the TCO analysis consists of three network elements:

GGSN

The GGSN function is implemented using a leading IP router-based design. It does not use charging or DPI software loads.

Charging

The charging function is implemented using server technology with 10GE line cards. Its features include:

- Fine level of detail in content measurement – meters data traffic and generates accounting records at the content level
- Real-time prepaid billing support – meters subscriber usage so that the subscriber cannot exceed the balance allocated by the billing system
- Specific user-awareness capability – identifies users by their IP addresses and correlates this with a user ID that is obtained from the AAA RADIUS flows or from an external database

DPI

Deep Packet Inspection supported functions are delivered through a standalone DPI system supporting application and subscriber-level awareness for mobile data networks, offering traffic optimization, incremental service security, tiered services, and premium IP service delivery. The system includes 10GE interfaces to the Operator Private IP Network.

TCO Results

Figure 6 compares the TCO of the integrated PCC architecture with that of the multi-chassis PCC architecture as estimated by the TCO model.

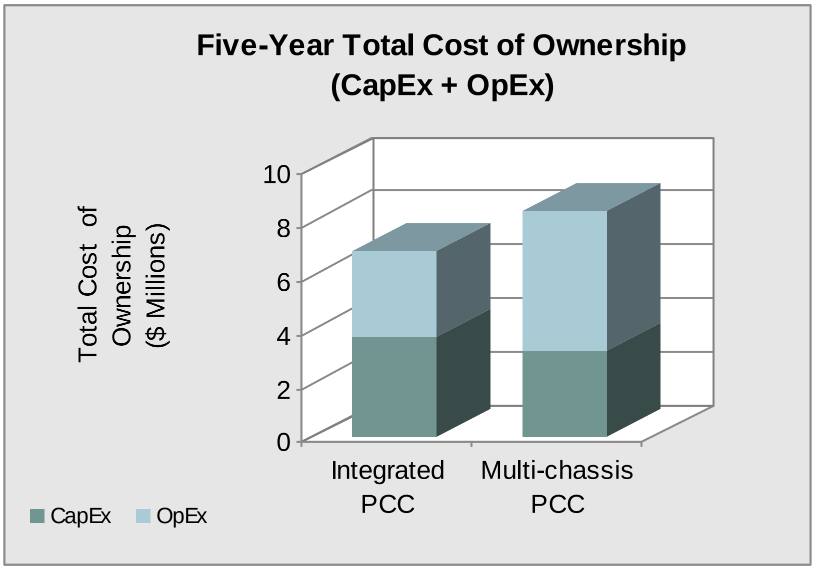

Figure 6. TCO of Integrated PCC vs. Multi-Chassis PCC architecture

The TCO of the integrated PCC architecture is $6.9 million while that of the multi-chassis PCC architecture is $8.4 million. This is a 17% TCO savings for the integrated PCC as compared to the multi-chassis PCC architecture. CapEx for the integrated PCC architecture is 15% higher than that of the multi-chassis PCC architecture while its OpEx is 38% lower. The large OpEx advantage of the integrated PCC architecture is primarily due to the reduced complexity of the integrated PCC architecture as compared to the multi-chassis PCC architecture. As mobile operators reduce their CapEx budgets the integrated PCC architecture's OpEx advantage will create an even larger TCO differential for the integrated PCC architecture as compared to the multi-chassis PCC architecture.

Figure 7 compares OpEx for the two architectures. (The Appendix provides definitions for each OpEx category.)

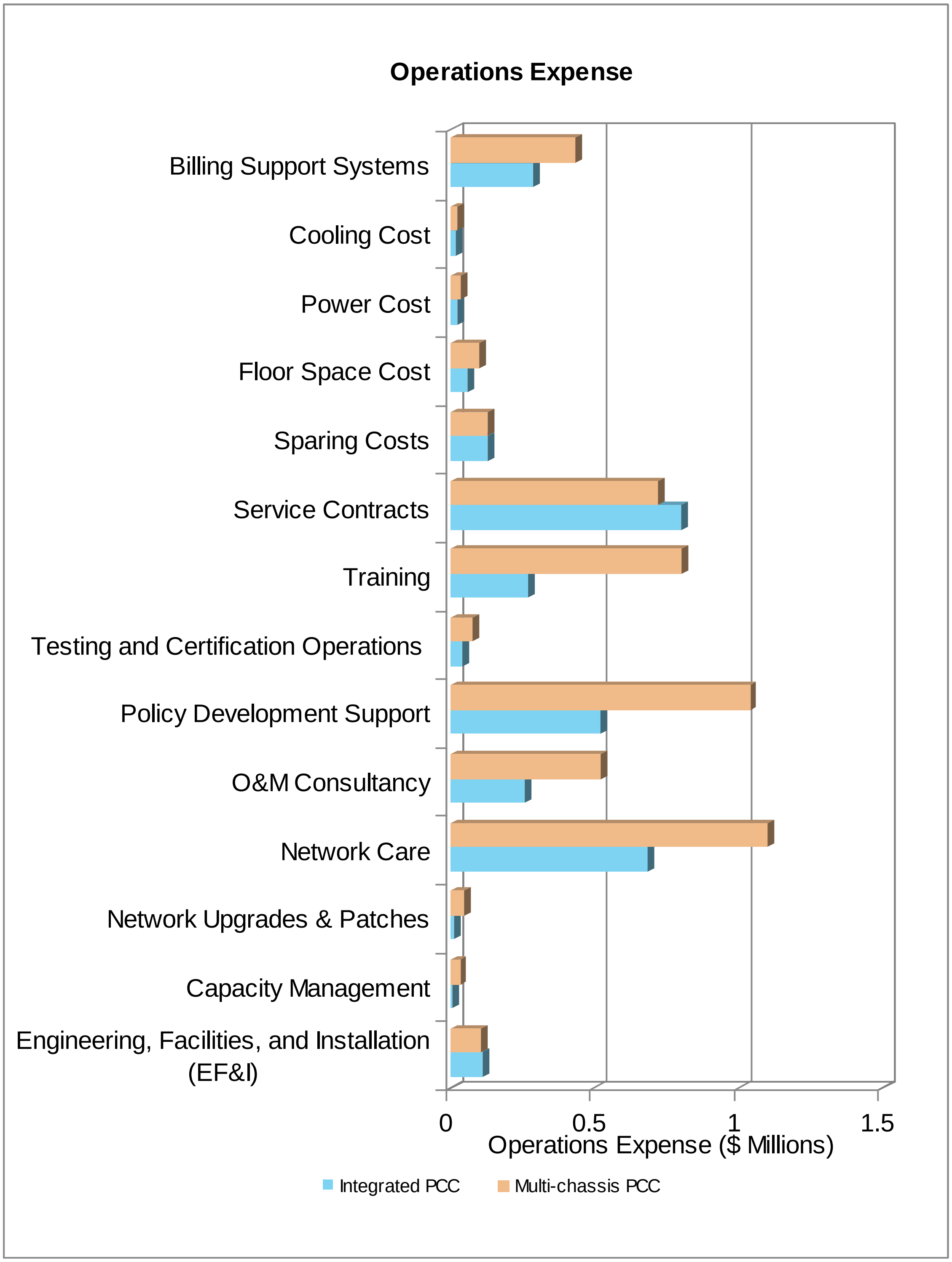

Figure 7. OpEx of Integrated PCC vs. Multi-Chassis PCC architecture

The integrated PCC architecture has significant OpEx advantages over the multi-chassis PCC architecture in the Network Care, Policy Development Support, Training, and O&M Consultancy operations expense categories. These four OpEx categories are examined in more detail in the following paragraphs.

Training Expense

Training expense includes the hours expended by operator staff to attend training on each system as well as fees charged by systems vendor(s) to deliver training classes. Training expense is 67% less for the integrated PCC architecture as compared to the multi-chassis PCC architecture. The cost is less for the integrated architecture because all training is done once for the integrated architecture versus separate training that is required for each multi-chassis architecture network element.

Policy Development Support Expense

Policy development support expense is the cost of support expenses billed by the systems vendor(s) to help establish the system policies. Most of this expense is incurred during the first year of operations, however, policy changes in subsequent years also will incur support expenses. It is 100% higher for the multi-chassis PCC architecture as for the integrated PCC architecture because many policy development tasks must be performed in duplicate to develop policies for the GGSN and for the combination of the Charging and standalone DPI systems. Different personnel may also be needed due to the technical differences among the three chassis used in the multi-chassis PCC architecture.

Network Care Expense

Network care expense includes the costs of provisioning, surveillance, monitoring, data collection, maintenance and fault isolation for all network elements. It is 38% less for the integrated PCC architecture than for the multi-chassis PCC architecture. The integrated architecture delivers lower cost network care because it is less complex than the multi-chassis architecture and because there are fewer network elements under management. The cost of complexity is explored further below.

O&M Consultancy Expense

Operations and maintenance consultancy expense is a fee charged by the system vendor(s) during the first year of operations to provide consultancy services to integrate the PCC solution with existing OSS and billing systems. It is 100% higher for the multi-chassis architecture as for the integrated architecture because these services must be done twice—once for the GGSN and a second time for the charging and standalone DPI combination of systems.

Operations Expenses Driven by the Number of Chassis Under Management

Capacity management, network upgrades and patches, network care, and environmental expenses (power, cooling, and floor space) are all driven by the number of chassis under management. In this study the mobile core is consolidated so that there is only one chassis of each type. All these expense categories become more important as multiple sites are added to the mobile core network. This clearly favors the integrated architecture since it employs only one chassis at each site versus three chassis for the multi-chassis architecture.

The integrated architecture has 40% less environmental expense as compared to the multi-chassis architecture. This is a direct consequence of its integrated design and savings will increase in overall importance as the number of sites increases.

The Cost of Complexity

The activities that underlie these operations expense categories include configuring, maintaining and operating the software applications used to provide the PCC functions. OpEx is higher due to the complexity of managing the logical data flows of the multi-chassis PCC architecture as compared to the integrated PCC architecture—compare Figure 3 with Figure 5. The integrated PCC architecture also enjoys an operations expense advantage for most expense categories due to its use of a single chassis—many activities must be repeated for each chassis.

The complexity of the multi-chassis architecture is compounded as the network scale increases. At higher scale multiple charging and DPI chassis, as well as load balancers are required to perform each function. Since services are deployed serially, each subscriber session will run sequentially through each server cluster whether or not the service is applied to that subscriber. As a result, the operator has to overprovision hardware and software for each service in order to deploy enough bandwidth for all sessions to flow through each application as well as the load balancers to manage the traffic. Figure 8 is an illustration of this type of architecture.

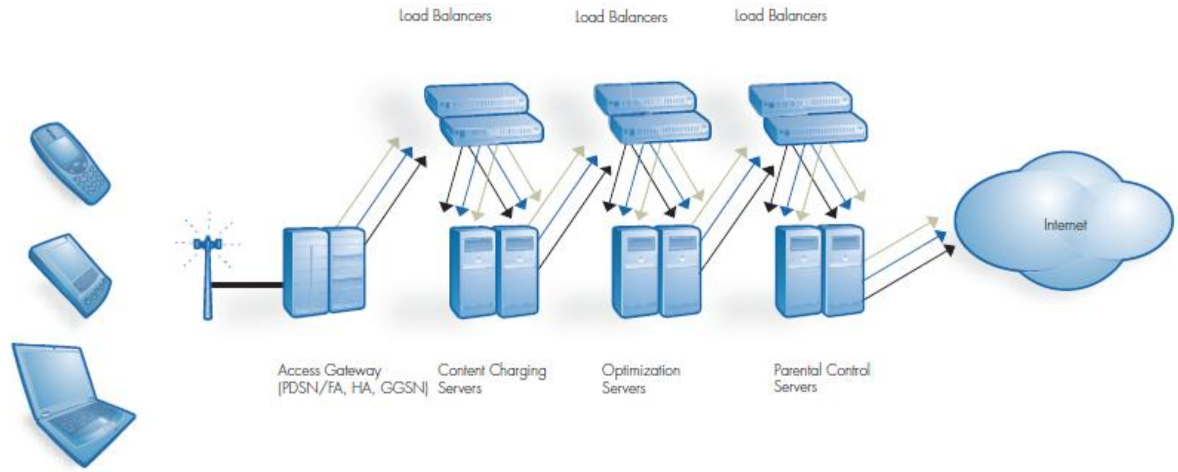

Figure 8. Load Balancers with Multi-chassis architecture

The integrated PCC architecture reduces complexity and therefore operations expense in many ways:

- No specific functional cards—simplifies upgrades
- Distributed resources across the entire system—maximize network resources and simplifies capacity management
- Easy to maintain
    - Managed from a single IP address
    - Built-in protocol monitor
    - Real-time diagnostics

    - Single command line to activate new card
- Simplify network through integrated functions and services
    - Simpler manageability
    - Fewer points of configuration
    - Consolidated accounting and billing
    - Integrated network policy enforcement for increased network efficiency

The multi-chassis architecture incurs higher operations expense due to the inherent complexity of managing multiple chassis and redundant logical data flows among support systems. In particular, its bladed architecture requires complex provisioning of logical connections between cards as well as platforms. Multiple days are required to add a card, configure and wire a bladed platform. In addition, five days of service provider planning is needed to support the detailed configuration and installation work.

Incremental Revenue Opportunities

The integrated PCC architecture supports many incremental revenue opportunities because functionality such as enhanced charging, policy control, content filtering and ad insertion are provided on a single platform. Support for tiered pricing plans and content specific packages such as sports, music downloads or gaming packages provide substantial revenue increases as compared to single price flat rate billing plans. Policy control, content filtering and ad insertion capabilities produce additional revenue through sale of advertising and parental control features. In addition enhanced charging can be used to increase net revenue by eliminating refunds caused by billing mistakes.

The next several paragraphs analyze the incremental revenue opportunities for four initiatives:

1. Eliminate overbilling
2. Provide tiered pricing
3. Sell advertizing inserts into mobile data services
4. Offer parental controls

Return on investment (ROI) then is analyzed showing the investment leverage created by use of integrated PCC.

Eliminate Overbilling

Overbilling can be eliminated by using Enhanced Charging Services (ECS). In this example Blackberry subscribers were being overbilled because billing data was not being accurately rated. 10% of the Blackberry subscribers were making service calls seeking refunds for overbilling each month. The cost of each service call is $10 and the average refund was $7 . Table 3 shows the annual savings that result from a subscriber base of 1.5 million when ECS is used to eliminate billing mistakes.

ITEM	AMOUNT
Total subscriber base	1,500,000
Percent subscribers with data service	35%
Total data service subscribers	525,000
Percent data service subscribers with Blackberry	30%
Total Blackberry subscribers	157,500
Percent of Blackberry subscribers who make service call	10%
Number of service calls per month	15,750
Average cost of service call	$10.00
Average refund	$7.00
Monthly cost of service calls	$157,500
Monthly cost of refunds	$110,250
Annual savings by eliminating overbilling	$3,213,000

Table 3. Overbilling Example

This example shows that $3,213,000 per year is saved by eliminating overbilling. Equally important subscriber satisfaction is increased by eliminating billing mistakes. The Enhanced Charging Service software package is required to improve billing accuracy. The ROI analysis at the end of this section demonstrates the very substantial investment leverage that is achieved in the integrated PCC architecture by sharing ECS and other revenue generating capabilities across multiple revenue opportunities.

Tiered Pricing

Tiered pricing whether tiers are defined by a tiered series of monthly usage caps or by offering specific content for a flat monthly fee produces a significant revenue boost as compared to a single price for flat rate service. Figure 9 illustrates the economic concept underlying tiered pricing plans.

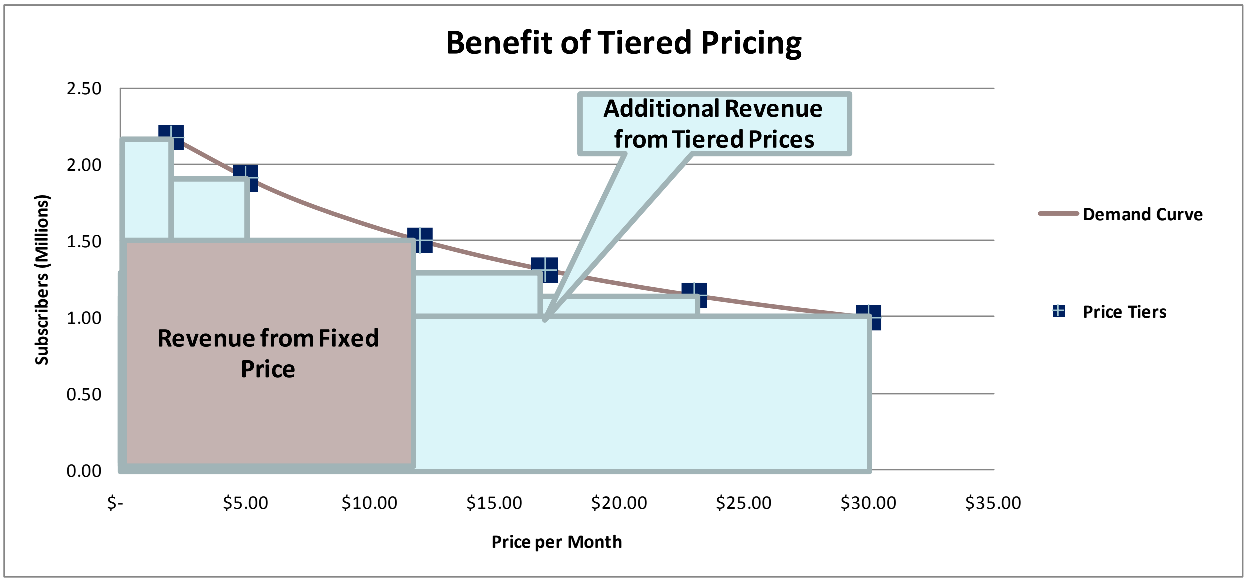

Figure 9. Tiered Pricing Example

The figure shows an example demand curve with the expected pattern that as prices increase the number of subscribers decline. In this example a single price flat rate plan with a $12/month price attracts 1.5 million subscribers and produces revenue of $18 million per month (The area of the rectangle shown in the figure.) However, the demand curve shows that many subscribers are willing to pay more than $12/month for the service—the area under the demand curve and to the right of $12/month. This is premium revenue that can be captured through premium pricing plans. On the other hand the demand curve also shows that some additional subscribers would subscribe to the service if it were priced under $12/month—this is the area under the demand curve, above the fixed price revenue box and to the left of $12/month. This is discount revenue that can be captured through discounting plans. The figure shows a tiered pricing scheme with two discounted price points and three premium price points. The sum of the areas of the rectangles shaded in blue on the diagram is equal to the additional revenue that can be captured through the tiered pricing plan with these additional price points.

Table 4 shows a tiered pricing plan with two discount levels and three premium pricing levels.

PRICE TIER	LEVEL 2 DISCOUNT	LEVEL 1 DISCOUNT	SINGLE PRICE (NO TIERS)	LEVEL 1 PREMIUM	LEVEL 2 PREMIUM
PRICE	$2.00	$5.00	$12.00	$17.00	$23.00

Table 4. Tiered Pricing Plan (Monthly Prices)

The plan's additional revenue is $22.9 million per month which increases total revenue to $40.9 million per month. Also the lowest discounted price increases total subscribers from 1.5 million to 2.2 million. At the same time ARPU (Average Revenue Per User) increases by $6.85 per month.

PCRF (Policy Control and Rules Function) and Enhanced Charging Service software capabilities are required to implement tiered pricing. Within the integrated PCC solution the cost of this software is shared by other revenue enhancement initiatives.

Advertising

The addition of advertising banners to mobile data applications such as SMS, Web Browsing and Apps provides an additional source of revenue to service providers. Table 5 provides an example of its revenue potential.

ITEM	SMS Based	Web Browsing	Application Based
Total subscriber base	1,500,000	1,500,000	1,500,000
Percent of subscribers who receive marketing messages	10%	35%	5%
Total subscribers receiving marketing messages	150,000	525,000	75,000
Number of views per month per subscriber	20	90	30
Total ad message per month	3,000,000	47,250,000	2,250,000
CPM (Cost per 1,000 Impressions)	$25.00	$20.00	$30.00
Advertising revenue per month	$75,000	$945,000	$67,500
Total monthly revenue	**$1,087,500**		

Table 5. Advertising Example

This example produces incremental revenue of $1.1 million per month. It requires the ECS and PCRF capabilities discussed previously as well as content filtering and ad insertion capabilities. The integrated PCC solution spreads the cost of these capabilities across multiple revenue initiatives.

Parental Controls

Parental controls enable parents to control their children's use of voice and data services. They include:

- Set thresholds for voice minutes
- Set specific limits for text, picture, instant and video messaging as part of pay-as-you-go or message bundle plans
- Set time of day restrictions for data use and messaging
- Create lists of "trusted" and "blocked" numbers
- Employ content filters

Table 6 shows an example of the revenue potential derived from a parental control service.

ITEM	AMOUNT
Total Subscriber base	1,500,000
Percent of subscribers with Parental Controls	10%
Total Parental Controls subscribers	150,000
Price per month for Parental Controls	$4.99
Total revenue per month from Parental Controls	$748,500

Table 6. Parental Controls

ROI for Incremental Revenue Opportunities

The capabilities that must be added to the integrated PCC solution to produce incremental revenue are shared among the various revenue initiatives. Table 7 itemizes the annual additional revenue created by the four initiatives discussed above.

REVENUE SOURCE	AMOUNT ($ millions)
Eliminate Overbilling	$3.2
Tiered Pricing	$275.2
Advertising	$13.1
Parental Controls	$9.0
Total additional annual revenue	**$300.5**

Table 7. Total Annual Incremental Revenue

The table shows that Tiered Pricing has a much larger contribution than the other categories. However, the other services are important to creating customer loyalty which supports higher profit margins and reduces churn.

Table 8 shows the investment cost of the capabilities required to deliver the incremental revenue of the four examples.

COST OF CAPABILITY	AMOUNT ($ millions)
ECS	$1.0
PCRF	$1.5
Content Filtering	$0.6
Advertising	$586,390.5
Total cost to add advanced features	**$3.7**

Table 8. Total Investment Cost for Required Revenue Generation Capabilities

The cost to deploy the advanced features is $4 million while the added revenue is $300 million per year. The payback on the investment is very rapid. The shared nature of these capabilities on the integrated PCC leverages this investment even further such that the addition of another incremental revenue opportunity is essentially free.

Conclusion

By providing a complete PCC architecture on a single integrated platform the integrated PCC architecture has lower total cost of ownership than competing architectures that employ multiple chassis to implement the GGSN, charging and deep packet inspection functions. Specifically a TCO analysis found that with one million concurrent subscribers that TCO was 17% less for the integrated PCC architecture as compared to a multi-chassis alterative architecture. Total OpEx was 38% less as compared to the multi-chassis alternative with large savings found in:

- Network Care
- Policy Development and Support
- Training
- O&M Consultancy

The integrated PCC architecture provides significant investment leverage to add capabilities that generate incremental revenue. Four incremental revenue initiatives are examined as an example in a deployment to 1.5 million subscribers. They are:

5. Eliminate overbilling
6. Provide tiered pricing
7. Sell advertizing inserts into mobile data services
8. Offer parental controls

They produce a total of $300 million in incremental revenue where the required investment in the necessary service delivery capabilities is $1 million. The investment cost in the service delivery capabilities is kept low because the integrated PCC architecture allows the capabilities to be shared across multiple revenue opportunities.

Appendix

Table 9 provides definitions for each OpEx category.

OpEx Category	Definition
Engineering, Facilities, and Installation (EF&I)	Cost of engineering, facilities, and installation of network equipment
Capacity Management	The engineering function of planning and provisioning additional network capacity
Network Upgrades & Patches	Hardware and software upgrades to the network
Network Care	Network provisioning, surveillance, monitoring, data collection, maintenance, and fault isolation
O&M Consultancy	Operations and maintenance consultancy expense charged by the system vendor(s) during the first year of operations to provide consultancy services to integrate the PCC solution with existing OSS and billing systems
Policy Development Support	Cost of support expenses billed by the systems vendor(s) to help establish the system policies
Testing and Certification Operations	Costs associated with the testing and certification necessary for all new hardware and software releases that go into the production network
Training	Initial training expenses as well as ongoing training expenses
Service Contracts	Vendor service contracts required for ongoing support of network equipment
Sparing Costs	Costs associated with line card spares
Floor Space Cost	Costs associated with the floor space cost in equipment rooms, closets, and the data center
Power Cost	Cost of the electric power used by active network elements
Cooling Cost	Cost of the electric power used by HVAC systems as well as the prorated carrying cost of the HVAC equipment itself
Billing Support Systems	Cost of hours of operator's IT staff to modify billing systems to work with the PCC solution

Table 9. Definition of OpEx expense categories

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