Billing Presentation

Agenda

• Part I: Billing on Cisco’s IP Infrastructure
  Usage Based Billing
  NetFlow
  Internet Packet Detail Record (IPDR)
• Part II: Billing on Cisco’s Open Packet Telephony
  RADIUS
  Pre-Paid Calling
  Billing Settlements, Reconciliation and Inventory
• Conclusions / Questions & Answers
Part I: Billing on Cisco's IP Infrastructure

New World Service Provider Requirements

- Rapid invention of new services and technology
- Intelligent apps and services cross traditional layers
- Convergence of services and customer interfaces to services
- Meeting Service Provider Billing Needs:
  - Usage Detail
  - Accuracy
  - Integrity & Auditability
  - Revenue Assurance

... Need for new world architectures
Specific Business Requirements

• How do I efficiently track Network and Application resource usage?
• How do I know if my customers are adhering to usage policy agreements?
• How do I account and bill for resources being utilized?
• How do I effectively plan to allocate and deploy resources most efficiently?
• How do I track customers to enhance marketing customer service opportunities?

What's Needed Is Usage-Based Accounting and Billing

• Flat rate billing is OK when
  network is not congested - any new customer revenue is upside
  simplicity is needed to gain market share
• Once congestion sets in, must optimize profits by customer segment
  Heavy users: Raise prices to match costs - make profitable
  Light users: Lower prices to match costs - attract more customers
• Need Product Differentiation & SLA Granularity
  Distance, pay per view and personalized network services
Requirements for Usage Detail

- Very high detail
  Precise usage information is needed for auditing, as well as for creating varied rating plans - this is a challenge at high data rates
- Very high accuracy/integrity
  Absolutely correct information is also needed for credibility and auditing. Records cannot be lost
- Readily auditable (persistent)
  SP’s must satisfy accountability requirements imposed by regulators and customers
- Easily Accessible

Usage Detail Rating Elements

- Flat rate
  Default
- Time-based
  Peak vs. Non-peak
- Usage-sensitive
  By the byte or usage-bands
- Destination/Distance/Carrier-based
  Local traffic could be cheaper than international
  Intra-carrier could be cheaper as it avoids settlements
- Application or Class of Service (CoS)- based
  Email or other non-real-time could be cheaper than real-time voice/video. Certain app functions could demand premium service
Meter Configurations

Integrated

- Metering Function
- Routing Function

External (probes)

- Routing Function

Metering function

Cisco’s Mediated Approach to Billing

Tier 1: Accounting Record Generation

- Netflow
- Dial/Radius
- VoIP1
- VoIP2
- VoX
- ATM1
- ATM2

Tier 2: Accounting Mediation

- NARUS
- XACCT
- HPSIU
- Others...

Tier 3: CC&B

- Portal
- Belle
- Solect
- Kenan
- Saville
- Amdocs
- Others...

Fewer, simpler, customizable API’s

Multiple APIs

Enabled Services

(CPS/AD)
Cisco Billing and Mediation Architecture

Tier 1: Usage Data Generation

Services:
- Layer 3 Routers (Connectionless)
- Layer 2 Switches (Connection oriented)
- Dial / Connect Access (Session Oriented)
- VoX (Tandem Replacement)

Collection Protocols:
- NetFlow via UDP
- LS 1010 SVC
- BPX SVC
- CWM file - PVC
- Via File & SNMP
- RADIUS via TFTP
- Extended VoIP RADIUS
- Cisco WAN Manager
- Cisco Secure
- Cisco Access Registrar
- Cisco Billing And Measures (BAM) Server
- Virtual Switch Controller
- NetFlow via UDP

Tier 2: Mediation

Web Servers
- Firewalls
- DNS
- DHCP
- LDAP
- RDBMS
- NetFlow

Tier 3: CC&B & OSS

3rd Party Customer Care and Billing Solutions:
- Application Recognition
- Billing System APIs
- Operational Measures & Specialized Reporting
-AMA CDRs, POR, & Operational Measures
- Compacted CDRs via TFTP

Operations Support Systems

Building on the Internet EcoSystem

Over 130 EcoSystem Partners including the best of the metering, collection, mediation, and customer care and billing vendors, such as those listed on the right of this page.
NetFlow Overview

- NetFlow statistics empowers users with the ability to characterize their IP data flows
- With NetFlow the who, what, where, when and how much IP traffic questions are answered
- Is integrated metering
NetFlow Enables

Traffic Analysis and Monitoring for Network Planning

Usage Based Billing

Router Feature Acceleration

NetFlow

Applications
NetFlow Application Strategies

- Usage-Based IP Accounting & Billing
- Application/User Monitoring, Profiling and Trending
- Data Warehousing and Mining

Application: Usage-Based IP Accounting & Billing

- Understand how customers are using the network
- Show your customers how they are using the network
- Offer usage based pricing to stay competitive and better scale your network
Application: User Monitoring, Profiling and Trending

- Profile network over time
  - What protocols are dominating the network?
  - How many active users?
  - Who are my top talkers?
- Time-based view of application usage
- Allocate network resources
  - From and to where are users are coming from and going?
- Web/application host charging
  - Charge for usage of network, server and services

Application: Data Warehousing and Mining

- Data can be stored for later retrieval
- Analyze for proactive marketing and customer service programs
  - Collect info of who, what, where and how long about internet customers
- Up-sale opportunities
NetFlow Components

Cisco IOS®, Collector, Analyzer

NetFlow Infrastructure

NetFlow/Data Export  Flow Collectors  Partner Value Add

Network Planning  Accounting/Billing  Flow Profiling  Network Monitoring  End-user Apps
NetFlow Cache Tracks Flows

• A “Flow” is defined by **Seven Characteristics:**
  - Source/Destination IP address pair
  - Source/Destination application port pair
  - IP Protocol
  - Input Physical Interface Index
  - IP Type of Service (ToS) byte
• Flows are unidirectional
• NetFlow is enabled on a per input-interface basis

Flows Can Be Exported

• **v1**
  - Initial definition
  - Not commonly used
• **v5**
  - Superset of v1
  - Adds AS accounting and datagram sequence numbers
  - Commonly used
  - Recommended over v1
• **v7**
  - Supported only on Cat5K NetFlow Feature Card
  - Not Cisco IOS Software
• **Router Based Aggregation**
  - Used for router-based NetFlow aggregation
  - Five aggregation schemes introduced in 12.0(3)T and 12.0(3)S

*Versions 2, 3, 4, and 6 were experimental and are not supported*
Router Based Aggregation Scales

- Reduces router’s NetFlow output
- Can scale to high speeds, i.e. GSR
- Easier to collect

Platform Support in 12.0(x)

- CatSK w/NFFC
- C1720
- C1x00
- MGX8850/BRX8650
- AS5800
- C3600
- C4500/4700
- C2600/2600
- C7200/7500/ubR7200
- Available since 11.1CC/CA
- GSR 12.0(6)S
Highlighted New Features in NetFlow

- Router Based Aggregation including TOS byte information
- Redundant Data Streams
- Minimum Prefix
  Possibly full IP Address, though memory and performance constraints may apply.
- Sampled NetFlow (GSR Only)
  Allows the GSR to have a sampled NetFlow state. Instead of every packet being forwarded getting inspected and cached, only 1:N packets being forwarded are inspected. N is a value between 10 - (2^14 - 2). This feature works with Router Based Aggregation. It is perfect for collecting Traffic Engineering information on the router such as AS or Prefix data.

NetFlow Example Implementation
**Example of Generic NetFlow Distance Based Accounting**

Customers  
- Global AS  
- Regional AS  
- Domestic AS  
- Internal

**Example: Digital Island Distance-Based Billing**

**Tier 1: Usage Data Generation**
- Four regional data centers
- “Overnet” with direct access to tier one service providers in 19 countries
- Cisco LocalDirector, Catalyst, 7200 with NetFlow, and IGX ATM elements

**Tier 2: Mediation**
- Custom mediation layer resolves server IP address to customers, AS to destination country
- Could be implemented with standard mediation, a directory and QoS

**Tier 3: CC&B**
- Invoice aggregates volume by country
- CNM web interface provides data mining
- QoS and SLA could easily be added

Customer Web Server Farms  
- Cisco NetFlow Collector  
- Mediator

LDAP  
- Customer Geographic

Invoice  
- $$$
- $$$$$
- $$$$$$

Data Mining  
- Tiered Billing

*Example: Digital Island Distance-Based Billing*
Example: NetFlow to User, Group or Service Resolution

Tier 1:
- NetFlow usage data collected from gateway routers

Tier 2: Mediation
- Remote users:
  - Resolve IP address to hostname via DHCP log or DNS
  - Hostname to billing ID, group, or service type via LDAP

Dedicated VPN
- Resolve subnet to department via LDAP
- Aggregate by QoS for tiered billing
- Threshold usage billing

Tier 3: CC&B
- Invoice aggregates by billable group and service
- Group or host-level usage data can be offered for analysis or department bill-back

Mediator
- DHCP or DNS Server
  - IP to name resolution
  - DHCP log => MAC
  - DNS => hostname
- LDAP
  - Mac or hostname to Billing ID
  - Group membership
  - Associated service

Invoice
- $$$
- $$$$$
- $$$$$
- $$$$$
- QoS-level or threshold-usage billing
- Department-level Reporting

Internet Packet Detail Record (IPDR)
Initiative Overview
IPDR Mission

The Internet Protocol Detail Record (IPDR) initiative is an industry consortium program with its mission to:

Define an open, extensible record format for exchanging usage information between all network elements, services and applications provided on IP networks to any system that uses this data (OSS, BSS, etc).

IPDR Charter

IPDR Membership

IPDR Goals

The goals of the IPDR are to create:

- Open, flexible IP detail record and protocol
- Definition of IP-based services
- Definition of exchange of IP usage metrics
- Facilitation of exchange of IP usage metrics
- Repository for IPDR formats

IPDR Services

Services considered by the BSS working group in version 1.0 of the IPDR Specification are:

- Voice over IP (VoIP)
- Fax over IP
- E-mail services
- Virtual Private Networks (VPN)
- Video on Demand (VoD)
- Application Services (ASP)
- Dial-UP access

Wireless Application Protocol (WAP) -based Services are expected to be targeted in subsequent versions of the IPDR Specification.
IPDR Use of XML

- The IPDR embraces XML as a definition language. The use of XML was selected to do the descriptor work in order to have a standard mechanism for exchanging structured data and to enable automatic validation of well-formed of IPDR records.
- It is anticipated that a binary exchange protocol or protocols, yet to be selected, will be utilized for production operations. But it is planned to be implemented for production using additional, “faster” exchange mechanism for performance.
- Due to the use of XML, the IPDR-specific DTD enables formal, flexible, and easily extensible expression of the record structure and the specification of attributes supported.

Reference Interface Points

The IPDR has defined five reference interface points as shown in the diagram below.
IPDR As Related To IETF

- It is likely that the “A” interface will not be defined by the IPDR but rather that this will be left to the IETF AAA and ROAMOPS Working Groups.

- Therefore, IPDR is not expected to be in conflict with the discussion or outcome related to the use of RADIUS, DIAMETER or other accounting protocols, as it is likely that one or more of these protocols will be selected for recommended by the related IETF Working Groups.

Most Likely Use of IPDR

Where IPDR will be most likely used is in some combination with the selected accounting protocols related to:

- Direct WAP application level creation of accounting events (IPDR native end-to-end)

- From the “B” or “C” Interfaces, where the Recorder or the Store are using IETF AAA protocols, and then convert to IPDR

- Most definitely from the “D” Interface point, at least on the egress side of the AAA servers, where an IPDR Transmitter will be implemented in order to provide IPDR compliant records to other service providers or to internal BSS (and the “E” Interface)
IPDR Impact

• The IPDR should provide a common exchange definition for services, just as the Call Detail Record (CDR) format has provided for common exchange of metered voice services.

• What the IPDR does provide is a common method of creating usage detail records into a common exchangeable method, where the method itself can be learned and used from one application to another. Due to the use of XML, the IPDR-specific DTD enables formal, flexible, and easily extensible expression of the record structure and the specification of attributes supported.

• Overall, with the IPDR it shall be possible to lower the overall costs to create, maintain and implement convergent billing systems.

Part II: Billing on Cisco’s Open Packet Telephony
Billing Architecture & Components for VoIP

Billing Architecture & Components for VoIP

Billing
- Billing
- Discounting
- Invoicing
- Tariffing

Inter-SP Settlement

Usage data generation on elements

Element Layer

CDR

PSTN

SS7 (Dial & VoIP)

AAA

Packet Telephony Network

SS7 Network

SC2200

ASS300s

PSTN

Corporate

Billing Data Sources
Billing Data Sources

Radius
- Call duration
- Data volume
- CLI & DNIS

Access method

Additional Sources:
- DHCP (cable)
- Web Log Files
- ATM Switches
- Content Sales

NetFlow
- Source/Destination
- Time of day
- Data volume
- IP Application

SS7
- Call duration
- CLI & DNIS
- CLI/DNIS conversion
- IN functionality

Open Packet Telephony

RADIUS Call Accounting
Call Leg RADIUS Records

- Each of the call legs can generate Start and Stop records
- Each call leg reports the NTP time for:
  - SETUP
  - CONNECT
  - DISCONNECT
- The Stop records have the required information for Billing

Call Legs

- In today’s H.323 VoIP implementation, the gateway sends messages to a RADIUS server to provide start & stop records.
RADIUS Record Format

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAS-IP-Address</td>
<td>4</td>
<td>IP address in 4 hex octets (ASCII string)</td>
</tr>
<tr>
<td>NAS-Port-Type</td>
<td>61</td>
<td>4 octets (used for MLPPP)</td>
</tr>
<tr>
<td>User-Name</td>
<td>1</td>
<td>ASCII string field up to 63 octets</td>
</tr>
<tr>
<td>Called-station-Id</td>
<td>30</td>
<td>1 or more octets (DNIS phone number, ASCII string)</td>
</tr>
<tr>
<td>Calling-station-Id</td>
<td>31</td>
<td>1 or more octets (ANI phone number, ASCII string)</td>
</tr>
<tr>
<td>Acct-Status-Type</td>
<td>40</td>
<td>4 octets (hex ASCII number)</td>
</tr>
<tr>
<td>Service-Type</td>
<td>6</td>
<td>4 octets (hex ASCII number)</td>
</tr>
<tr>
<td>Acct-Session-Id</td>
<td>44</td>
<td>&quot;overloaded&quot; for CDR - ASCII string up to 256 bytes</td>
</tr>
<tr>
<td>Acct-Input-Octets</td>
<td>42</td>
<td>4 octets stop records only (hex number)</td>
</tr>
<tr>
<td>Acct-Output-Octets</td>
<td>43</td>
<td>4 octets stop records only (hex number)</td>
</tr>
<tr>
<td>Acct-Input-Packets</td>
<td>47</td>
<td>4 octets stop records only (hex number)</td>
</tr>
<tr>
<td>Acct-Output-Packets</td>
<td>48</td>
<td>4 octets stop records only (hex number)</td>
</tr>
<tr>
<td>Acct-Session-Time</td>
<td>46</td>
<td>4 octets (hex number rep. Seconds) stop records only</td>
</tr>
<tr>
<td>Acct-Delay-Time</td>
<td>41</td>
<td>4 octets (hex number in seconds)</td>
</tr>
</tbody>
</table>

Stop Record for Call Leg 2

Thu Feb 4 121429 1999
Client-Id = 10.10.253.5
NAS-Port-Type = Async
User-Name = "1234"
Called-Station-Id = "4085551212"
Calling-Station-Id = "408"
Acct-Status-Type = Stop
User-Service-Type = Login-User
Acct-Session-Id = "25/120918.074UTC Thu Feb 4 1999/ch1-gw.mwest.FC82262C.9CD60028.0.4C285F4/originate/VoIP/120922.018 UTC Thu Feb 4 1999/120932.022 UTC Thu Feb 4 1999/10/10.10.254.5"
Acct-Input-Octets = 2300
Acct-Output-Octets = 12800
Acct-Input-Packets = 115
Acct-Output-Packets = 640
Acct-Session-Time = 13
Acct-Delay-Time = 0
Open Packet Telephony

Debit / Pre-Paid Calling

Why focus on Pre-paid calling?

- Low barrier for non-carriers to get into voice business
- Eliminating service node network element can make this a cost-competitive solution
- Pre-paid popular in countries with less-developed telephone systems, international calling where tariff arbitrage still a good business
- Relatively high-margin business even in competitive markets
- Growth market, in terms of ports and providers
Why are Debit Cards so Attractive to SPs?

- High Margin: Market rate ~ $0.20 - $0.25/minute for debit cards vs $.05-$0.10 for dial 1 service (US)
- 17% of prepaid minutes are never used, cards are routinely lost or discarded - free profit!
- Low Risk - Cash in advance for services can finance operations

Debit/Prepaid Calling Service Architecture

- AS5300
- Called Party
- IP Network
- C3600
- Calling Party
- BAS (Belle, Mind, Portal)
- Cisco Partner Application Server
- RADIUS Server
- RADIUS Client
- • Authorizes call
  • Reports balance ($)
  • Rates call
  • Reports minutes available
  • Updates balance after call termination
- • Call authorization
  • Balance remaining info
  • Call detail records
Debit/Prepaid Calling

Service Architecture

Debit/Prepaid Calling

Architectural Options
Open Packet Telephony

Billing Settlements, Billing Reconciliation and Inventory

Telephony and VoIP Settlement

• Telephony settlement
  Bilateral agreement between carriers
  Static intercarrier routing
  CDR from C7/SS7 information

• VoIP settlement
  ISPs to build connectivity and sign with ClearingHouse
  Settlement provider does inter-ISP routing/authorization
Voice Settlements

- Ability to divide per call revenue among multiple carriers

VoIP Settlement Scenario

- Secure settlement protocol
- Call signalling protocol is not included
Open Settlement Protocol

- Standard track within ETSI, approval in Sept 1998
- Wide support
  TransNexus, iPass, GRIC, Cisco, 3COM...
- Extendable to additional services
- Settlement independent from IVR, gatekeeper...

Billing Reconciliation

Billing World - May 1999

- “Access Cost can be 50% of the cost of doing business”.
- “A telecom service provider can expect an 7-8% error factor in a complex CABS bill.”
- “It can mean the difference between a company being massively profitable or loosing money.”
Billing Reconciliation

Biggest place to *make* money is billing reconciliation and inventory management to prevent orphaned circuits.

- CLEC’s commonly can find over 8-10% of their billing is in error and with proper systems can contest this. That can add 3-5% to the pre-tax bottom line!
- Orphaned circuits are most common problem created by bad inventory control and management.

Billing Reconciliation is significantly understaffed.

- Most CLECs don’t consider Network Cost Management (NCM) fully till 2nd to 4th year in business in favor of just building.
- At 7-8% of recoverable cost, and all of that variable, prudent fiduciary and operations management would invest in fully automated systems EARLY on to support this task, as well as three to four times as many staff as is normally assigned now (meaning for a 100M revenue company a staff of 5-6 with proper tools).
What is an “orphaned circuit”?  
- Customer orders product requiring circuit A----D.  
- Originally order A--B--C--D, where we own B--C.  
- Either by grooming, reconfiguration or customer loss, we lose need for A----D as configured.  
- Since B--C is ours and likely shared, we leave this circuit in place.  
- Do we know to cancel A--B and C--D? Are they shared? Most likely they remain in service, even if not needed. Thus they are “orphaned”.

Circuit Inventory is a significant problem right now.  
- In one account, Telecom and Technology found over $1M/month in orphan circuits.  
- They further found that CLEC’s not tracking closely their number of circuits and need could be off by as much as 100% of their inventory.
Inventory Management is becoming a Key Issue.

- In order for flow-through provisioning to work, first you must have a common data-model and taxonomy. A clear definition of authoritative ownership of inventory data is necessary to be effective.
- Must be integrated to Network Cost Management systems.
- Without a common inventory access and structure, mixed network / services provisioning solutions are all but impossible.

Conclusions
Conclusion

• Cisco provides an open, extensible billing and management framework supported by partners
• Cisco focuses on tier 1 and 2 to enable tier 3 partner solutions
• Cisco supports open interfaces and actively promotes standards

Questions?
Cisco’s CLEC Networkers Power Session
Billing Presentation