Case Study: Cisco’s IP Telephony Deployment

Session VVT-214

Agenda

• Cisco IT Positioning
• Cisco Network Infrastructure
  Cisco Multi-service Network
  Cisco LAN / WAN Overview
• Cisco’s Telephony Infrastructure
• Road to 3.0 from 2.X
  Migration Strategies Deployed
• IP Telephony Everywhere
• Lessons Learned and Next Steps
Consultative Business Partner

- CFCN - Cisco Field Comm Network
- CiscoCast for Partners
- Electronic Order Submission
- Next Generation Call Center
- Sales Ticker & Real Time Alerts
- Collaboration Tools
- PDA Integration & Wireless
- IP Telephony
- CCO Dynamic Content
- IT Globalization

Develop Business Leaders in IT

Promote Culture Of Innovation

Leverage globally & x-functionally

Strategic Solutions

Previous Network Services

- Low bandwidth
- Few applications
- Latency insensitive

Web
E-Mail

Data Link
WAN
Multi-service Network

- More bandwidth
- Prioritised qualities of service

Exploit Additional BW

- Multiservice BW “always available”
- Slack periods enable new services
Integration of AVVID Technologies

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- Next Steps
Cisco Campus Map

80+ Buildings, 20,000+ People, Growing at 150+/week

LAN MAN
Enterprise Topology
Highest Level of Redundancy

- Access Layer
  - In-line Power
  - Multiple queues, PQ & Classification
  - 802.1Q/p capable
  - Layer 2 Mesh with quick convergence

- Distribution Layer
  - Multiple queues
  - 802.1Q/p capable
  - Layer 3 Switching module (MLS)
  - CoS to ToS mapping

- Network Egress
  - WAN QoS
  - Security

Branch Design Topology Options

- Call Processing
- ISDN Backup
- Redundant Platform's + Links
- Non - Redundant
- Redundant WAN Links
- Application Server(s)
- V-Mail Server
- Application Server(s)
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Initial San Jose Topology

• 20,000 users and growing
• Three exchanges (525, 526 and 527)
• 2 Lucent G3r PBXs
• Number portability across the PBXs
• 3 Octel 350 Voicemail systems
• Networked Voicemail to 80+ other systems

Problems
• Growth exceeding PBX/VM
• Scaling ability
• Adding 4th exchange (853)
• Choices—IP Telephony or add PBX/VM
• Difficult to deploy new voice applications
• Lease expiration approaching
• Need a “shrink and grow” migration
• Remote offices can “flash cut”
Branch/Hub Connectivity

Hub/Hub Connectivity
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History – Introduce IP Telephony Fall ’98

Voicemail Integration Challenge

- IP phones do not have transparent Voicemail
Issues with Fall ’98 Introduction

- IP phones given new DID numbers
  Two numbers per subscriber not viable (running out of DID numbers)
- IP phone in addition to “legacy” phone
  Confused subscribers as to which number they were to use – resulted mainly in outgoing calls
- IP phones assigned “real” IP address
  Had issues of no IP addresses available with current DHCP scheme

Next Steps

- Removed existing configuration of IP phones
- Installed new CallManager 2.4 system with new “853” DID range (for new hires)
- New dedicated Voicemail system installed
- Grow incrementally to over 1,900 users on single Server
Telephony View of Cisco Campus
Late ’99—Early 2000

- Only IP phone for 2,500 users
- Full Voicemail integration
- Integrated dial plan—Caller ID

Migration from CallManager 2.4 to 3.0

- April 2000 - Cut over existing 2.4 CallManager to 3.0 Cluster
- Migrate handsets to IP Phone 7960
  User self installation
**Step 1—Install Pilot (Q1 2000)**

- All new employees on pilot—“853”
- Pilot grew to 3,000 users
- CallManager connected to existing VM for networking to rest of system (proprietary VM restricted this)
- Pilot runs on development software

**Step 2—Production Cutover (Q2 2000)**

- New employees on pilot—“853”
- Total of 7,000+ users
- CallManager connected to existing VM for networking to rest of system (proprietary VM restricted this)
- IP phones using 10.0.0.0 Network
Cluster as Deployed by Cisco Support for up to 10,000 users

“853” Cluster

CM-A  CM-B  CM-C  CM-D
Backup  Backup
TFTP Server  Publisher

San Jose Campus Topology
Step 3—Install CallManager Cluster for each Exchange

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Isolated Deployments (Single Site)

- Call processing (CallManager/cluster at each site)
- Voice message and DSP resource at each site
- 10,000 users per site
- PSTN used for all external calls
- No limit to the number of Sites
- Compressed voice not required
- Uniform dial plan

Hybrid Solution Migration Today
Inter-Cluster Communication (LAN/MAN)

How Do I scale to 20,000 phones, 30k, etc

- H.323v2 between CallManagers (clusters)
- An Example of H.323 cluster trunks for one CCM server (each server will require trunks to all other servers)

Dial-Plat at 10,000 Feet

Phone Restriction

Route Pattern:
- 0
- 2xxx
- 3xxx
- 4xxx
- 5xxx
- 6xxx
- 7xxx
- 8xxxx
- 9 [2-9]xxxxxx
- 90
- 900
- 9011!
- 91800xxxxxxx
- 91866xxxxxxx
- 91877xxxxxxx
- 91888xxxxxxx
- 91900xxxxxxx
- 91xxx976xxxx
- 91xxxxxxxxxx
- 9411
- 9611
- 9811
- 9911

Route Group:
- PBX Tie
- Local
- LD
- CapNet
- Intercluster
- Each Cluster

Call Flow
**Strategies for User Migration**

- **Building by building**
  Easy from a phone provisioning standpoint
  PBX’s need to remain as tandem for PSTN calls and Inter-cluster calls—more complex call routing

- **Block of DN’s at a time**
  More difficult to provision phones (80+ buildings)
  Calls to PSTN direct, Inter-cluster calls direct via IP network—easier to program on PBX
  Less prone to error

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**Exchange Transition Topology Today**

Allows for “Smooth” Migration from Lucent PBX to CallManager Cluster

- 526 NXX Cluster
- CM-A
- CM-B
- CM-D
- CM-E
- Ethernet
- Octel VM
- PIC
- PBX
- Gateway’s
- PSTN
- Legacy SJ Users
- Migration of Users
- Require New Device (DPA) to Allow for Voicemail Dual Integration Functionality

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The Voicemail Migration Solution

- Require new device (DPA) to allow for Voicemail dual integration functionality

DPA = Digital PBX Adapter

Scaling the Migration

- Add more voice paths to IP phone side with DPA
Small Branch Site

- Can Be Integrated with existing Voice Mail Systems for Network Voice Mail
- Supports Analog Modems, Faxes, Polycoms

Flash Cut PBX—Keep Legacy VM Example—Cisco New York Office

Digital PIC Integration (Most Common Type of Octel to PBX Integration)

Legacy PBX

Nortel PBX

CallManager-Based Network

In this Case the Octel Was Converted to SMDI with Analog Ports
DPA for Octel with CallManager Option 2 (DPA)

- Cisco CallManager replaces PBX
- Cisco DPA 7630 interfaces to the Octel system
- Cisco CallManager looks like Legacy PBX to the Octel system
- No changes to the Octel system

Allows for Octel PIC Integration to CallManager

DPA Features

- Provides G.711, G.729a
- Supports automatic failover
- Supports Telnet or SNMP management
- Supports auto or manual registration with CCM
- Upgradeable from any FTP client
- Provides two-level password security
- Supports DHCP or manual configuration
DPA Benefits

- Seamless migration to CallManager for Legacy PBX
- No change to Octel hardware or software
- Fault-tolerant (versus SMDI-based solution)
- Inexpensive (versus analog gateway)

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Migrating Existing Users Moving Forward

• Goal is to move remainder of campus to IP telephony by mid 2001
  Users need to keep existing DID #'s
  Voicemail functionality must be maintained
  No additional investment in legacy hardware
  New users

Architecture Summary

• PBX – 2 PPN’s, 45 EPN’s
• Trunks – Local, Long Distance, PBX Ties
• CM – 6 Clusters
• Voicemail – Octel 350’s
  DPA – Digital
  SMDI – Analog(Serial Connection)
• H.323 – Inter-Cluster Calls
• MSN – Chelmsford, RTP, Petaluma…
More IP Phones in San Jose than Lucent Phones – Cisco’s SJ Campus

Current: 17,000+ IP Phones

IP Telephony after Phone Migration
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Lessons Learned and Recommendations

- Management Considerations
- Infrastructure LAN/MAN
  - TFTP, Building Layout
  - IP Addressing
  - Campus QoS
- Support Services
- Deployment Considerations
- Benefits and Challenges
Recommended Management Processes

Standard Management Processes for Collection, Monitoring, Alerting, and Reporting using MCS in branch and HQ sites. Centrally Managed Cisco IT developed Management Tools (EMAN).

Data Collection
- Availability
- Call Detail Records
- Dial Plans
- Configuration
- Performance
- Events / Traps

Monitoring
- Availability
- IP Devices
- Memory
- CPU
- Availability
- Applications
- Performance

Alerting
- Alert Services
  By E-Mail, or
  E-Page when
  Threshold, or
  Trap to on-Duty
  Support

Web-based Operations
- Report Availability
- Report Exceptions
- Change Management
- Client Subscription
  Services

IP Address Plan

- IP phones need addresses too!
  Configure phones statically or use DHCP

- Address space options:
  Double current address space
  Phones on separate subnets
  Secondary addressing per subnet
  Use of RFC addresses for “voice” subnet – user of 10.0.0.0 Network for IP Phones
IP Addressing Deployment Options

- **IP Phone and PC on Same Switch Ports**
  - 171.68.249.100
  - 171.68.249.101
- **IP Phone and PC on Separate Switch Ports**
  - 171.68.249.101
  - 171.68.249.100

**Real IP Addresses**

- **IP Phone and PC Share the Same Device (Soft Phone)**
  - 171.68.249.100

**IP Phone Uses “10.0.0.0” Network**

Automatic Subnet Placement & In-line Power

- **Phone VLAN = 200**
- **PC VLAN = 3**
- **Desktop PC: IP Subnet A**
- **IP Phone: IP Subnet B**

**Catalyst Multiservice Port Provides Automatic Phone VLAN Configuration**

- New in-line power on Catalyst® Switches
- 4 Wires
- 48V DC Power
- 10/100 Ethernet
Campus Building Infrastructure Plan

Catalyst 6509 Switch - 9 Slots
- Part #: CAB-7514AC AC Power Cord (2)
- Part #: WS-X6K-SUP1A2GE (2) - Supervisors
- Part #: WS-X6624-FXS (1) - 24 Ports Analog
- Part #: WS-X6608-T1 (1) - 8 Ports T1
- Part #: WS-X6348-RJ-45 (5) - 48 Ports 10/100
- Part #: WS-F6K-VPWR (5) - 48 Ports Power

POWER SUPPLIES:
- Part #: WS-CAC-1300W (2) - 110V 1300 Watt
  96 MAX Inline Powered IP Phones
- Part #: WS-CAC-2500W (2) - 220V 2500 Watt
  240 MAX Inline Powered IP Phones

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Campus Building - Avg. 800 persons

WS-X6K-SUP1A2GE
WS-X6624-FXS
WS-X6608-T1
WS-X6348-RJ-45
WS-F6K-VPWR

1 Per IDF
1 Per BDF
1 Per IDF

16 Conference Sessions x 8 Participants per port
16 MTP Transcoding sessions per port

Wiring Closet Redundancy

Core Layer 3
Distribution Layer 3
Access Layer 2

HSRP Primary VLANs 1xx
VVID=110
VLAN=10

HSRP Primary VLANs 1xx
Campus QoS - Access/Distribution/Core

- A robust, modern switching design is a requirement
  
  
  

- Multiple queues are required on all interfaces at all layers to guarantee voice quality
  
  2900 XL (8 MB DRAM), 3500, 4000, 6000

- Catalyst 5000 designs should use a separate path for voice traffic

- Voice RTP Bearer traffic should always go into the highest priority queue (PQ.)

- Voice and Video Call Control should go into queue #2 regardless of device

- Distribution Layer switches must have the ability to map between CoS and ToS values

TFTP Consideration - Multi-Cluster Deployments

Only 1 IP address per phone for TFTP server ???

Centralized TFTP Service

IP Subnet A

Cluster A Phones

Cluster B Phones

IP Subnet B

Cluster A Phones

Cluster B Phones

CCM Cluster A

DHCP Server

Cisco TFTP Server

CCM Cluster B

Campus LAN

IP Backbone
Centralized TFTP Configuration

1. Select FileLocation Parameter

2. Specify Root Directory
   - OR -
   UNC Path of Different Server (Central TFTP Server)

Centralized TFTP Services

Centralized TFTP Service — Single Point of Config Repository

All Files Written on One TFTP Server After Creation by the Publisher/TFTP server
Support Services

- Planning
  - Strategic Network Services
  - GSAT Applications
  - Advanced Technologies

- Design
  - Call Manager
  - Unified Messaging
  - Call Center
  - LAN IP Telephony
  - WAN VoIP

- Implementation
  - Corporate
  - Field Offices
  - Remote Offices
  - EMEA Offices
  - Asia Pacific Offices
  - Japan Offices
  - Professional Services

- Operations
  - LAN OPS
  - Telecom OPS
  - NT OPS
  - WAN OPS
  - Ntwkg & Telecom OPS
  - Field Sale IT OPS
  - Call Center OPS
  - ECS OPS

Cisco "The Customer"

Cisco IT

NSA Services

PS = Professional Services
CA = Customer Advocacy
GSO = Global Service Organization
NSA = Network Supported Accounts
TAC = Technical Assistance Center
EVBU = Enterprise Voice Business Unit

Products

- Cisco CallManager
- Cisco Unified Messaging
- Cisco ICM
  (Call Center Solutions)

Deployment Considerations

- Have Clear Business Priorities
- Have Easy to Follow Design, Implementation and Support Specs
- Communicate expectations to management, users, and teams
- Re-use Lessons Learned where possible
- Focus on Support Models
  - Service Level Agreements, measuring Availability
  - Provision IP Address space in advance of implementations
  - Outsource remote management where possible
- Prepare for, and use special teams for New Technologies
Anticipate Challenges

1. Management of distributed LAN and Voice Services Environment
2. Defining New Roles, Processes, Responsibilities and Ownership
3. Communication and integration of teams
4. Establishing guidelines and standards for installation
5. Providing tools and processes for management, both Financial and Service Level

Expected and Unexpected Benefits

1. Common Infrastructure and Savings
2. Cost savings for IP to IP Calling
3. Reduced Move, Add, Change Administration
5. Higher Skill sets for Data, IT and Voice Services
6. New IP and IT Services available – Directory Services, Softphone, Personal Productivity Apps, Global and Virtual Contact Center Agents
7. Support for Telecommuting, IP Phone @ Home over DSL Lines - single number reach
Lessons Learned

- QoS strategy to guarantee voice quality
- Create a simple dial-plan to:
  - Eliminate potential routing loops with PBX
  - Prevent unauthorised phones by using auto-registration and then place into restricted pool
- Take advantage of IP phone and switch features to make IP addressing easy
- Power planning for IP phone sets (inline power)
- Using a single Codec (G.711) makes life simple
- Transparent Voice mail functionality for user migration
- Single phone at a time on the users desk
- Merging/cooperation of Telecom/Data teams

What’s Next

- Finish migration of existing Lucent phones
- Continue to flash cut-over branch offices
- Trials of telecommuter IP phones
- Upgrade LAN Infrastructure for Cisco for QoS
- Unified messaging to replace Octel
- Replace call-centres with IP contact center
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Please Complete Your Evaluation Form

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