Introduction to IP-PBX-Based Call Processing
Session VVT-120

Old World/New World Architecture
Aspects of Traditional Telephony

• Separate wire
• Separate support groups
• Separate hardware
• Separate vendors
• Geographically limited

TDM PBX Architecture

Mainframe Cabinet
- Proprietary Processor Card(s)
- Proprietary TDM Switch Card(s)

Applications (Voicemail/IVR)

Proprietary Terminals

Proprietary Line Card(s)

Proprietary Trunk Card(s)

Voice Path (TDM)
- Proprietary Interface

Signaling Path
- Proprietary Interface

Proprietary Interface

PSTN

Standard Interface
Aspects of IP Telephony

- Same wire (voice, video, and data converged)
- Same support group
- Same hardware
- Same vendors
- Not geographically limited (virtual CallCenter)
- Integration with applications (web-based directories, XML, phone services)

IP Telephony Architecture

- High Availability Server
- Applications Server (Voicemail/IVR)
- TCP/IP Network
- IP to PSTN Gateway
- PSTN
- Standard OR Proprietary Interface
- Standard Interface
- Standard Interface
- Standard Interface
- Voice Path (TDM)
- Signaling Path

IP Phones and PC Applications

Standard Processor

Call Processing Application

Standard Interface
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CallManager Architecture
Basic Architectural Components

- Database
- DBL Layer
- Call Processing Engine
Data Source

- Microsoft SQL server 7.0 is one example of a database that can be used
- DB users should read from the same source to which they write
- The Glass House is the primary database with one way replication

Replication

- Database writes to the database only occur at the Glass House
- Call detail records are not replicated
Replication (Cont.)

Glass House

Client

SQL

Backup

Client

SQL

Backup

Computer

Application

Database Access

Directional Replication

Database Availability/Redundancy

Master DB

CallManager A

CallManager B

CallManager C

CallManager D

CallManager E

CallManager F

Automated Replication
Basic Architectural Components

- Database
- DBL Layer
- Call Processing Engine

Database Layer and Cisco Database Layer Monitor

- The database layer is a set of Dynamic Link Libraries (DLLs) that provide a common access point for data insertion, retrieval and change.
- Cisco Database Layer Monitor is a Windows NT service that monitors the layer and aspects of the database relating to call detail records.
Database Layer Requirements

- Provide a common ActiveX and C++ interface to the database
- Hide the data source from the applications
- Use the primary database when it is available
- Fail over to backup databases when the primary database is not available
- Validate data insertion and changes
- Provide scalability
Call Processing Engine

- Distributed among several servers
- ‘One’ IP PBX
- These characteristics introduce the concept of a cluster
Cluster Internal Communication

Database

Publisher

Subscriber

Subscriber

Subscriber

Intra Cluster Messaging

Cisco CallManager

Signaling/Call/Media-Control

X5201 Dials x5202

Cisco CallManager

1—Call Setup

2—E.164 Lookup

3—Call Setup

4—Alerting (Ring)

5—Media Connect

RTP/UDP

All Signaling and Media Over IP

x5201

x5202

6—Off Hook

7—Media Connect

RTP/UDP

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CallManager Cluster Architecture

CallManager Cluster Reliability

- Distributed server architecture provides redundancy and reliability
- This reliability is only as good as the network it resides on
System Redundancy

CallManager Clustering

Network Design

CallManager Clusters
N+1 Redundancy

• CallManager Cluster characteristics
  - Appears as one distributed CallManager
  - 2500 users maximum per CallManager (even under failure conditions)
  - Maximum of 10,000 users in a cluster
  - Maximum of seven CallManagers in a cluster
  - Cluster members are confined to a campus

SQL 7.0 Database
CallManager Failover

- Each device (IP phone + Gateway) has a prioritized list of up to three CallManagers to which it can connect
- This is called a CallManager Group and this list is downloaded during device initialization

Cluster Recommendations
Up to 2500 Users (with Redundancy)

- A cluster of two CallManagers
  Single active CallManager
  Dedicated publisher also acts as a Secondary CallManager
Cluster Recommendations
Up to 5000 Users (with Redundancy)

- Every IP phone would have a CallManager group consisting of two CallManagers (primary and backup)

Cluster Recommendations
Up to 10,000 Users (with Redundancy)

- Every IP phone would have a CallManager group consisting of two CallManagers (primary and backup)
Introduction to IPP-BX-Based Call Processing
Recommendations, Tool, and Troubleshooting Tips

Tools and Utility to Configure, Monitor and Troubleshoot CCM

- CCM administration
- Performance monitor (PerfMon)
- EventLog
- SDL trace
- Local log file
### EventLog

- This trace allows the developer engineer (DE) to know that the code is functioning properly or to find the cause of an error; provides a C interface to trace and alarms

- SDL Trace can be directed to local files, NT Event Log and Cisco Works

- Alarms are used to inform the administrator of the unexpected events (unable to access a file, database, Winsock or unable to allocate other operating system resources)
Trace Utility

Trace Configuration

A Look at a Large IP PBX Deployment in New Zealand
Case Study

• New Zealand Enterprise Deployment
  An example of the contrast and the solution

Initial New Zealand Landscape

• 8000 users over 200 offices
• 130 PBX’s
• Four major hub sites
  Auckland, Wellington, Hamilton, Christchurch
• 150,000 calls a day
• Growth exceeding PBX/VM scaling ability
• Needed user mobility while maintaining number
• Lease expiration approaching
New Zealand Enterprise Network
Motivation for Change

- Standardization of Service Providers
  Want a converged network for voice and data—single provider
  Currently have a separate service provider for voice and data

- Standardization of network equipment suppliers
  Single vendor for networking equipment

New Zealand Motivation for Change

- Improved availability
  Current PBX network—reboot nightly

- Standard operational environment
  Consistent service for all users
  Currently a hybrid of PBX/Centrex

- Reduce ongoing costs—capital and operational
  Manage a single converged network
New Zealand Solution Overview

- 10 CallManager servers replaced 130 PBXs
- 20 VM servers for 8000 people
- Call processing only at four major hub sites
  - Auckland, Wellington, Hamilton, Christchurch
- Centralized call processing and administration

Summary
## Summary

- 3 layer architecture (database, DBL, and call processing engine)
- Distributed servers for reliability, redundancy, and load sharing
- Clustered, scalable architecture
- Several monitoring and troubleshooting tools available

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