Enterprise PBX to IP Telephony Migration Strategies

Session 2100
Agenda

- Concepts in Legacy Migration
- Management of Migration Projects
- Protocols and Interfaces in Migration
- The Basic Migration Topology
- Two Flash Cut Models (with Voice Mail)
- Three Migration Models (with Voice Mail)
- Migration Example: Networking Company
- Billing
- Other Aspects of Migration

Migration Exercise Phase 0

In the Legacy Voice World, Locations Are Networked Via PSTN or TDM Leased Lines
Migration Exercise Phase 0

But All Corporate Locations Today Have LAN Installations

Rest of World

Initiate a Pilot Trial at the Headquarters Site

Migration Exercise Phase 1 (Order of Phases Is Not Important)
Migration Exercise Phase 2

When the Aims of the Pilot Trial Have Been Achieved, Cut Over a Branch Office to IP Telephony; Continue Migrating Users at Headquarters

Migration Exercise Phase 3

Continue Cutting over in Branches, Migrating at Larger Locations
Migration Exercise Phase 4

When All Locations Are on IP Telephony, Migrate Voice Messaging to IP Unified Messaging

Migration Exercise Phase 5

Use the Corporate WAN to Transport IP Telephony: Extend to Home Offices Add Other IP Telephony Apps
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Considerations in Migration

- What do we have?
  - How many lines and users
  - Numbering plan and trunking
  - Features used
- Where do we need to go?
  - Desired architecture
  - Final network design
- What intermediate steps should we take?
  - Minimize disruption
  - Minimize risk
Considerations in Migration (Examples)

Feature Examples:
- Display Sets
- Hands-Free Sets
- Fax Lines
- Modem Lines
- Transfer
- Conference
- Call Park
- Call Pickup
- Paging Trunks
- RAN
- Attendant
- Consoles
- Night Service
- Voice Messaging
- IVR/AA

Dialing Plan:
- Line
- Appearances
- Trunk Access
- ARS/LCR
- Multiple Carriers
- Emergency Calls
- Call Barring
- TEHO

System Features
- Power-Fail Resilience
- Hardware Redundancy
- Billing

Typical PBX—PBX Migration

Survey Current Installation
Freeze Changes

Install New PBX (If Space Available)
Burn in and Run Admin, User Training
Prepare for the Big Weekend Cut:
Place and Label New Phones

Flash Cut Over a Weekend
Everyone Running on New PBX on Monday
Contingency Plan Is to Swap it Back Next Weekend

- General rules of voice trials:
  Move in small, incremental steps with fallback contingency plans at each step
  Start with a pilot trial with a small group of users, sample them often for problem reports

- But in practice:
  Swapping out a PBX or VM is nearly always a flash cut
Management of Migration

- Don’t ever give users bad service
- Start with a small pilot trial
  - Perhaps the Telecom Group
  - Survey and monitor for trouble reports
  - Get a real understanding for feature operation
- Then migrate in blocks
  - Each block over a weekend
  - One or two weeks between blocks to allow for acclimatization
  - Define communities of interest (unlikely to be DN blocks)
  - Make blocks as large as can be managed
- Move trunks either to follow traffic, or in one block (easier for billing)

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Traditional Voice Networking Protocols

Old World

- Old-world VM vendors have reverse-engineered PBX interfaces
- Not only closed protocols: some contracts prohibit reverse engineering
- AVVID provides open interfaces and protocols

AVVID 3.0

<table>
<thead>
<tr>
<th>Vendor</th>
<th>PBX-PBX Protocols</th>
<th>PBX-VM Interfaces</th>
<th>VM Networking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco CCM</td>
<td>PRI</td>
<td>SMDI, Analog</td>
<td>AMIS-A*</td>
</tr>
<tr>
<td>Lucent</td>
<td>PRI, DCS, DCS+, QSIG</td>
<td>Digital Set Emulation Proprietary, X.25-Based</td>
<td>Octelinet Digitaline AMIS-A</td>
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<tr>
<td>Northern Telecom</td>
<td>PRI, MCDN, DPNSS, QSIG</td>
<td>Proprietary (IVMS), Digital Set Emulation</td>
<td>Meridian Mail Network VPI AMIS-A</td>
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<tr>
<td>Siemens</td>
<td>PRI, Cornet, DPNSS, QSIG</td>
<td>BRI with Proprietary Extensions</td>
<td>PhoneMail Networking AMIS-A</td>
</tr>
<tr>
<td>Mitel</td>
<td>PRI, MSDN</td>
<td>Digital Set Emulation Analog DTMF,</td>
<td></td>
</tr>
<tr>
<td>Alcatel</td>
<td>PRI, ABC, QSIG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC</td>
<td>PRI, CCIS, QSIG</td>
<td></td>
<td>MCI</td>
</tr>
</tbody>
</table>

A Selection of Open and Closed Protocols

- Vendors typically offer PRI (and QSIG), but prefer to sell proprietary rather than QSIG
- VM interfaces are nearly all based on reverse-engineering PBX display set interfaces, but the only 'open' standard is analog/SMDI
- VM open networking standards are AMIS-A (but proprietary offers more features) and VPIM, which is based on email standards but is not yet widely available
Voice Messaging Integration Methods

- In-band
- PBX integration devices
- Serial
- Set-emulation–PIC

In-Band Integration

- Voice path by analog extensions in a hunt group
- Integration information is sent on the voice path prior to VM session using DTMF tones
- MWI is set and cleared via feature access codes on dedicated ports
PBX Integration Devices

- An external set-emulation device provides Integration information via a serial link
- Voice path by analog extensions in a hunt group
- MWI may be carried out via the serial link or in-band using analog ports and activation codes

Serial Integration

- Voice path by analog extensions in a hunt group
- Serial data link passes call information
- Call information is sent down serial data link simultaneously with the voice call
- MWI is set and cleared via the serial data link using SMDI or a proprietary protocol
Digital Set Emulation—PIC

- Voicemail system ports emulate proprietary PBX digital feature phones (e.g. voicemail system ports appear as digital extensions on the PBX)
- Also known as “Per-port Integration Card” (PIC)
- Voice path is the same as the data path
- Integration information is derived from the emulated phone’s display
- MWI is set and cleared via feature access codes on dedicated ports

SMDI Overview

SMDI works on an RS232 serial link.
SMDI defines three message types:
Call History message (from PBX to VM):
Includes the following elements:
md-num   A reference number for the call (000-999)
md-port    The analog port for the call
fwd-type   The reason the call was forwarded to VM
   D - direct call
   A - forward all calls
   *B - forwarded on busy
   *N - forwarded on no answer
   *U - forwarded for unknown reason
fwd-sta   the original called (dialed) number
Source-num the original calling number

MWI messages (from VM to PBX):
MWI On   Contains Station Number
MWI Off   Contains Station Number
Error Messages (from PBX to VM):
  *MWI Message was for Unknown Station (NACK)
  *Too Busy to Process MWI Message (BLOCK)

* not passed in CCM 3.0
Voicemail System in Dual SMDI Mode

May require reconfiguration of the Voicemail System

VTG Solution Splits an SMDI Link

VBMux Splits SMDI into Two (Identical) Streams
Calista PBX Link Adapts a PBX for SMDI

Legacy PBX

Voicemail System

Analog

SMDI

Connected Systems
PBXLink
Set Emulation

Call Manager

Gateway

Gateway

Analog

SMDI

To Support Migration, VM System Must Be Converted to SMDI but Some PBX’s Do Not Support SMDI (Lucent, Nortel): PBX Link Is a Product Which Converts the PBX Interface to SMDI

Commonly Used VM Terms

Station Forwarding to Personal Greeting: Upon Receiving a Forwarded Call from the PBX, the VM Must Route the Call to the Appropriate Mailbox

Multiple Personal Greetings: The User Can Record Different Greetings to be Used if the Call Rings No Answer, Rather than Busy, or Forward-All-Calls

Message Waiting Notification: Message Waiting Indication (Usually a Light on the User’s Phone) Is Switched on to Indicate Unread Messages (and of Course Switched Off). Usually, Alternate Methods of Notification, Such As Paging, Are Supported

Out-Calling: Callers in VM Can Press Keys to Transfer Themselves to an Extension, Whether Using ‘Call Sender’ Functions or Dialing the DN

Automated Attendant: Most VM Systems Offer Functions Built on the Out-calling Feature to Provide a Full Auto-Attendant

Multiple Return-to-Operator: VM Users Can Press a Key (Usually 0) to Transfer Themselves to the Operator

Direct Call: When Calling From Their Own Phone (or Using the Message Key) the User Is Immediately Prompted for Their Password – the Mailbox Is Assumed

Reply to Internal Message: Allows the Mailbox Owner One-key Reply by Saving the Caller’s DN (Internal Only) When a Message is Recorded

Call Sender: An Extension of the Above Feature, Where the VM Call Is Transferred to the DN That Left the Original Message
AMIS—A Overview

- Audio Messaging Interchange Specification-Analog standard for networking voice mail systems from different vendors (lowest common denominator)
- Analog connection through the PSTN
  No trans-coding required, mailbox info passed via DTMF allows send/receive/reply (originating mailbox number sent via DTMF tones
  Max message size of eight minutes; max of 9 messages per connection
- Voice only (no fax/e-mail)
- No support for privacy, notification, priority, ‘spoken name’ or distribution lists

VPIM Overview

- IETF RFC2421 (V2.0)
  (uOne supporting V3.0 in 5.1E)
- Utilizes email envelope with MIME attachments
- Multimedia
- Support for privacy, notification, priority, ‘spoken name’ or distribution lists (but not explicitly defined in the RFC)
VM Vendor Characteristics
Cisco Certified Solution

<table>
<thead>
<tr>
<th>Vendor</th>
<th>SMDI Support/Call Manager Certified</th>
<th>Dual SMDI Support</th>
<th>Digital Phone Integration</th>
<th>VPIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Octel 250/350</td>
<td>Yes/Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Lucent Overture 200/300</td>
<td>Yes/Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lucent Intuity</td>
<td>Yes/No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Meridian Mail</td>
<td>*Yes/No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Siemens Phone Mail</td>
<td>*Yes/No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

*Yes = In Centrex Version Only

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Typical PBX-AVVID Migration Steps

PBX/VM Network → Period of Coexistence (Migration) → AVVID Network

Simple Migration PBX-CCM (No Voice Messaging)

- Easy and inexpensive to implement
- Requires minimal reconfiguration of the PBX
- Billing may be difficult to reconcile across the two systems
- Display set users in particular will notice a lack of feature support on CCM-PBX calls
## Capabilities of Links Between PBX and CCM

<table>
<thead>
<tr>
<th>Feature</th>
<th>Calling Number</th>
<th>Calling Name</th>
<th>Diversion Reason</th>
<th>MWI On/Off</th>
<th>Both-Ways Origination</th>
<th>Relative Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>FXO/FXS</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Tiny</td>
</tr>
<tr>
<td>E&amp;M/R2</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Small</td>
</tr>
<tr>
<td>BRI/PRI</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Med/Lrg</td>
</tr>
<tr>
<td>QSIG</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Large</td>
</tr>
<tr>
<td>Digital Set Emulation</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Medium</td>
</tr>
<tr>
<td>PBX Wan Protocol</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Large</td>
</tr>
</tbody>
</table>

PRI Is The Best Available in 3.0

## Features Expected to Work Across the PBX-CCM Link

<table>
<thead>
<tr>
<th>Feature</th>
<th>PBX-PBX</th>
<th>CCM-CCM</th>
<th>CCM-PBX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer</td>
<td>Y</td>
<td>Y</td>
<td>Y (On Originator’s System)</td>
</tr>
<tr>
<td>Conference</td>
<td>Y</td>
<td>Y</td>
<td>Y (On Originator’s System)</td>
</tr>
<tr>
<td>Calling Number Display</td>
<td>Y</td>
<td>Y</td>
<td>Y (May Depend on PBX Configuration)</td>
</tr>
<tr>
<td>Calling Name Display</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Called Name Display</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Call Pickup Groups</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Music on Hold</td>
<td>Y</td>
<td>N</td>
<td>N (No Music When CCM Puts the Call on Hold)</td>
</tr>
<tr>
<td>Camp-on Features</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
| Operator Services     | Y       | N       | N (Unless a Separate CCM Attendant Is Configured) * May require special configuration
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Two AVVID Flash Cut Models (Telephony and Voice Messaging)

A: PBX/VM to AVVID/uOne
B: PBX/VM to AVVID/VM
Flash Cut from PBX/VM to Ccm/uOne (Model A, Moving to uOne)

VM System

Legacy PBX

Legacy PBX/VM

uOne Gateserver

Call Manager

Cisco AVVID Network

Relatively Easy

Flash Cut from PBX/VM to CCM/uOne (Model A with VM Networking)

Networked VM

VPIM, AMIS-A or Proprietary

VM System

Legacy PBX

Legacy PBX/VM

Cisco AVVID Network

Must Use a Standard Voice Mail Networking Protocol (e.g. uOne AMIS-A in 5.0E)
Flash Cut from PBX/VM to CCM/VM (Model B)

Digital Set Emulation (Most Common Type of PBX to VM Integration)

VM System

Legacy PBX

Legacy PBX/VM

Must Convert VM to SMDI/Analog Interfaces
Must Use VG200 or AT8 or Catalyst 6000 Gateway (Not H.323 gwy)
Allows VM Networking

SMDI

Analog Trunks

Gateway

Call Manager

Cisco AVVID Network

Verify SMDI Support

VM System

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Three AVVID Migration Models (Telephony with Voice Messaging)

A: The initial AVVID trial
Simple, inexpensive to set up
Functional except for AVVID MWI

B: The enhanced AVVID trial
More difficult and expensive to set up
Adds AVVID MWI functionality

C: The initial AVVID/uOne trial
Simple, inexpensive to set up
uOne does not network with VM

Simple Migration PBX/VM—CCM (Model A)

- Gives CCM users access to voice messaging as they migrate from the PBX
- Relatively inexpensive to implement
- No MWI for CCM users
- Calls to CCM users will not receive personal greeting unless the workaround is used
Complex Migration PBX/VM-CCM (the Model A Work-Around)

Whenever a user is added on CCM (e.g. 3002), a phantom port is added on the PBX (here 7002 for 3002)
This number is configured for call-forward-all-calls to 4000
Now all calls diverted out of CCM to VM forward via the respective phantom port; they will receive the appropriate mailbox greeting

Migration from PBX—CCM Using One VM (Model B)

Provides MWI for AVVID users
VM must support two PBXs simultaneously
Often requires that the VM system (and PBX) are converted to analog/SMDI (if “VM only supports one type of integration at a time”)
Requires administration effort as users are moved to CCM
Dual Integration (Required for Model B)

- Sometimes necessary for migration or co-existence
- SMDI is currently the only protocol that can handle this requirement
- Lucent (Octel) 250/350 “can” talk to two systems simultaneously as long as integration type is SMDI
- Supported by Lucent
- Need to verify ability and support on vendor by vendor basis
- PBX/VM conversion to SMDI may be required

Migration PBX/VM—CCM/uOne (Model C)

- Gives CCM users access to full CCM features as they migrate from the PBX
- Relatively inexpensive to implement
- No VM interaction between VM and uOne (until AMIS or VPIM networking)
- DID trunks should be moved from PBX to CCM follow users
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Company C Telephony Migration: Original Network

Company C network characteristics:
- Heavy reliance on VM networking
- Less concern for voice features
- Too many users to do in a weekend

Company C migration strategy:
- Move voice first, VM later
- Flash-cut field offices
- In San Jose, make all new phones IP
- Use a new DID block for IP phones
- Migrate existing SJ users later

San Jose: 15000 Users, 25000 Lines
2 Definity G3
4 Octel 350

Larger Field Office: 300 Users, 400 lines
1 Definity G3 or Meridian1
1 Octel 250
Current California Topology
Build-Up ‘133’

California Migration Strategy
(Model B)

- Provides MWI for AVVID users
- Often requires that the VM system (and PBX) are converted to analog/SMDI (if “VM only supports one type of integration at a time”)
- VM must support two PBXs simultaneously
- Requires administration effort as users are moved to CCM
Install Call Manager Cluster for Each NXX

126 NXX Cluster

127 NXX Cluster

125 NXX Cluster

133 NXX Cluster

Basis for Existing User Migration

Migrate PBX’s Out, Keep Octel

Call Manager NXX to NXX Voice Path
Primary Path—Via Campus IP
Sec Path—Through PSTN if necessary

S.J. Campus IP

PSTN

Octel Net

OctelNet to Remote Sites

SMDI Link

Octel VM

Octel VM

Octel VM

Octel VM

Octel VM

Octel VM
Smaller Field Offices: Flash Cut from PBX/VM to CCM/VM

Digital Set Emulation
(Most Common Type of PBX to VM Integration)

VM System

Legacy PBX

Legacy PBX/VM

Cisco AVVID Network

SMDI

Analog Trunks

Gateway

Call Manager

Migrate Out PBX’s and Keep Octel
Maintain Voice Mail Networking

California

4 Octel’s

4 SJ Clusters

North East Area

NY

Boston

Charlotte

Atlanta

South East Area
Migrate to uOne by Theatre
Maintain Voice Mail Networking within
Administrative Areas

uOne/Octel Networking Assumptions

- Networked voicemail features are more important to Company C users than networked PBX features
- Critical to keep administrative theatres networked (communities of interest)
- Networking to California not as important
- AMIS-A between California and theatres
- VPIM when available
Staged Flash Cuts of VM (Octel) to uOne

- California
  - 4 Octel's
  - 4 S.J. Clusters

North East Area
- Boston
- NY
- Charlotte
- Atlanta

South East Area

Flash Cut VM Per Area/Operation

Cut over California VM Last

- California
  - 4 S.J. Clusters

North East Area
- Boston
- NY
- Charlotte
- Atlanta

South East Area
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The PBX Billing Environment

- Conventional PBX setup
  PBX logs to a CDR file or uses SMDR to external logging device
  Software can be owned/operated by PBX owner, or by post-processing application/bureau
- Used for departmental bill-back
- Used for carrier billing check/reconciliation
- Options for networked PBXs
- Used for fraud detection
The AVVID Billing Environment

- AVVID billing setup
  CallManager (or cluster) logs call records to the SQL database
  Billing partner’s software can interface to the AVVID CDR database
- Offers all the features of PBX-based billing
- With AVVID, there are more often on/off net WAN and networking considerations

Billing: The Importance of Trunk Location

- Tracking for external calls is more important than internal
  Because external calls cost real $;
- In migration, the system (PBX or CCM) with trunks attached should track billing information
  So billing is simpler if all trunks are on one system
  Depending on the PBX-CCM link, it may be difficult to track a call’s originator
AVVID CCM 3.0 CDR

- CDR is now part of the SQL database (was a flat file in 2.4)
- CDR is maintained across a cluster
- If a call manager in a cluster fails, its call records are automatically closed
- If the publisher in a cluster fails, other CCMs in the cluster continue to collect their CDR’s (and update the database)

Current AVVID Billing Partners

- MIND CTI
- IntegraTRAK
- ISI
- Telemate.Net
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Power-Fail Resilience

- PBX model: Centralized equipment in a switch room is backed up
  - By batteries and inverter
  - By short-term UPS
  - By UPS and diesel generator
**Power-Fail Resilience**

- AVVID model: equipment is distributed
  - To back up phones, use line-power and local UPS in wiring closets
  - To back up call managers, use local UPS
  - For resilience to long-term outages, use a diesel generator

**Reliability-Backup Power (Simplest Solution)**

- A UPS powers the switch room equipment
- In a power outage, lighting, phones and data comms will not work (unless analog sets are driven from gateways in the switch room)
- After a power outage, no CallManager reload is required
Reliability-Backup Power (Comprehensive Solution)

- A UPS powers the switch room equipment with a UPS with each floor-level switch
- Provides power for voice and data comms through short outages (<20 minutes)
- During a power outage, phones will work provided in-line power is used

Reliability-Backup Power (Long-Term Solution)

- A UPS powers the switch room equipment with a UPS with each floor-level switch
- UPS provides short-term power
- Generator provides long-term power
Reliability-PBX Redundancy

Normally:

- Redundant rectifiers
- Redundant common equipment (CPU)
- Redundant network switching cards
- Non-redundant line and trunk cards
- Non-redundant wiring and distribution
- Non-redundant phones

- Since trunks are redundant it is not usual to make trunk cards redundant
- Worst case failure is if a line card fails (<16 phones fail)

Reliability-AVVID Redundancy

- Call managers will normally be redundant (possibly N+1)
- If there is a main LAN switch, that may be made redundant
- Other components are normally replicated, as they are distributed in an N+1 fashion due to the network design
- Worst case failure is one of the floor-level LAN switches: Perhaps several tens of phones; or a trunk gateway: A large number of trunks may fail
Recommended Wiring Plan

Switch Room to Closet-10/100BaseT or Gigabit Ethernet
Closet to Office-Catalyst 5 UTP

Emergency Services

- Enhancements can include:
  - Provide ANI (calling number) with the call
  - Alert local emergency response team
  - Link to a database mapping ANI to location of the phone
  - Special access code
  - Maintain call even if the caller hangs up
E911 Services in the USA

- Basic 911 (B911: not applicable to PBXs)
- Enhanced 911 (E911: currently legally required only in the States of Illinois and Washington)
- E911 provides 3 functions:
  - When 911 is dialed from any phone, the call is routed to the public network (as 911)
  - A call-back number is routed with the call. (ANI/PRI, or ANI/MF signaling on FGC CAMA trunks)
  - Phone location information is provided to the Public Service Answering Point. (This is normally done by a database which maps location information (ALI) to the ANI provided)
- AVVID complies with (1) using the normal route tables
- AVVID complies with (2) using a PRI trunk (DT24+)
- External equipment can be added to analog lines/trunks to support CAMA
- AVVID complies with (3) by using an external database (see below)
- Privacy features must not hide the calling number on 911 calls

Many Large Companies and Universities Also Alert Internal Security Offices on 911 Calls
Some Large Companies and Universities Have Their Own PSAP, Manned by Security Personnel
Enterprise PBX to IP Telephony Migration Strategies

Session 2100

Please Complete Your Evaluation Form

Session 2100