

# Cadence Design Systems, Inc. C\*D\*N Global Network Overview

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# Executive Summary:

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1. Present a High Level View of Our Old Environment
2. State the Voice Networking Challenge
3. Describe of Engineering Parameters Needed
4. Discuss the Different Alternatives and Our Options
5. Diagram Out the Network Design and Ramifications
6. Illustrate our Findings after 8 months of Operations

# Who is Cadence?

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Cadence Design Systems, Inc. is the world's leading provider of software for electronics designers and services to support them.

Our technologies are used in the design of almost every electronic system produced anywhere in the world today.

# Cadence Demographics

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- We are a Fortune 1000 Company
- Our Headquarters is in San Jose, CA USA
- We have 57 Sites in 17 Countries
- We employ roughly 5,300 Employees Globally

# Network Environment at the start of FY2003:

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1. One Private Line Route between San Jose and Austin (48 voice channels)
2. One VoIP Route between San Jose and Noida, India (10 voice channels)
3. One VoIP Route between San Jose and Japan (12 voice channels)
4. All other calls placed on MCI V-Net or In-Country PTTs

Vast Majority of the PBXs are Meridians or other Nortel platforms.

# Call Center Environment at the start of FY2003:

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1. One Customer facing Call Center based in Austin, TX.
2. One IT Helpdesk Call Center, based in Sandy, UT.
3. One Educational Services Call Center in San Jose, CA

The Austin Call Center and the IT Call Center based upon an old version of the Nortel Symposium Platform w/ Periphonics IVR.

Educational Resources used Basic ACD

# FY2003 C\*D\*N Action Plan:

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1. Deploy a Global Call Center Platform with Multiple Virtual Call Centers
2. Place the Initial Focus for Customers and Agents in India, EMEA, and North America
3. Link our Major Sites together to lower Operations Cost
4. Plan for Disaster Recovery!

# C\*D\*N Operations Challenge:

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1. Create an **Excellent** Value for our Customers
2. The Network **MUST** be Very Cost Effective
3. Keep the Total Cost of Operations (TCO) **VERY** Low
4. Keep a **Consistent** User Experience Across all Sites.
5. Toll Quality Voice **Everywhere** to **Everywhere** if at All Possible

# Design Factors for the New Voice Network

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- Toll Grade Voice
  - It can be hard enough understand one another with different cultures & dialects without voice quality degradation of the conversation
- Sustain or Improve the Quality of the Voice from the Carriers
  - The Dublin Example!
- Absolute Lowest Latency
  - Eliminate the “Walkie-Talkie” effect as much as possible
- Design for Extremely Reliable & Robust 7 / 24 / 365 Operations
- Seamlessly Support the Call Centers & PBXs
- Very Low Total Cost of Ownership
- Very Fast Deployment & Turn-Up

# Alternatives Considered

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## Transport Methods:

- Private Line Routes
- Nortel VoIP
- Cisco VoIP
- Nortel Passport 7400s

## Network Design:

- Where to Place Network Nodes
  - One POP per Region vs.. Multiple POPs per Region?
- Which Carriers to Interface with
  - Single Vendor vs.. Regional Carriers?
- Call Center Locations
  - Keep existing 3 Call Centers or Place a Call Center Node in Each Region?

# Transport – Private Line Routes

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- How To Deploy:
  - Directly Tie the Chosen PBXs Together
- Advantages:
  - Fast, Easy Deployment
  - Proven Solution
  - Seamless PBX / Call Center Interconnection w/ MCDN
  - Allows Direct Trunking vs. Hub and Spoke Network Architecture
- Disadvantages
  - No Voice Compression – each voice channel = 64k bandwidth hog
  - No Echo Suppression
  - Harder To Manage
  - Legacy Style Private Network

# Transport – Nortel VoIP

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- How To Deploy:

- Tie each Chosen PBX together via the Cadence WAN, with the IP conversion in each Nortel switch

- Advantages:

- Reasonable Voice Compression – one voice channel = 21k bandwidth
- Seamless PBX / Call Center Interconnection w/ MCDN

- Disadvantages

- No Echo Suppression
- Cadence WAN did not support QoS and was Designed “Hub and Spoke”
- Troubleshooting Tools Not Where We Felt They Should Be
- Longer Deployment Anticipated
- Would have to Upgrade Multiple PBXs from Several Vendors

# Transport – Cisco VoIP

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- How To Deploy:
  - Tie each Chosen PBX into the local Cisco Router via an PRI pipe, convert the TDM to IP, then route through the Cadence WAN
- Advantages:
  - Reasonable Voice Compression – one voice channel = 21k bandwidth
  - Cadence WAN would handle Entire Transport
- Disadvantages
  - No Echo Suppression
  - Cadence WAN did not support QoS and was Designed “Hub and Spoke”
  - Troubleshooting Tools Not Where We Felt They Should Be
  - Cisco Didn’t Appear To Support the Entire MCDN Protocol
  - Longer Deployment Anticipated

# Transport – Nortel Passports

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- How To Deploy:

- Tie each Chosen PBX into a local Passport Node, then tie to other Passports through our own Network

- Advantages:

- Best Voice Compression – one voice channel = 8k bandwidth Voice/ATM
- Complete Echo Suppression – Inbound PRIs to Each Node
- We Completely Control Our Network & Dial Plan
- Seamless PBX / Call Center Interconnection w/ MCDN
- Can Handle IP as well as Voice over ATM
- Allows Direct Trunking vs. Hub and Spoke Network Architecture
- Passports are a “Carrier Grade” Solution

- Disadvantages

- It's a Separate Network

# Bandwidth Comparison

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- Bandwidth Utilization was Absolutely Key in Keeping The TCO to a Manageable Level

<b>Transport:</b>	<b>Compression:</b>	<b>Effective Bandwidth / Call:</b>	<b>Calls / T-1:</b>
Private Lines	none	64k	23
Nortel VoIP	G.729	21k	68
Cisco VoIP	G.729	21k	68
Passport VoATM	G.729	8k	170

# Transport Choice: Nortel Passports

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- Major Considerations

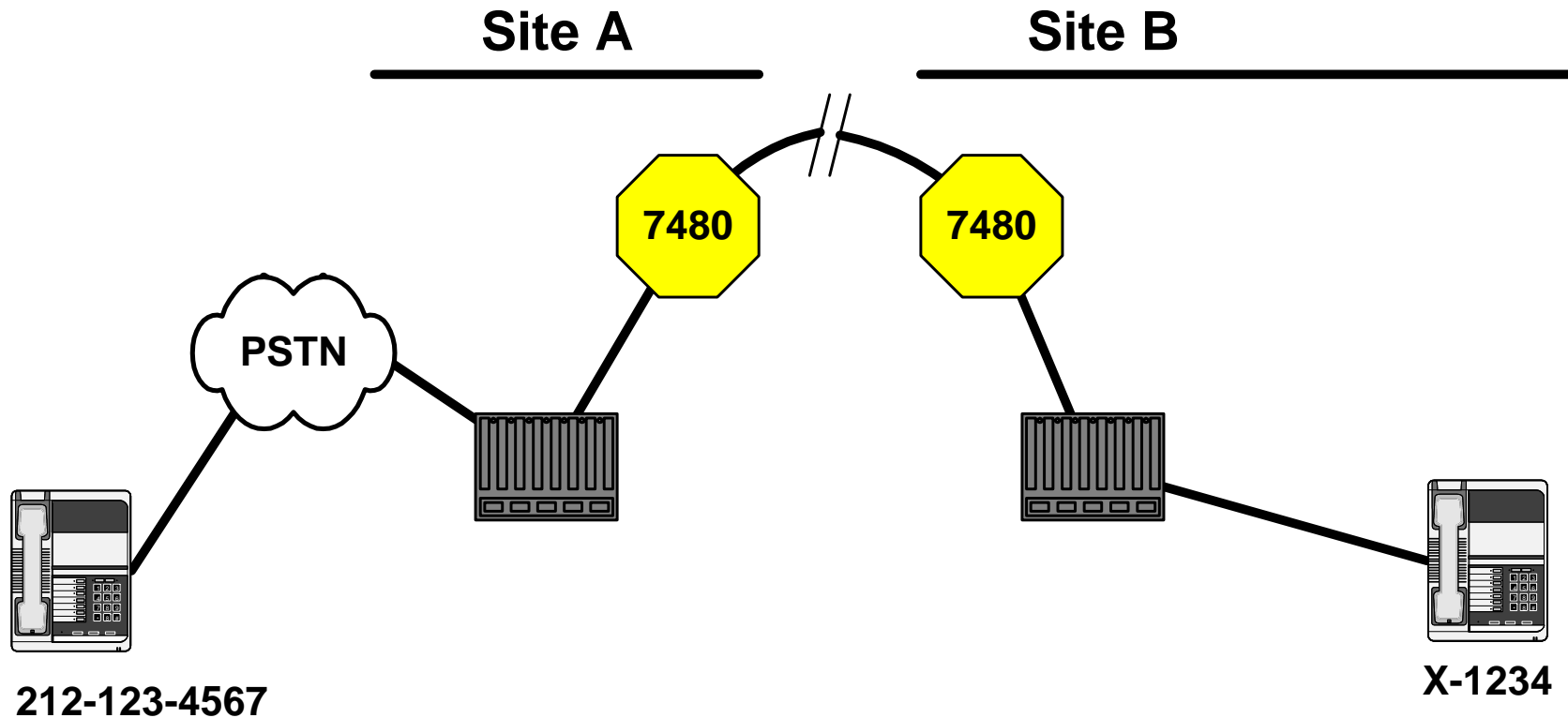
- Superior Bandwidth Utilization
- Echo Suppression
- Allows Immediate Direct Trunk Network Layout
- Seamless end to end Support for MCDN and the Call Center Architecture
- “Carrier Grade” Solution
- Fast Deployment Time

- Supporting Considerations

- ‘0’ Bandwidth Utilization when no calls present
- We can have three separate dialing plans
- Clean Automatic Fail-over
- Numerous Network Features

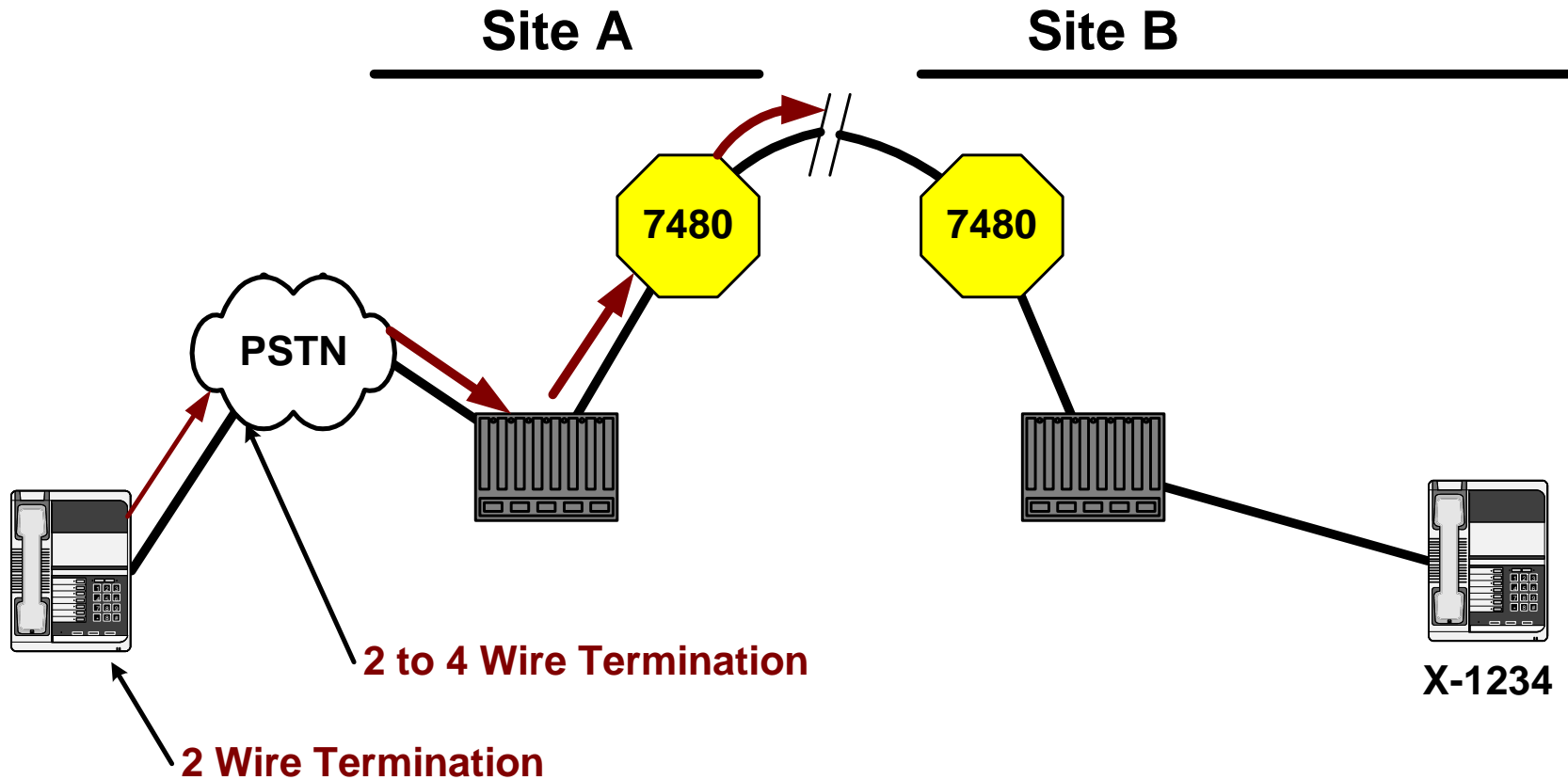
# Quality Issue #1 - Echo Suppression

Typical Forwarded Call From Vendor to You at a Remote Site



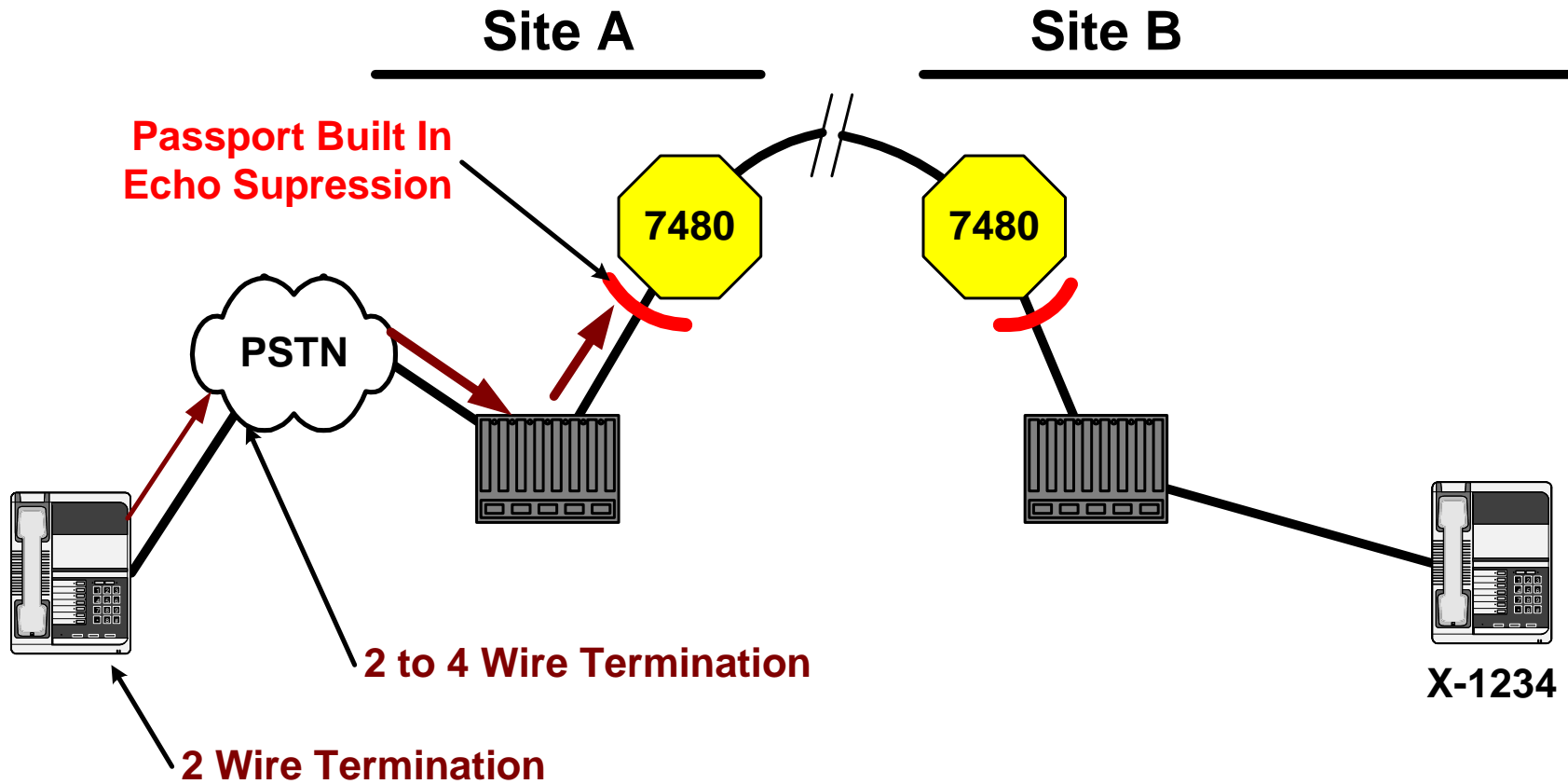
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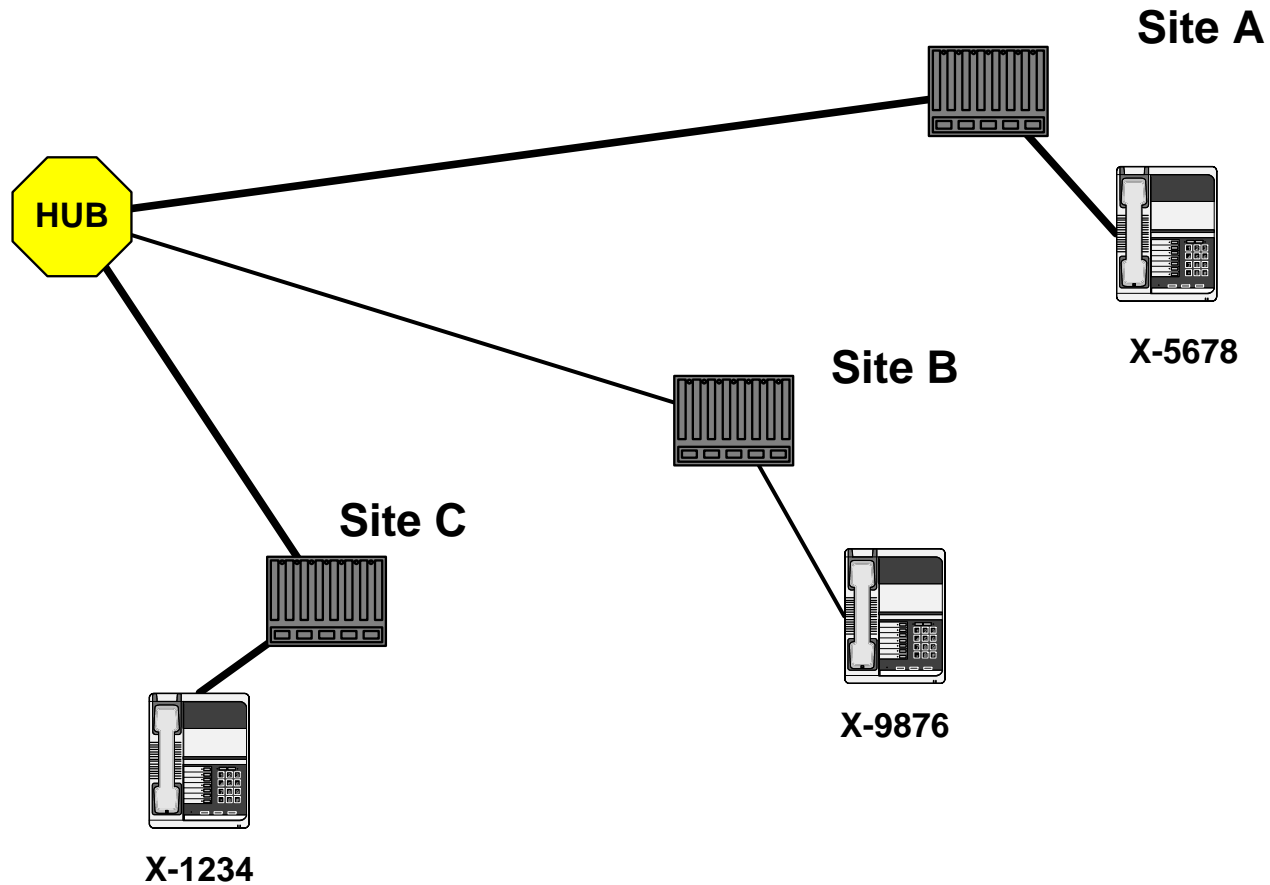
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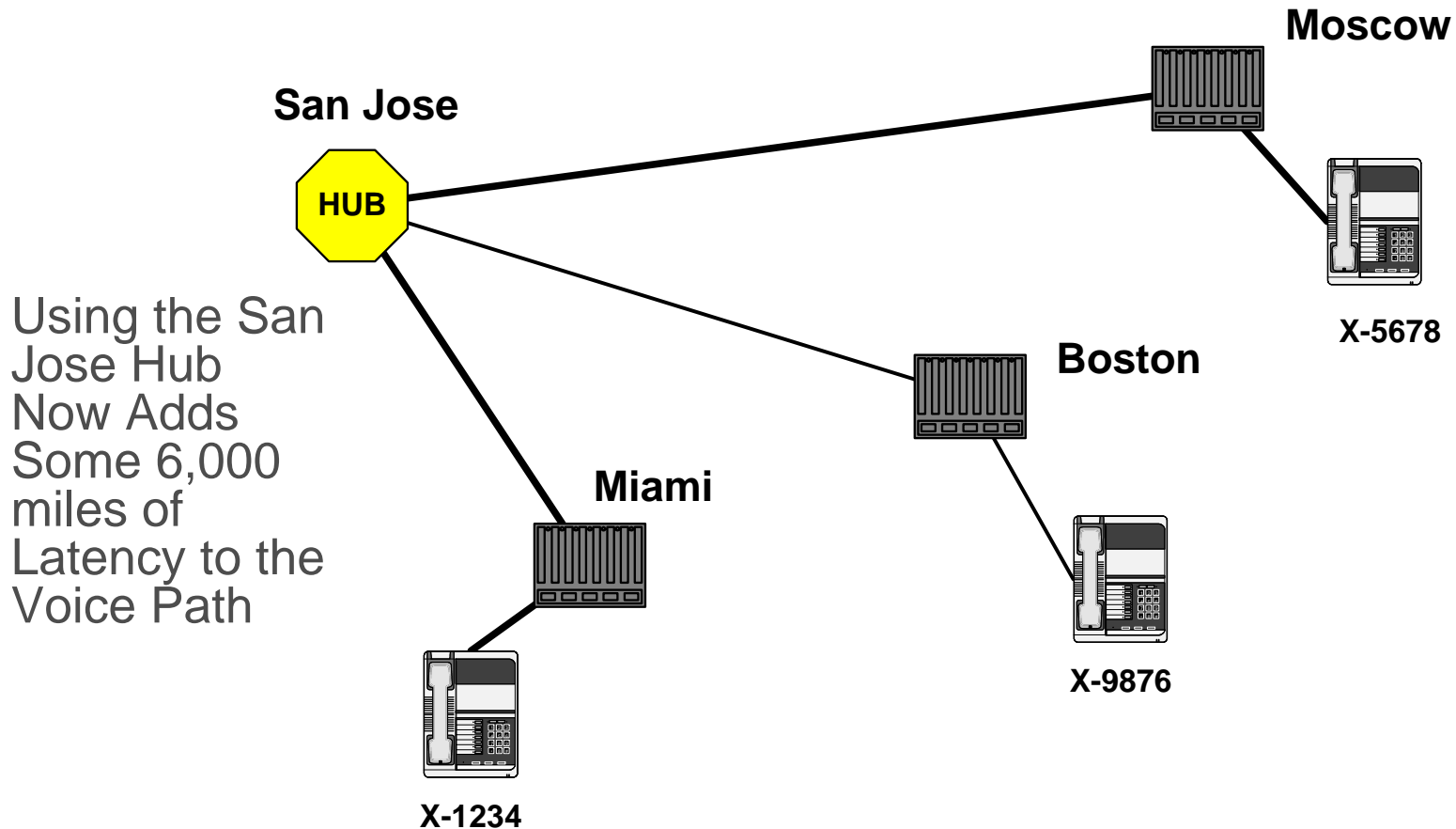
# Quality Issue #2 - Latency

Typical Call From Site A to Site C via the Hub



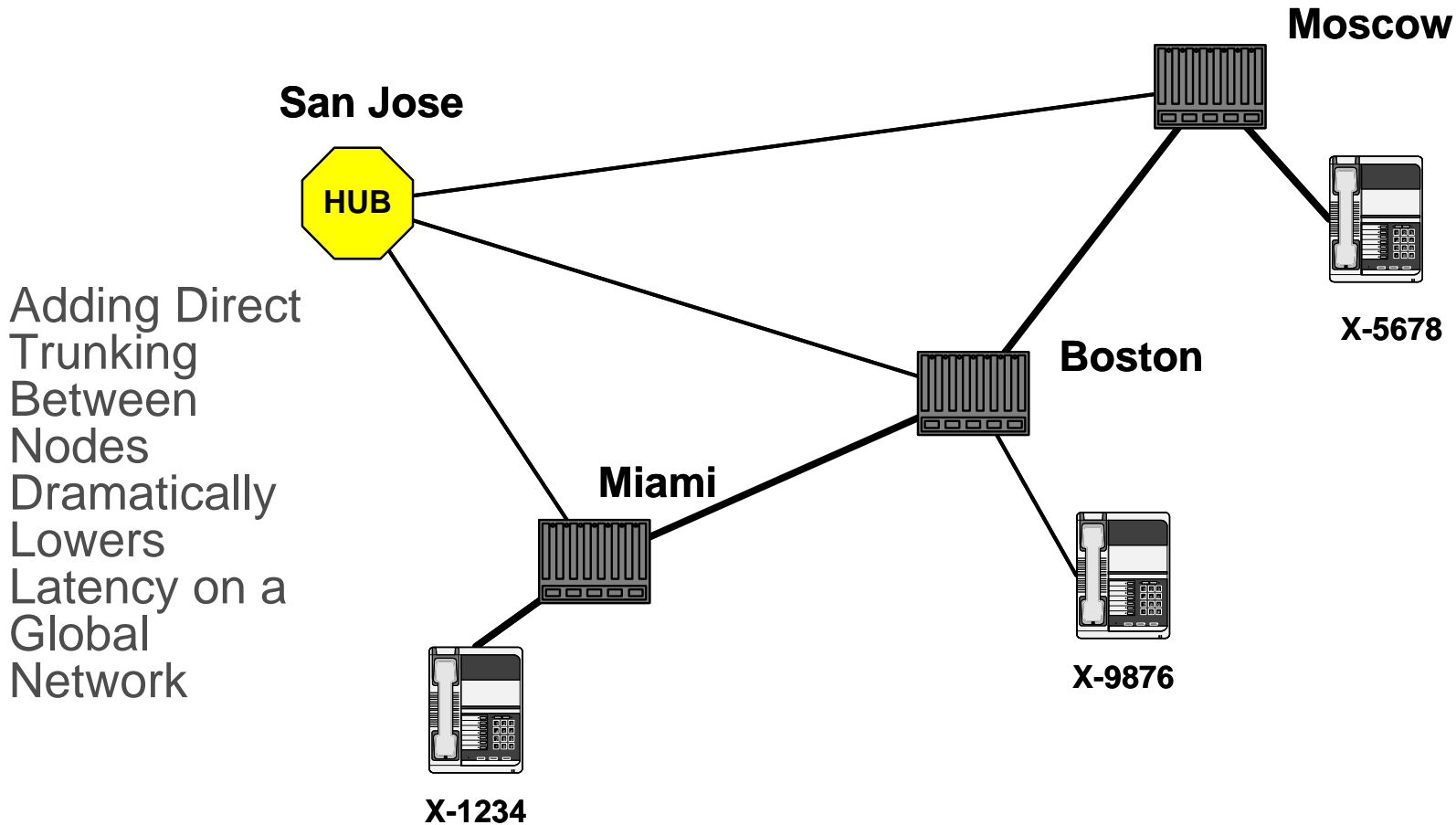
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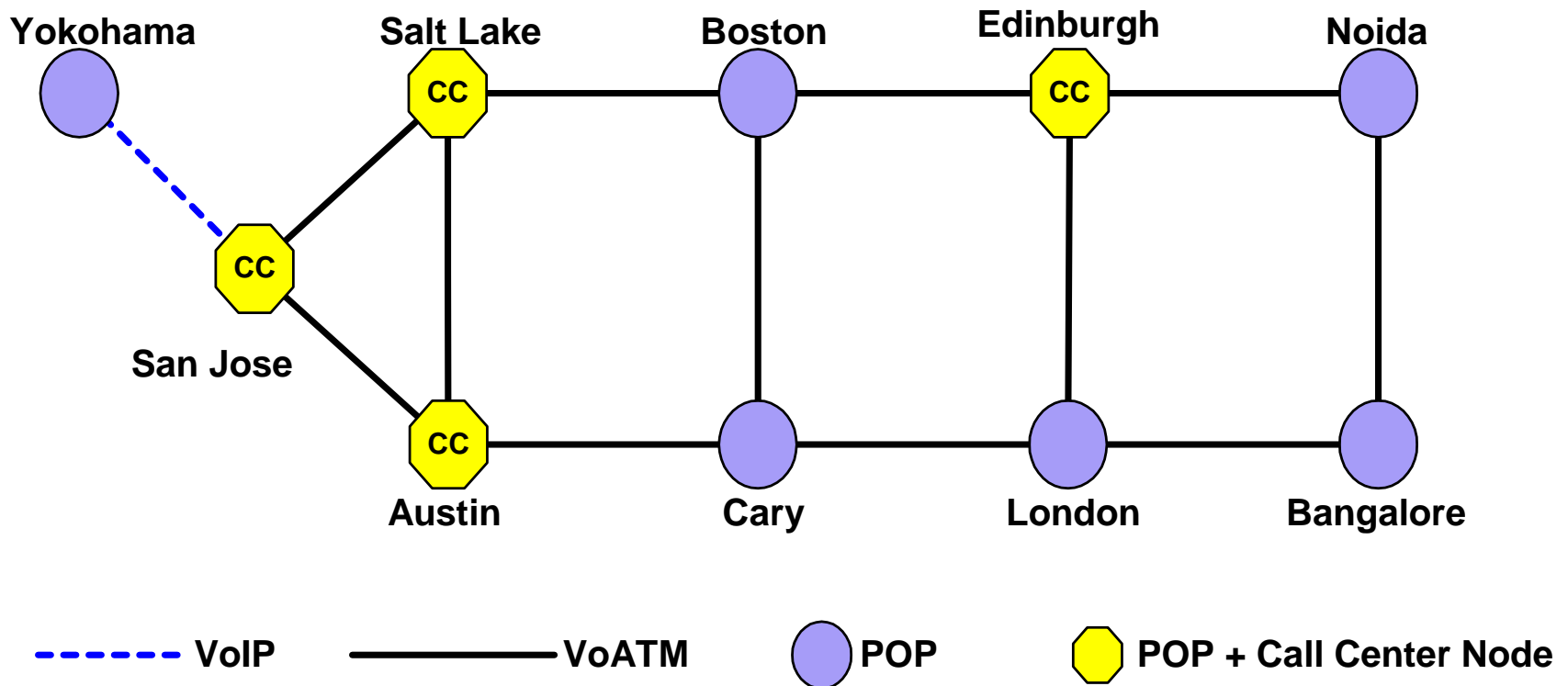
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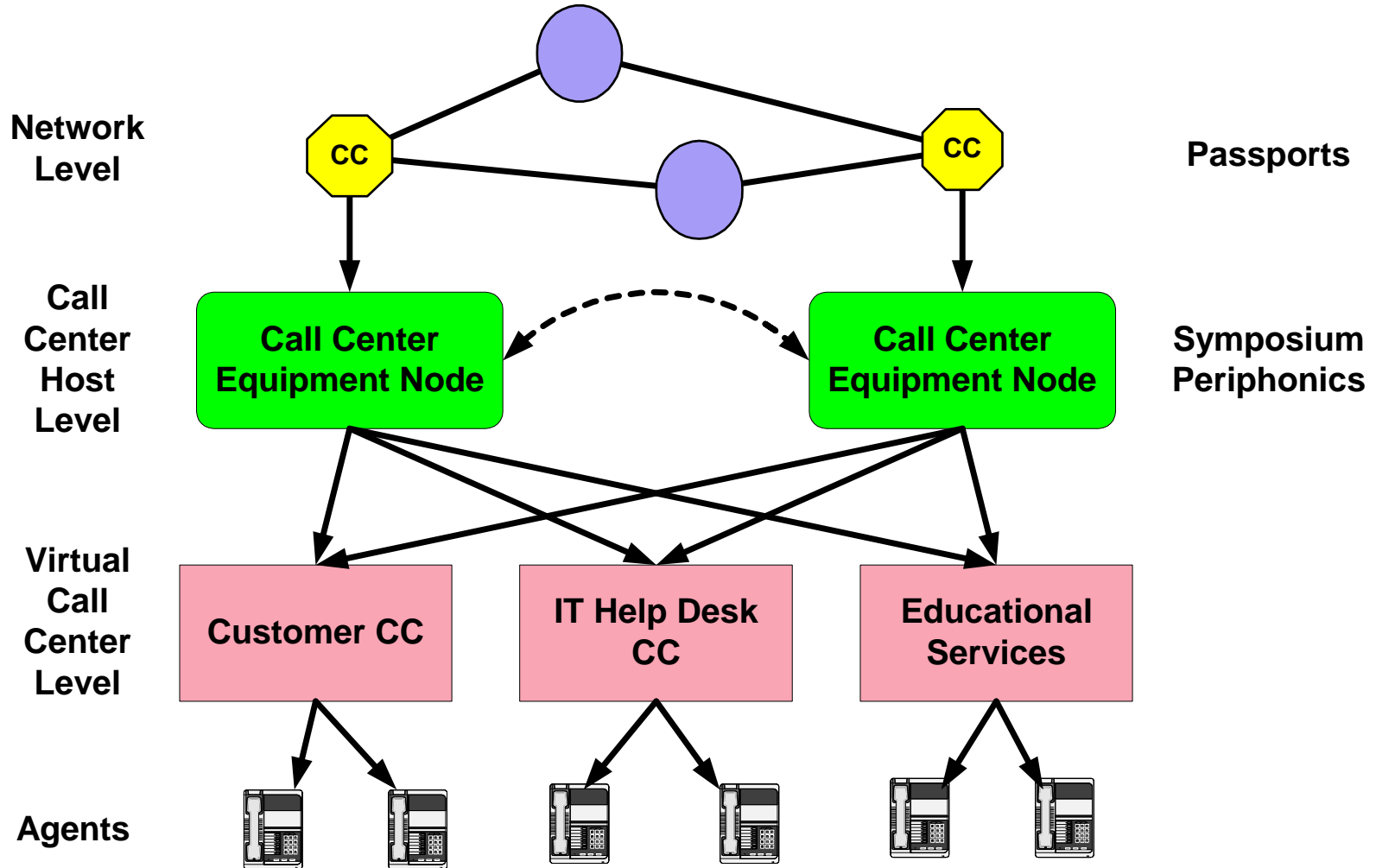


# Overall Network Design

9 Passport Nodes, Multiple POPS / Region,  
Eliminate Common Single Points of Failure



# Overall Call Center Design



# Cost Analysis Using the PSTN

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Effective Cost per Minute per Month is calculated:

$$\frac{(\text{Average Cost / Minute} \times \text{Total Minutes of Use}) + \text{Fixed Monthly Circuit Cost}}{\text{Total Minutes of Use}}$$

$$\frac{\$0.03 \text{ average cost} \times 500,000 \text{ total minutes} + \$5,000 / \text{month}}{500,000 \text{ total minutes}} = \$0.04 / \text{minute}$$

*For the purposes of this analysis, we are ignoring the labor and depreciation on the PBX and it's ports.*

# Cost Analysis Using a Private Network

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Effective Cost per Minute per Month is calculated:

$$\frac{\text{Fixed Monthly Circuit Cost} + \text{Monthly Depreciation on Equipment}}{\text{Total Minutes of Use}}$$

**#1**

$$\frac{\$18,000 / \text{month} - \text{circuits} + \$2,400 \text{ depreciation}}{500,000 \text{ total minutes}} = \$0.0408 / \text{min}$$

**#2**

$$\frac{\$18,000 / \text{month} - \text{circuits} + \$2,400 \text{ depreciation}}{600,000 \text{ total minutes}} = \$0.0340 / \text{min}$$

*On a fixed cost network, the more calls you transport, the lower your effective cost / minute*

# How Is This Working?

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- Good News:

- We now run over 500,000 minutes of use / month
- Passports are extremely reliable and dependable
  - MTBF > 226,800 Hours
  - No Multi-Node Network Outages
- Voice Quality is Excellent
- Our Customer Satisfaction Level is Very High
- We are now expanding our Voice Network using these same Design Principles

- Improvements:

- One hard disk problem with-in 3 weeks of the Node turn-up
- We needed and obtained a patch in the Passports to get Network ACD functions with longer dial strings
- We need to purchase the Hunt Group Server so that the Dial Plan routing responds to Node Outages

# Our Conclusions:

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1. Good Network Design is Critical
  - Right Transport Medium
  - Right Equipment and Vendor
  - Right Network Design
2. You can have absolute Seamless Integration with Symposium & IVRs and form a Global Call Center Infrastructure
3. Good Toll Quality Voice is achievable with G.729 compression on a global scale
4. Best Bandwidth Utilization Possible is Critical to keeping your operations costs to a minimum
5. Your Initial Hardware Choices will Dictate what your Operational and Support costs will be.