Transformation of Enterprise Communications Network Topologies

Driven by Unified Communications Adoption

Including Collaboration and Social Networking

Introduction: Unified Communications Changes

Innovative communication technologies are emerging at an unprecedented pace. As with almost any new technology, businesses are adopting and adapting these new technologies wherever they can provide improvements for their owners, shareholders, customers, employees, communities, and societies. A brief description of new technologies and the changes they are enabling is provided in Appendix B.

One very important effect of these changes is a radical revision to the communication topology of most business enterprises world-wide. In the category of real-time communications, this seemed to be addressed by the movement to Voice over Internet Protocol (VoIP). Almost all existing makers of Private Branch Exchanges (PBXs) evolved their systems and telephone end-points to Internet Protocol (IP). Also, both small and large suppliers from adjacent technology categories entered this market. This is exemplified in the Gartner Magic Quadrant for Corporate Telephony 2011 by the inclusion of Cisco (Leaders quadrant), Microsoft (Visionaries), and Huawei (Niche).

However, with the exception of Microsoft, Skype, Google and a few other smaller entrants, both the incumbents and the new entrants have essentially produced copies of older PBX systems and architectures using IP packets rather than Time Division Multiplexing (TDM) digital formats. Since Microsoft and some smaller players entered the market from the perspective of Unified Communications rather than VoIP-based telephony, the architectures of their systems do not follow traditional PBX models. Some traditional players, most notably Cisco and to some extent Avaya, Siemens and NEC, are moving as swiftly as possible to reposition their products and solutions (through acquisitions and redesigns) as multi-media business communications engines, primarily under the banner of 'collaboration.'

SIP Trunks: Based on Flawed Assumptions

Because the PBX market has evolved to VoIP, the traditional telephony carriers needed to offer a migration from their TDM trunk facilities to VoIP. Since many of the IP PBX suppliers used the Session Initiation Protocol (SIP), the carriers created and began to deploy IP connections known as SIP trunks. Today, a major thrust in the enterprise telephony market is the emphasis on migration to SIP trunks as a direct replacement for TDM trunks (referred to as "T-1", "E-1", "PRI", etc., depending on deployment options).

However, this emphasis by the telephony (local and long distance) carrier industry on SIP trunks appears to be a sub-optimum approach to meeting enterprise needs for new communications facilities when an enterprise migrates to Voice over IP/IP Telephony and to Unified Communications. The sub-optimization characterization is based on two major, but flawed, assumptions:

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1. The first flawed assumption is that most of the enterprise customer's traffic would continue to be voice conversations routed through the PSTN or through PSTN carrier facilities, even as those voice conversations moved to VoIP technology.
   This assumption is flawed for three reasons:
   a. With the exception of consumer-facing contact centers and some inter-company communications, a large portion of business communications has moved away from voice calls to more efficient methods including e-mail, web portals, instant messaging, and various forms of collaboration. All of these alternative methods use pure Ethernet or IP bandwidth, not PSTN connections. Those alternatives are far less costly and generally far more efficient in labor costs and business results.
   b. For much of the remaining voice traffic, new unified communication products (such as Microsoft OCS/Lync, IBM Sametime, Cisco WebEx, Skype and others) deliver voice conversations as Ethernet packets utilizing enterprise or network provider bandwidth, not PSTN circuits. These products can provide end-to-end encryption of the voice sessions between user's endpoints or between endpoints and servers. Therefore, SIP trunks and the additional cost of Session Border Controllers are not needed for voice calls within the enterprise or between enterprise users and their customers or suppliers who are using an appropriate software end-point or who are federated with the organization's UC platform.
   c. Enterprises are becoming much more 'virtual' as employees increasingly work from IP-network connected home offices and also shift their residual voice communications to mobile devices. Further, mobile devices are increasingly implementing VoIP on the wireless data network, as exemplified by Skype smartphone clients and tablet apps. None of the traffic in this category would flow in or out of the enterprise, or between the remote end points, on SIP trunks. Rather Internet bandwidth is used with appropriate encryption and with software adjustments for quality of experience (QoE) rather than network management for quality of service (QoS).

2. The second flawed assumption is that buyers of communication services for VoIP installations and for TDM PBX upgrades would most readily purchase a product that was as similar as possible to a "trunk" connection. Thus as enterprises migrate to VoIP/IP Telephony and Unified Communications, the buyers could simply order like-for-like, one-for-one SIP trunks in place of the existing TDM circuits, i.e. T-1 and E-1 premise terminations.
   This assumption has some validity, but is also partially flawed for the following reasons:
   a. The implementation of SIP trunks is roughly as capital-intensive as for traditional TDM trunks. Specifically, enterprises currently feel they must purchase and install Session Border Controllers (SBCs) to manage the security of the enterprise network at the point of the IP connection to the common carrier. These SBCs (or Cisco Unified Border Elements, or CUBEs) cost roughly the same amount as the TDM gateways and the circuit packs they replace.
   b. The migration from TDM to SIP trunks is not mandatory. All IP PBX providers offer TDM (T-1 and E-1) options for connection to the carrier networks and between the

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enterprise's locations. Thus, if there is any question of economics or functionality, the enterprise is able to move to VoIP while remaining with TDM trunks for some or all of their traffic.

c. SIP trunk services do not provide all the services of TDM trunksand are inconsistent between the carriers' points of presence (e.g. local central offices). In many cases, the carriers have not upgraded their local central offices for SIP services consistently. Consequently, the customer may find that SIP trunks are not available in each location or do not provide important functions such as incoming Direct Inward Dial (DID) service or circuit failover options commonly available with TDM connections.
d. Unified Communications applications utilize different network services. SIP trunks are designed for direct replacement of TDM voice channels. However, UC brings new requirements such as higher bandwidth SIP channels for video over IP sessions, much lower bandwidth IP sessions for presence and Instant Messaging, or very irregular bandwidth needed for desktop image and application sharing. While SIP trunks can be grouped to provide a more generic bandwidth pipe, the standard offering of one SIP Trunk per simultaneous voice conversation is not compatible with Unified Communications bandwidth requirements.

Internet Bandwidth: A Cost-saving Option

In parallel to these developments, Internet bandwidth offered by Ethernet-based IP Backbone providers is becoming increasingly economical and available. Expert sources report reliable Ethernet-based IP backbone services carry a monthly charges of approximately $10 per megabit per second. Even at 50% load (500 kbps), this would support 5 simultaneous voice conversations with G.711 encoding (90 kbps including headers) or 16 voice conversations with G.729A encoding (30 kbps including headers). Clearly, a monthly cost of $1 to $2 per voice channel per month would be a significant savings over either SIP trunk or TDM trunk monthly costs. Or, enterprises could spend, say, $5 per voice channel per month and be able to deliver higher quality wide-band, uncompressed voice quality while still reaping some portion of the savings compared to TDM trunk replacement or SIP trunk avoidance.

An even greater advantage can be had if the bandwidth provider is able to deliver the voice traffic into the PSTN via points of presence appropriate to the customer. In other words, the enterprise would not have to contract for either TDM or SIP trunks to the PSTN from their own premises. Rather, the bandwidth provider could insert voice traffic onto the PSTN at the most attractive points of presence (POPs). A monthly service charge plus any applicable PSTN tolls and taxes would be billed back to the enterprise, but major savings could still accrue both since (1) the enterprise would not need to configure on-premise trunks for peak traffic, but rather share larger trunk groups operated by the bandwidth provider; and (2) the enterprise could experience major cost reductions in long distance charges, especially in the case of international calling.

The consequence is that increasing numbers of enterprise customers are likely to base their communication architectures on expansions of their Internet bandwidth as part of a converged network plan rather than investing in SIP trunks as a separate, partitioned, and unshared communication facility. SIP or TDM trunks will then be needed only for those voice communications which need to connect to

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the public switched telephone network (PSTN) (whether from the premise or via the network provider's POPs) for outgoing or incoming calls with the public or with partners and clients who are not accessible via Internet connections (federated, shared carrier backbone, native internet, etc.).

New Unified Communications Network Topologies

The impact of these developments for any specific enterprise will require a more detailed analysis, but modeling tools can readily be created by network /communications architects and systems engineers. A progression of illustrations is provided in Appendix A, following. The enterprise structure is overly simple (One large, one medium, one small location), however this structure is used in the Enterprise Connect 2012 RFP sessions for VoIP, Unified Communications, and Cloud-based communications options.

The illustrations show non-redundant configurations, though many enterprises would implement redundancy for some or all of their locations. That would change the number of circuits involved, but not the basic topologies as shown.

The illustrations show how the topology can potentially shift as enterprises adopt their appropriate selection of Unified Communications technologies. A table representing traffic types, bandwidth and estimated costs is shown for each example. As mentioned above, the number of SIP trunks required progressively declines as the enterprise increases adoption of UC.

For the sake of simplicity and brevity, this paper does not include considerations of adjustments (usually reductions) in PTSN tolls costs, of variations network management costs for the different topologies, nor of enterprise considerations of redundancy for business continuity. If a topology evolution seems important to your enterprise, a specific design and cost analysis can be prepared that is based on your enterprise's specific situation and requirements.

Summary

In summary, enterprise communication topologies are changing. This change can be viewed in two ways: either as a like-for-like replacement of TDM trunks with SIP trunks, or as a redesign of the topology in response to the new communication patterns created by the shift to Unified Communications and the utilization of Internet Protocol bandwidth.

This IP bandwidth is available either as MPLS or similar services from the more progressive carriers or as managed bandwidth available from the growing community of Ethernet-based IP Backbone services. Either of these options can dramatically reduce the cost of the enterprise communications network topology. The Ethernet-based IP Backbone services currently offer the lowest monthly recurring costs, but may require more enterprise management of the bandwidth and facilities compared to carrier offerings.

In order to realize the savings and benefits of these new topologies, enterprises are advised to develop a Unified Communications strategic plan including a year-by-year deployment roadmap. This plan and the roadmap will provide the details needed to redesign and optimize the enterprises communications network topology.

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Appendix A: Communications Network Topology Examples

The following Examples illustrate the evolution of a sample enterprise from traditional TDM trunks to various versions of SIP trunks to an example of Ethernet-based IP backbone services.

Assumptions used in these examples include:

- This simplified example shows three locations with the station counts as shown
- Bandwidth is calculated at:
  - Voice: G.729A at 30 kbps
  - Video: Primarily desktop and limited to 128 kbps
  - Desktop Sharing Sessions: 40 kbps
  - Instant messaging: .010 kbps
  - Mobility IM/Presence Sessions: .010 kbps
  - Mobility Voice Sessions: 30 kbps (whether over PSTN/cellular trunks or VoIP)
- 30% of users may be working outside the office using a softphone with VoIP (not PSTN) and 15% of them are active at peak traffic periods (90 sessions)
- 30% of users may be mobile on the cellular network (on-site or remote) and 33% of them are active in IM/Presence sessions during peak traffic periods (200 IM/presence sessions). 10% of these users are on voice sessions during peak traffic periods (20 sessions) plus a small number (6 sessions) for intra-company voice communications.
- The enterprise has seventy (70) contact center agents; two (2) voice trunks are provided for each agent in the peak traffic period (to allow for IVR and queuing).
  - Note: Traffic and costs also shown without call center.
- A small number of analog lines (shown as POTS – plain old telephone service) are used at each location for emergency purposes in case the communication system or the primary communication network connections are out of service at that location.
- Session Border Controllers are not shown in these high-level diagrams but should be assumed to be provided on the enterprise premise for SIP trunks terminated at the premise. Ethernet-based Internet backbone terminated at the premise will be managed by the enterprise Integrated Threat Management systems, which also are not shown in those diagrams.
- T-1 trunks assumed at $30 per trunk per month
- SIP trunks assumed at $20 per trunk per month.
- MPLS pricing per Mbps per month is 50% of SIP trunk costs, i.e. $10 per trunk equivalent (64 kbps) or $150 per Mbps per month.
- SIP trunks provided by the MPLS or Ethernet IP backbone providers is assumed to be bundled with the MPLS or Ethernet IP Backbone service at a 30% discount to premise SIP trunks.
- Ethernet IP Backbone rates are approximately $10 per Mbps per month.

The examples follow, one per page, below.

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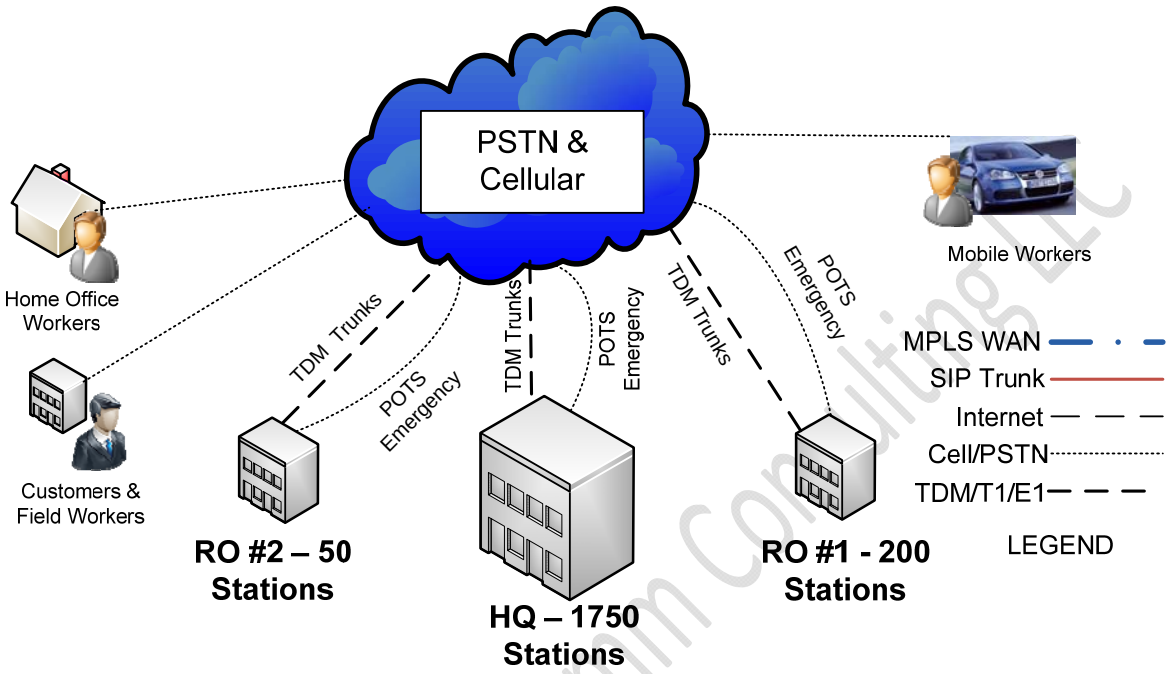
1. Traditional Decentralized TDM-Based PSTN Trunks



Mobile and Remote Workers continue to use traditional PSTN and Cellular connections.

No Unified Communications applications or functionality is included in this example.

Enterprise Facilities including Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	500	$12,500
SIP Trunks	0	$0
Voice MPLS	0	$0
UC Apps MPLS	0	$0
Total Circuit Costs		$12,500

Three year cost: $450,000

Enterprise Facilities Excluding Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	360	$9,000
SIP Trunks	0	$0
Voice MPLS	0	$0
UC Apps MPLS	0	$0
Total Circuit Costs		$9,000

Three year cost: $324,000

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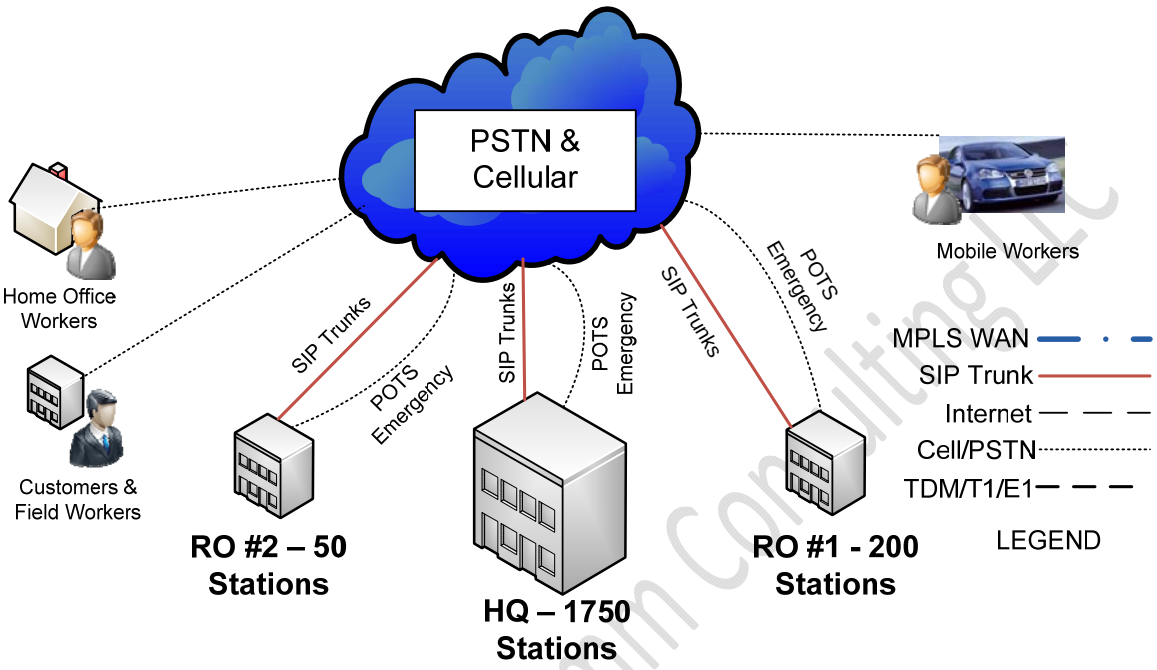
2. Like-for-Like SIP Trunk Replacement



Each traditional TDM voice channel is replaced by a SIP trunk.

No Unified Communications applications or functionality is included in this example.

Enterprise Facilities including Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	500	$10,000
Voice MPLS	0	$0
UC Apps MPLS	0	$0
Total Circuit Costs		$10,000

Three year cost: $360,000

Enterprise Facilities Excluding Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	360	$7,200
Voice MPLS	0	$0
UC Apps MPLS	0	$0
Total Circuit Costs		$7,200

Three year cost: $259,200

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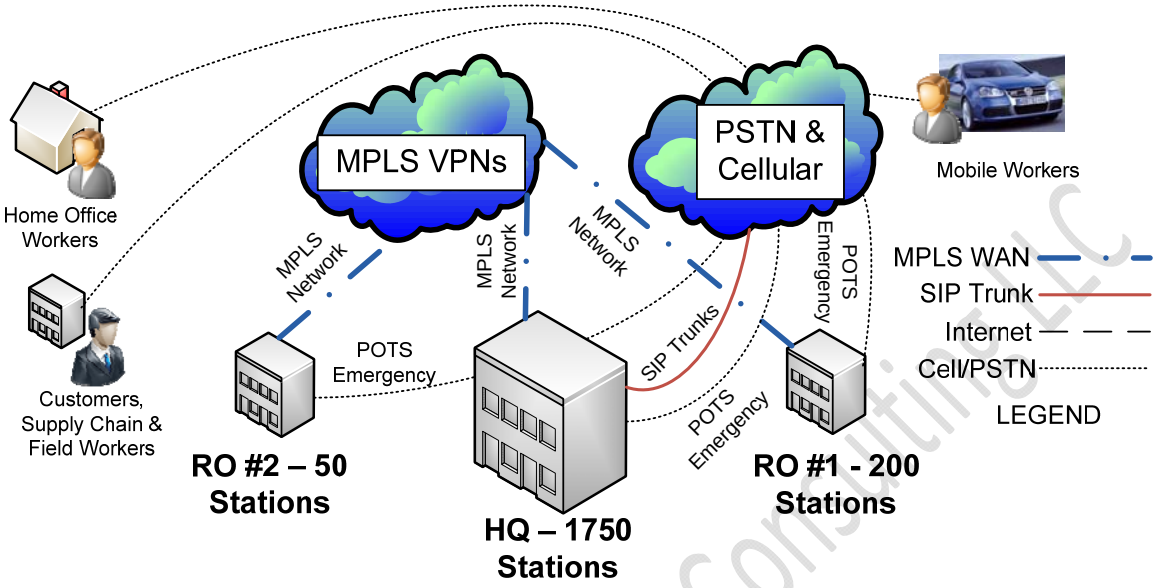
3. Inter-Site MPLS with SIP Trunks from Premise HQ Location



SIP Trunks between sites are converted to MPLS bandwidth. PSTN access over SIP trunks is centralized at HQ.

Enterprise Facilities including Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	440	$8,800
Voice MPLS	2	$300
UC Apps MPLS	0	$0
Total Circuit Costs		$9,100

Three year cost: $327,600

Enterprise Facilities Excluding Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	300	$6,000
Voice MPLS	2	$300
UC Apps MPLS	0	$0
Total Circuit Costs		$6,300

Three year cost: $226,800

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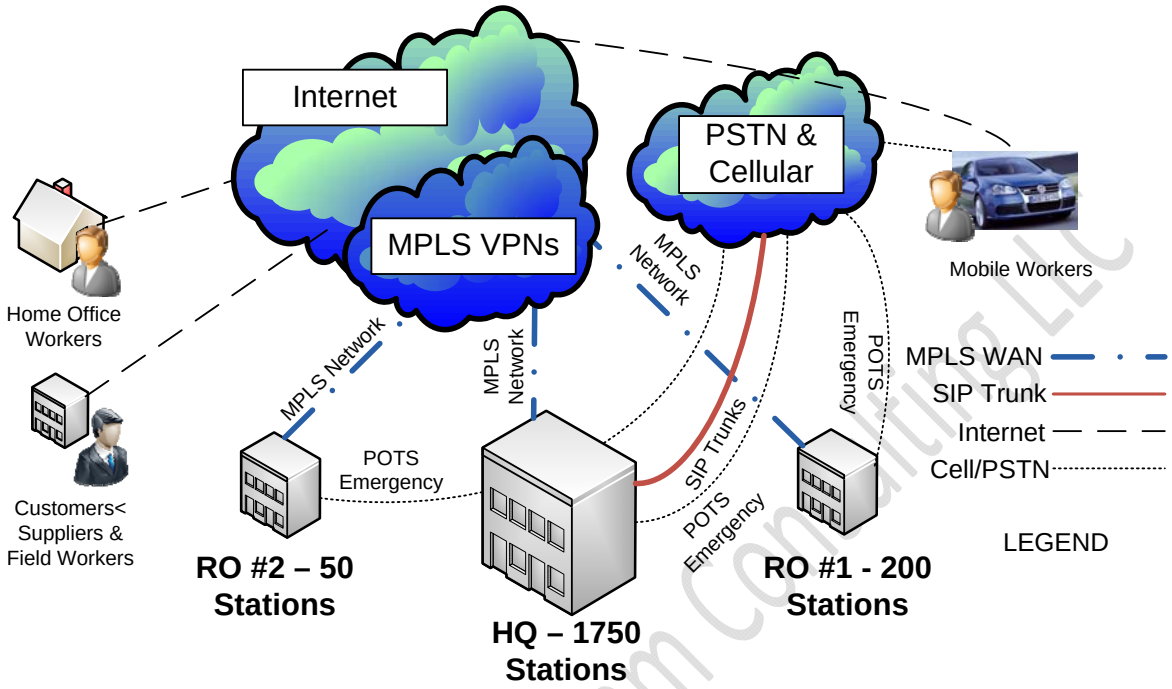
4. Remote User IP Access Via MLPS Network Provider



Remote users move to VoIP and Internet Protocol (for Unified Communications) reducing voice trunk usage (based on IM, presence and IP to remote workers, customers, & suppliers). Inter-site communications is still provided over MPLS with PSTN access over SIP trunks centralized at HQ.

Enterprise Facilities including Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	310	$6,200
Voice MPLS	6	$900
UC Apps MPLS	12	$1,800
Total Circuit Costs		$8,900

Three year cost: $320,400

Enterprise Facilities Excluding Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	170	$3,400
Voice MPLS	6	$900
UC Apps MPLS	12	$1,800
Total Circuit Costs		$6,100

Three year cost: $219,610

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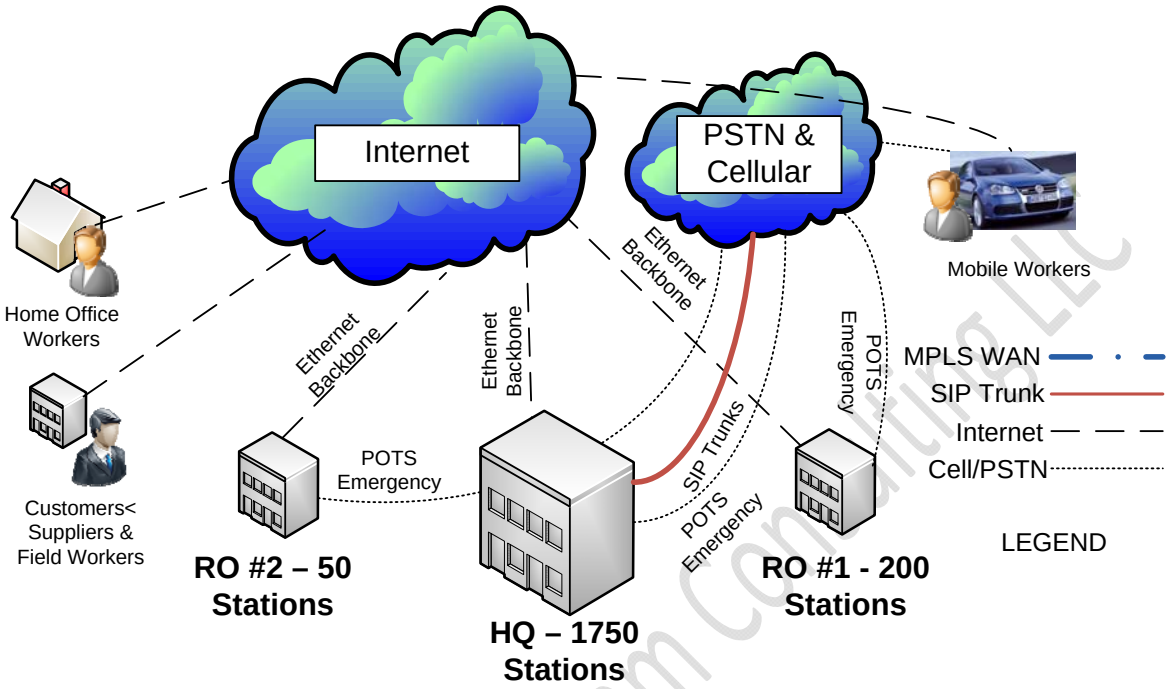
5. All IP via Ethernet Backbone Provider



All communication, except for SIP trunks, is IP on Ethernet Backbone provider. PSTN access over SIP trunks is centralized at HQ.

Enterprise Facilities including Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	310	$6,200
Voice Ethernet Backbone	6	$60
UC Apps Ethernet Backbone	12	$120
Total Circuit Costs		$6,380

Three year cost: $229,680

Enterprise Facilities Excluding Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	170	$3,400
Voice Ethernet Backbone	6	$60
UC Apps Ethernet Backbone	12	$120
Total Circuit Costs		$3,580

Three year cost: $128,880

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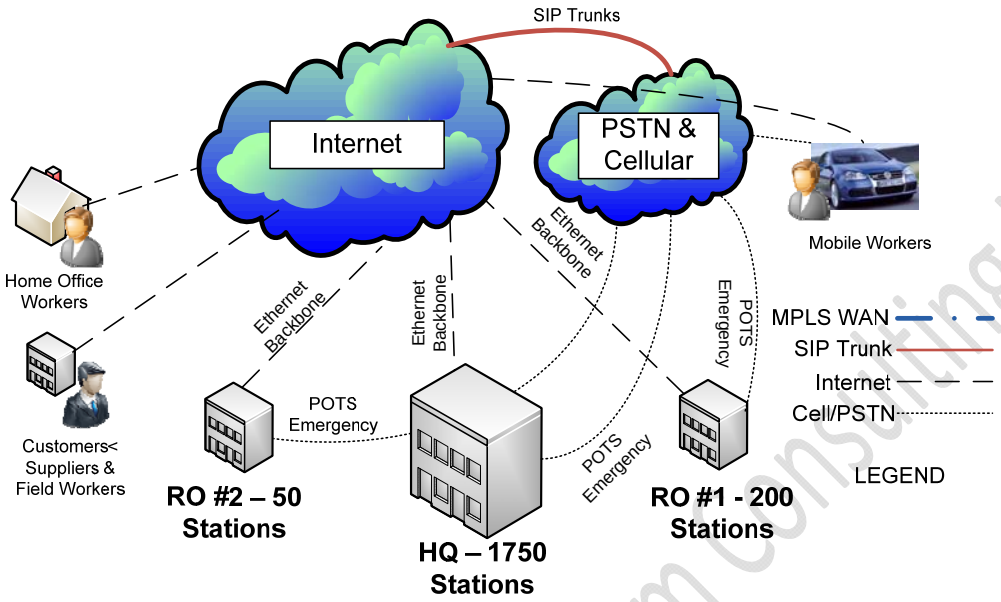
6. All IP via Ethernet Backbone Provider with Remote SIP Connections to PSTN



SIP trunks are terminated into the PSTN by the Ethernet IP Backbone provider at a discount to premise terminations (based on capacities, bulk rates and lower service costs). No PSTN access (except emergency access lines) terminated directly at each location.

Enterprise Facilities including Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	310	$4,340
Voice MPLS	6	$60
UC Apps MPLS	12	$120
Total Circuit Costs		$4,520

Three year cost: $162,720

Enterprise Facilities Excluding Contact Center

	Count	Est. Cost/Mo.
TDM Trunks	0	$0
SIP Trunks	170	$2,380
Voice MPLS	6	$60
UC Apps MPLS	12	$120
Total Circuit Costs		$2,560

Three year cost: $92,160

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Appendix B: New Communications Technologies Driving Change

Unified Communications, including collaboration and social networking, dramatically changes the communications profile of an enterprise:

- The number of communication events will increase dramatically
  - However, the percentage of real-time voice and video events will decline.
- The communications signaling and media can, and likely will, shift entirely to Internet Protocols.
- These events comprise a rapidly expanded range of communication options and usage including:
  - E-mail (now the highest volume communication medium in business)
  - VoIP and video conversations
  - Desktop sharing
  - Voice/video/web conferencing
  - Presence
  - Instant messaging and texting
  - Social networking which is mostly non-real-time content posting and viewing
  - Collaborative workspaces (persistent information with individual content editing) with interspersed live collaboration session for editing, discussions, or decision making
  - Communication-enabled applications and business processes (CEBP) such as:
    - Communication tools embedded in business software applications
    - Communication tools embedded in web pages or portals
    - Communication delivered via apps for PCs and smart mobile devices
- Increasing use of broadcast information sharing such as:
  - Digital signage
  - Kiosks combining digital signage with live interpersonal interactions
  - Broadcast (recorded and shared) communications including e-mail, web sites, and video sessions
  - Remote training and education
- Increasing communications to and between parties outside the enterprise premises. This includes communications:
  - With and between non-mobile remote workers (e.g. at home offices or client locations)
  - With and between mobile workers
  - With major customers/partners over Internet or dedicated broadband connections
  - With consumers and the public in forms other than voice calls

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