

# Integrating SIP Trunks in Enterprise Networks for Next-Generation Unified Communications

## Abstract

The adoption of Unified Communications within the enterprise is well underway. The major benefits of this transformation include gains in both employee productivity and operational efficiencies.

Most enterprise Unified Communications networks today are like islands relative to other such enterprise networks, interconnected by the public switched telephone network (PSTN) using older time-division multiplexing (TDM) trunking technology. The PSTN is used for all extra-enterprise or extra-campus communication with other businesses and, in some cases, even with remote branches within the enterprise itself. Service providers have also adopted Unified Communications solutions in their backend infrastructure, but a majority of service-delivery solutions for enterprise customers and interconnects to other service providers is still based on TDM trunking systems. This imposes limitations on intra- and inter-business communications due to the inherent limitations of TDM technology.

The far-reaching benefits of Unified Communications can truly be realized with “pervasive Unified Communications” networks. Pervasive Unified Communications require the transition from TDM to IP-based solutions of enterprise-to-service provider and inter-service-provider interconnect trunks. Trunking solutions based on Session Initiation Protocol (SIP) are emerging as the most versatile solution for this transition to next-generation, pervasive Unified Communications networks.

However, wholesale transition of TDM trunks to Unified Communications SIP trunks is not a trivial undertaking. TDM trunking, and the voice gateways that tie the trunks into the IP-based Unified Communications world, are a widely deployed, time-proven and trusted solution. Despite limitations in accommodating next-generation Unified Communications services, TDM's proven resiliency and rich feature set in the areas of security, privacy, diagnostics, billing, demarcation, and traffic shaping and policing still set the standard against which new solutions are measured. New Unified Communications trunking solutions must offer similar service-level assurances for enterprises and service providers to consider them as a viable alternative. Enterprises thus need a way to maintain all of the benefits associated with TDM interfaces while exploiting the efficiencies of extending Unified Communications beyond the enterprise.

To enable new pervasive Unified Communications services while minimizing risk, enterprises require an evolutionary and cost-effective approach to Unified Communications SIP trunk adoption. Proposed solutions should not require a complete replacement of existing equipment, but should instead allow for the incremental adoption of Unified Communications SIP trunks. Moreover, solutions must also allow the Unified Communications SIP trunks to coexist with TDM voice gateway trunks. As service provider offerings and enterprise confidence increase, such solutions allow organizations to gracefully migrate services from TDM trunks to Unified Communications trunks as needed, thereby minimizing risk. This is a similar approach to the one taken by enterprises during the migration of TDM telephony to IP telephony through the use of toll bypass, coexistence of both systems, and eventual replacement of TDM equipment – all done at the pace dictated by the business needs of the enterprise.

This paper is the first in a three-part series that discusses the evolution and adoption of Unified Communications trunking services in the enterprise (see “Further Reading” at the end of this paper), and provides an introduction to the relevant issues to consider. It briefly describes the business advantages and challenges of Unified Communications trunking and the network considerations for adoption. The paper introduces the Cisco® Unified Border Element, highlighting the features that make it a compelling solution for this far-reaching communications transformation. The paper concludes with recommendations for possible starting points for enterprises embarking on this evolution.

### **Business Advantages of Unified Communications SIP Trunking**

Unified Communications SIP trunking provides tangible benefits for enterprises in productivity improvements and operational savings. In brief, some of the major benefits are:

- **Next-generation features:** Unified Communications trunks provide significant, dynamic, and expandable bandwidth which can enable a whole new set of new rich-media services to be supported across the network. Examples of such services are wideband voice, high-fidelity audio, high-fidelity video, video interactive voice response (IVR), video contact center, and TelePresence. The benefits of these features on business applications such as voice or video conferencing are easily recognizable. The simplicity of Unified Communications SIP trunks allows such features to be brought to market and deployed quickly.
- **Applications convergence:** SIP facilitates the convergence of the numerous IP network-based applications. This enables powerful and flexible productivity tools, such as rich collaboration suites, to be efficiently developed and deployed on the network. Unified Communications trunks also offer the ability to carry more than merely caller ID and caller name information. The ability to carry vCards, bios, photographs, etc. enables enterprises to personalize customer experiences, which is a critical component in today’s customer loyalty strategies.
- **Business process integration:** Unified Communications SIP trunking enables tighter integration of voice communications with business processes. For example, it allows the extension of “Presence” features throughout the enterprise’s business ecosystem including customers, clients, partners, vendors, support centers, etc. Presence technology imparts the ability to reach the right person on the right end-device, using the right communication medium. This has an immense impact on responsiveness which is a critical factor in business operations such as customer service, just-in-time supply chains, healthcare, finance, retail, etc.
- **Infrastructure convergence:** Unified Communications SIP trunking can be offered over a variety of physical connection media such as DSL, cable, Ethernet, and wireless services (the same physical media used for delivering data services to the enterprise). This reduces the cost and simplifies the provisioning of physical connectivity to the service provider network, with additional savings realized by having to manage only a single data infrastructure.
- **Capacity scaling:** IP traffic is not bound to strict timeslot capacity of TDM trunks. Thus it is easier to scale the call capacity of Unified Communications trunks. Moreover, bandwidth can be dynamically allocated based on the application mix, number of sessions, etc. for optimum performance of the currently active applications.

### **Network Considerations for Integrating SIP Trunks in the Enterprise**

The implications of introducing pervasive Unified Communications on the enterprise network obviously present a number of major issues that must be considered beforehand. In brief, these include:

- **Demarcation point:** A clear point interconnecting the enterprise network and the service provider network must exist at the enterprise premises. This demarcation point is where perimeter functions such as diagnostics and fault isolation, traffic and voice quality monitoring, billing reconciliation, regulatory monitoring, privacy, policing, and external IP threat-defense mechanisms are deployed.
- **Call Admission Control (CAC):** The network needs the capability to control the volume of calls admitted to ensure quality of service before those calls reach the enterprise call control agent. Moreover, provisions must be made such that the powerful on-demand bandwidth scalability features of Unified Communications trunks do not leave the enterprise network vulnerable to rogue high-bandwidth applications. Control must be guaranteed at the edge of the enterprise network and dictated by the enterprise IT organization.
- **Voice call routing:** Call routing, CAC, and dial plans may require adjustments because the physical entry point into the service provider network may now be at a different location from where the TDM PSTN entry point is for calls originated from the same IP endpoint.
- **Security:** Unified Communications trunking adds an additional point of IP connectivity between the enterprise network and external networks. Additional security measures must be applied to these interconnects to mitigate threats inherent not only to data, but also new threats associated with IP telephony applications. These include telephony, voicemail, conferencing system, endpoint, and call control denial-of-service (DoS) attacks; identity impersonation; reputation identification; and threats found in the media itself.
- **Interoperability:** The Unified Communications trunk must interwork with the different protocols and their variations, numerous encoding mechanisms, and myriad endpoint idiosyncrasies to ensure continuous business services.
- **Graceful migration:** The solution must offer a graceful migration path from traditional TDM-based trunking implemented using voice gateways to Unified Communications trunking. An obvious way to address this is if the existing TDM voice gateway has the capability to add Unified Communications trunking on the same platform. This permits the graceful introduction of Unified Communications trunking with no abrupt changes in the overall connectivity architecture. As the enterprise becomes more comfortable with Unified Communications trunking over time, more traffic can be migrated over to Unified Communications trunks on that same platform.

### **The Cisco Unified Border Element as a Unified Communications SIP Trunking Solution**

The Cisco Unified Border Element operates as part of the Cisco integrated services routers and is designed to address all the major issues described in the prior sections. The Cisco Unified Border Element is fully interoperable with the Cisco Unified Communications Manager and Cisco Unified Communications Manager Express. It is intended to serve as a feature-rich demarcation point for connecting enterprises to service providers over Unified Communications trunks, including SIP trunks. The Cisco Unified Border Element coexists with TDM voice gateway interfaces and software that are already deployed on the Cisco integrated services router. It is based on Cisco IOS® Software's proven voice functionality and provides a full complement of data, voice, video, and security options. It thus allows the enterprise to connect securely over TDM trunks and Unified

Communications trunks over separate physical connections, or with Unified Communications trunking integrated with data services on the same physical connection. The Cisco Unified Border Element can be provisioned on existing Cisco enterprise voice gateways and voice-enabled routers with a simple software upgrade and a feature license purchase – no new hardware is necessary. Cisco Unified Border Element also uses the same Packet Voice DSP Modules (PVDM2) that are used for transcoding, conferencing, and voice gateway operation.

The major capabilities of the Cisco Unified Border Element for SIP trunking include:

### Network Demarcation

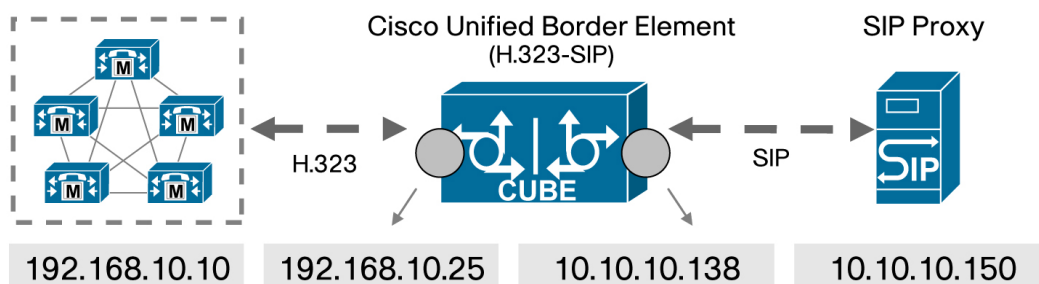
The Cisco Unified Border Element supports a wide range of physical media interfaces. IP interconnect between the enterprise and the service provider can be implemented with satellite, Gigabit Ethernet, wireless 802.11X, DS-1, DS-3, and DSL or cable for smaller offices. SIP trunk termination with the Cisco Unified Border Element at the enterprise also offers the troubleshooting and billing demarcation point that are essential for network fault isolation and operational management.

### Security Demarcation

A Unified Communications trunk offers IP access into the enterprise network. This requires all the security threat-mitigation techniques applicable to general IP connectivity. The Cisco Unified Border Element enables the following security concerns to be addressed effectively:

- Network topology hiding and Network Address Translation (NAT): Call signaling terminates at the Cisco Unified Border Element and is re-originated using the Cisco Unified Border Element's IP address. Media may also be terminated and re-originated, helping ensure more complete privacy than can be achieved with NAT of the IP endpoint's address (Figure 1).
- DoS protection: Intrusion detection and denial-of-service threat mitigation are available as Cisco IOS Software features.
- Firewall: The Cisco Unified Border Element provides firewall functions, disallowing traffic from unexpected IP addresses or ports.
- Authentication: the Cisco Unified Border Element uses SIP Digest Authentication to allow only valid users to establish calls between the service provider's SIP proxy and the enterprise network.
- VPN: Cisco IOS Software VPN encryption capabilities can be used on the Unified Border Element to protect and encrypt IP traffic.

**Figure 1.** The Cisco Unified Border Element Hides Enterprise IP Addresses



### **Cisco Unified Communications Manager Interoperability**

The Cisco Unified Border Element is fully interoperable with the Cisco Unified Communications Manager. Cisco Unified Border Elements are required when interfacing Cisco Unified Communications Manager to Unified Communications trunks.

### **Protocol and Media Interworking**

The Cisco Unified Border Element can function as a back-to-back user agent by terminating incoming Unified Communications calls and then re-originating calls to the destination. Different Unified Communications protocols can be used on each leg, a valuable capability if the enterprise and service provider use different Unified Communications protocols. The Cisco Unified Border Element performs protocol interworking between H.323 and SIP for voice, fax, and modem calls as well as for the various dual tone multifrequency (DTMF) encoding and relay techniques. This gives companies the flexibility to connect a Cisco Unified Communications Manager configured for either SIP or H.323 to a service provider using SIP trunks.

Different variations of protocol implementation such as H.323 FastStart and SlowStart, or SIP EarlyOffer and DelayedOffer can also interwork using the Cisco Unified Border Element. The codec interworking (transcoding) and filtering features can be used to allow enterprise IP endpoints configured with a limited set of codec capabilities to interwork with any external IP endpoint.

Supplementary services can be provided by enterprise call agents such as Cisco Unified Communications Manager, or by service provider services (Class 5/IP Centrex). The Cisco Unified Border Element can provide interoperability between service provider SIP proxy-based features and enterprise call agent features such as transfer, conference, and hold for calls between on-net and off-net IP endpoints.

The Cisco Unified Border Element also performs protocol conformance verification at the edge of the network which prevents malformed protocol messages from reaching the Cisco Unified Communications Manager or other call agents.

### **Traffic Overload Control (Call Admission Control)**

Call Admission Control (CAC), also known as traffic overload control, refers to the capability to admit a voice or video call only if network resources are available to deliver enterprise-class quality. The Cisco Unified Border Element can provide CAC on a SIP trunk based on a number of parameters, such as maximum number of connections, CPU utilization, or memory utilization, protecting the enterprise from overload by an accidental or malicious burst of incoming calls from the Unified Communications trunk.

### **Call Control and Call Routing**

Enterprises have the option to aggregate all long-distance calling into one location for volume benefits. To do this, the network is configured to route local calls from each site directly to the PSTN, while routing long-distance calls over the WAN to a central site that routes calls to the carrier network. Organizations that do not want to aggregate calls can provide each site with its own local Unified Communications trunking access point, used for local as well as long-distance calls.

Enterprise phone number reachability using the SIP trunk must be registered with the service provider's SIP call agent for calls to be routed correctly to the enterprise. The Cisco Unified Border Element is

capable of doing bulk SIP registration on behalf of endpoints behind Cisco Unified Communications Manager to enable calls to the entire enterprise to be routed to the Cisco Unified Border Element.

### QoS

The Cisco Unified Border Element supports all QoS features available in Cisco IOS Software. This helps ensure that voice traffic is always given priority over data traffic and meets thresholds for latency, jitter, and packet loss. Signaling and media packets can be re-marked with the appropriate differentiated services code point (DSCP) when traffic is sent to or from the service provider network. The Cisco Unified Border Element can be deployed as a voice-quality-monitoring demarcation point to help ensure voice-quality problems on either network can be tracked and resolved.

### High Availability and Graceful Trunk Adoption

The availability of a SIP trunk is paramount when a large portion of an organization's voice and video calls enter and exit the network using this interconnect. The Cisco Unified Border Element can be deployed in redundant and load balancing configurations to provide the level of availability required for enterprise applications. The existing TDM PSTN voice gateway on the same integrated services router platforms can continue to be used for additional voice traffic and for failover purposes.

#### Unique Features of the Cisco Unified Border Element

Cisco Unified Border Element features empower organizations to adopt Unified Communications trunking as and when needed for their unique business requirements. In addition, Unified Communications trunking solutions on Cisco Unified Border Elements provide the following unique advantages:

- **Integrated:** The Cisco Unified Border Element is deployed as a licensed feature on Cisco integrated services routers. No additional systems need to be provisioned, unless capacity or network scalability so requires. Integrating the border element function into the network infrastructure decreases the number of network elements and thus improves the resiliency and security of the overall network.
- **Flexible:** The Cisco Unified Border Element is a software component in Cisco IOS Software. Unified Communications trunking features can therefore be provisioned as per the enterprise's business-driven timetables, with no major replacements and ensuing service disruptions.
- **Robust:** The Cisco Unified Border Element takes advantage of robust, field-tested Unified Communications features in Cisco IOS Software. These include QoS, queuing, firewall, intrusion detection and prevention, routing, and Unified Communications call control.
- **Versatile:** The Cisco Unified Border Element supports multiple signaling protocols as well as multiple connectivity options for different locations, including satellite, Gigabit Ethernet, wireless 802.11X, DS-1, DS-3, and DSL for smaller offices.

### Where and How to Begin

Enterprises can introduce and integrate Unified Communications trunking gradually over time, deploying it in some locations for certain call patterns of traffic. Starting points to consider are:

- **Campus calling:** This is an attractive starting option if the service provider offers a single physical connection to the enterprise
- **Campus and branch calling:** Enterprises might prefer this option for redundancy and backup as well as to enable intelligent call routing throughout the enterprise
- **Outbound contact center operations**

Enterprises can begin preparing in the following ways:

- Complete the enterprise-wide adoption of Unified Communications
- Plan the network to support QoS
- Plan the network to support both voice and data security
- Provision adequate WAN bandwidth to carry voice traffic from branch offices
- Ensure that all WAN connections are secure

## Conclusion

Pervasive, end-to-end Unified Communications allow enterprises to take advantage of new IP-only voice, video, and integrated application services. Adoption of Unified Communications trunking by enterprises will be driven by sound business reasons and timelines. Such Unified Communications trunking solutions must address identified critical issues and be flexible enough to allow for coexistence with, and graceful migration from, existing TDM voice gateway solutions. Cisco voice gateways and routers can be provisioned to support Unified Communications trunking simply through software and license upgrades and are fully interoperable with Cisco Unified Communications Manager, Cisco Unified Communications Manager Express, and other call agents. A comprehensive feature set helps ensure safe, secure, and manageable Unified Communications SIP trunk implementations, and makes the Cisco Unified Border Element a compelling solution for enterprise SIP trunking needs.

## Further Reading

The evaluation steps to consider when planning Unified Communications SIP trunk adoption in enterprise networks are discussed in the white paper titled "Communications Transformations 2: Steps to Integrate Unified Communications SIP Trunks into the Enterprise." Technical considerations for integration of SIP trunks are detailed in the white paper titled "Communications Transformations 3: SIP Trunks for PSTN Access."

For additional white papers on using Cisco Unified Border Element solutions in enterprise networks, visit <http://www.cisco.com/go/cube>.



**Americas Headquarters**  
Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
[www.cisco.com](http://www.cisco.com)  
Tel: 408 526-4000  
800 553-NETS (6387)  
Fax: 408 527-0883

**Asia Pacific Headquarters**  
Cisco Systems, Inc.  
168 Robinson Road  
#28-01 Capital Tower  
Singapore 068912  
[www.cisco.com](http://www.cisco.com)  
Tel: +65 6317 7777  
Fax: +65 6317 7799

**Europe Headquarters**  
Cisco Systems International BV  
Haarlerbergpark  
Haarlerbergweg 13-19  
1101 CH Amsterdam  
The Netherlands  
[www-europe.cisco.com](http://www-europe.cisco.com)  
Tel: +31 0 800 020 0791  
Fax: +31 0 20 357 1100

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